

The Effects of Continuous and Interval Training Toward $\dot{V}O_{2max}$ Increase for Male

Moch.Yunus
Faculty of Sports Science
Universitas Negeri Malang
Malang, Indonesia
E-mail: moch.yunus.fik@um.ac.id

Endang Sri Wahjuni.
Faculty of Sports Science
Universitas Negeri Surabaya
Surabaya, Indonesia
E-mail: endangwahjuni@unesa.ac.id

Supriatna
Faculty of Sports Science
Universitas Negeri Malang
Malang Indonesia
E-mail : supriatna.fik@um.ac.id

Abstract—The research aimed at investigating the difference of continuous and interval training toward maximum $\dot{V}O_2$ increase. The research used randomized group pretest and posttest design. Population of the research were students of Sport Training Education Faculty of Sport Sciences Malang State . Sampling technique by using purposive random sampling with sampling of 40 persons, divided into two groups with ordinal pairing, that is continuous and interval training groups. The trainings done three times with moderate intensity up to sub maximum and for 8 weeks. The research type was quasi experimental research with quantitative approach. Data collection done by using Multistage Fitness Test to measure maximum $\dot{V}O_2$ during pretest and posttest. Data analysis technique by using t-test and ANOVA by using α 0,05. The results showed the mean of $\dot{V}O_2$ max for pretest and posttest for continuous group was 40,89 and 46,18, while at the interval training group was 41,01 and 46,53. [mL.min-1.kg-1], From the t-test and ANOVA can be concluded (1) the continuous training influences significantly toward the $\dot{V}O_{2max}$ increase; (2) the interval training influence significantly toward the $\dot{V}O_{2max}$ increase.; and (3) there is no significant influence between continuous and interval trainings toward the $\dot{V}O_2$ max increase.

Keywords-Training, Continuous, Interval, $\dot{V}O_2$ Max

I. INTRODUCTION

$\dot{V}O_{2max}$ or called as aerobic capacity maximum is the maximum oxygen capacity in milliliter, that can be used in one minute per kilogram of body weight. $\dot{V}O_{2max}$ is one of maximum components from the physical fitness. Physical fitness is the ability to do daily activities which are not expected [2].

Several factors influenced the $\dot{V}O_{2max}$: a) training method, b) heredity, c) sex, d) body composition, and e) age [11]. The training method to increase $\dot{V}O_{2max}$ is : circuit, interval and continuous trainings [16]. Interval training is an training done alternately between work and break. With this interval training the body able to adapt well to the nervous system or metabolism system. Continuous training is training done continuously without break interval during training. Continuous training is done

with good speed at moderate intensity or high intensity during certain time. Training intensity should able to stimulate the stimulation threshold of aerobic so occurs physiologically adaptation.

According to [11] if viewed from the physiological side, maximum $\dot{V}O_2$ is determined by several factors such as: (1) heart, lung, and blood vessel should function well so the oxygen inhaled and enter into lung, then up to the blood (2) process of oxygen transportation to the inactive tissues to active muscles will need more oxygen (3) tissues, especially muscle should have normal capacity to use oxygen delivered to it.

Research done to know the training adaptation toward $\dot{V}O_{2max}$ with varied results. It is influenced by many factors, such as the training program differences, the measured cell type, research subject, and measurement method. Differences between training program causes different results, it is related with intensity and duration of training during the training program.

Training model influences to the someone $\dot{V}O_{2max}$. The variation of $\dot{V}O_{2max}$ in the training model reflects the active muscle mass [11]. Routine training given will form the muscle mass. Stressor given to the certain muscle will be responded by body only at the certain muscle. Adaptation is important to keep by body so the body function not decrease.

Sport training is very important to improve the $\dot{V}O_{2max}$. The given training to increase the $\dot{V}O_{2max}$ will impact to the respiration system and cardiovascular system. The system will adapts, so the performance will increase. Adaptation occurs at the lung that is at the tidal volume value, inspiration and expiration value average, and pulmonary ventilation value for the oxygen exchange, also will occur the heart size and plasma volume increase at the cardiac output, so the oxygen stroke volume also will increase. [13].

Sport training has important role in maintaining the cardiorespiratory system including the organs of heart and lung [9] Physiologically, the training bring physical stress at the body that able to produce adaptation responses. The physical training suggested along the body able to adapt toward excessive load. Training at high intensity able to

induce specific adaptation that enable to body to function more efficiently [11].

To get maximum benefit, all the trainings also be done by considering the training dosage with FIT or frequency, intensity or tempo principle [10] Frequency: several times in a week to be done so bring training effect. The ideal frequency is 3-5 times a week. Training less than 3 times a week show no training adaptation, while training more than 5 times a week give no chance for body to recover. Intensity: training load weight given. Aerobic training done with light to moderate intensity. According to [10]KEN sport also increase significantly the heart capacity to be given weight between 60-80% from the maximum work capacity or with training pulse 70-85% from the maximum pulse. Tempo: duration of training. Research showed the duration 20-30 minutes is sufficient to give ability increase of 35% if done 3 times a week in one and half month.

Training method to increase the cardiorespiratory capacity: circuit, interval and continuous training. Interval training is a form of training done alternately between work and break. With interval training the body able to adapt well to the nervous system or at the metabolism system. Continuous training is training done without break interval at the training session. Continuous training done with constant speed (moderate) or high intensity at certain time. Training intensity should sufficiently stimulate the stimulation threshold value of aerobic so the physiological adaptation will occurs. Continuous training or ongoing training, namely training at the distance of each category sustainable [5].

Training with interval training method, the run training done with interval or break period. [8] explained that interval is a training system done alternately between training and work with low intensity activities break period in a training stage[4] explained several benefits of interval training system as follows 1) careful in control the strain occurred. 2) as the systematic approach day by day will enable and easy to observe the progress 3) further in improving the potential energy than the other condition method 4) The training program can be implemented everywhere and no need special instruments. Five principle done for interval training explained by [4] as follows: 1) size and distance of work interval 2) repetition of each training 3) interrupt Interval or time between work interval 4) activities during the interrupt interval 5) training frequency per week.

II. METHOD

The research method using quasi experiment, with randomized group pre-test and post-test design. Variables consist of: A). independent variable consist of: 1).treatment variable, that is running 4,8 km which is differentiated between interval and continuous training. 2). Control variable, that is: (a) sex. (b) age. (c) Body mass index. (d) hemoglobin content. (e). Erythrocyte cell amount, (f) Packet Cell Volume concentration, and (g) not smoking .3) uncontrollable variable, that is (a) activity out

of treatment. (b). nutrient intake. B). dependent variable that is VO_{2max} .

Research population is male students of Sport Training Education Department of Sport Faculty of Malang State University, force 2016/2017of 92 students. Sampling technique by using *purposive random sampling* with samples of 40 persons, which consist of two groups by ordinal pairing, continuous and interval trainings.

Before treatment given explanation about intention, goal and procedure of research, and followed with the inform concern signing as the research sample. Then anthropometry test done and health test at the research sample. At the pretest it was done Multistage Fitness Test to measure the $\dot{V}O_{2max}$. After that the research sample given treatment of continuous or interval treatment with moderate intensity, 3 times a week for 8 weeks. After 8 weeks done posttest.

Data be analyzed with *paired sample t-test and Anova* . The test technique analysis including normality test (Shapiro-Wilk) and homogeneity test in group (Levene's) using α 0,05 for the significant value.

III. RESULTS

TABLE 1. DATA ANALYSIS OF VO_{2MAX} [ML.MIN-1.KG-1] CONTINUOUS AND INTERVAL TRAINING GROUPS

Variable		Amount	Mean	SD
VO_{2max} of continuous training	Pretest	20	40,89	4,21
	Posttest	20	46,18	5,66
	Delta	20	5,29	4,02
$\dot{V}O_{2max}$ of interval training	Pretest	20	41,01	4,01
	Posttest	20	46,53	5,88
	Delta	20	5,52	4,45

Based on table 1 above, showed the delta (difference between posttest–pretest) at the interval training group higher than at the continuous group.

TABLE II. THE NORMALITY TEST OF DEPENDENT VARIABLE VO_{2MAX}

Variable	Shapiro-Wilk		Conclusion
	Statistic	Sig.	
PretestContinuous Training	0,954	0,713	Normal
Posttest Continuous Training	0,916	0,323	Normal
Pretest Interval Training	0,957	0,756	Normal
Posttest Interval Training	0,948	0,642	Normal
Delta Continuous Training	0,922	0,373	Normal
Delta Interval Training	0,941	0,562	Normal

Based on table 2 above showed that all data distributed normally, because sig. > 0,05.

TABLE III. ANALYSIS RESULTS OF T TEST OF VO_{2MAX} OF PRETEST BETWEEN CONTINUOUS AND INTERVAL TRAININGS GROUPS

	Levene's Test for Equality of Variances	t-test for Equality of Means

Table III. Cont

		F	Sig.	t	Sig. (2-tailed)
VO2 max pre	Equal variances assumed	.018	.895	-.065	.949
	Equal variances not assumed			-.065	.949

Based on Table 3. Showed the significance level of control variable 0,949 ($p > 0,005$), which means the initial condition of VO_{2max} variable between continuous and interval trainings, the initial condition not different or equal.

TABLE IV. T TEST ANALYSIS OF VO_{2MAX} OF PRETEST AND POSTTEST

		T	Sig. (2-tailed)
Pair 1	Pre. Continuous Training Post. Continuous Training	-9.223	.000
Pair 1	Pre. Interval Training Post. Interval Training	-7.830	.000

Based on Table 4. Showed the significance level of *pretest* and *posttest* of VO_{2max} of 0,000 ($p < 0,05$), which means the condition of VO_{2max} variable between pretest and posttest either at the continuous and interval trainings groups different. It means that continuous and interval trainings able to increase VO_{2max} significantly.

Anova analysis requirement

1. At the normality analysis requirements, normality data by using Shapiro-Wilk Test obtained all dependent variable distributed normally ($p > 0,05$).
2. At the data homogeneity analysis by using Levene's Test obtained all dependent variable the data variant results were homogenous ($p > 0,05$)

TABLE 5. RESULTS OF DELTA ANOVA OF VO_{2MAX} FOR CONTINUOUS AND INTERVAL TRAININGS.

Effect	F	Sig	Conclusion
Delta VO_{2max}	2,648	0,121	Not Significant

Based on table 5. Showed the significance level of the delta variable of VO_{2max} of 0,121 ($p > 0,05$), means that delta variable of VO_{2max} between continuous and interval trainings not different or equal. It means that continuous and interval trainings no significant differences in improving the VO_{2max} . Training aimed at improving the *cardiorespiratory* and oxygen usage in muscle. The aerobic endurance can be developed through continuous running or interval running.

IV. DISCUSSION

Continuous training with low intensity training, that is run or slow swimming whose the pulse between 70%-80% from MHR (maximum heart rate). With this low intensity, the lactic acid in general lack than 3 mmol, that is a little higher than resting level of 1-2 mmol, if the intensity too low, below 70% MHR will not feel the high intensity training. This training is aerobic training with higher intensity in this training the pulse 80%-90% from MHR. Because of that, the lactic acid in blood able to

increase become about 3-5 mmol. The training duration can be varied between 15-60 minutes, with this training type the trainer aimed at improving the maximum aerobic capacity [9]. It should be noted in the continuous training to avoid the accumulation of excessive lactic acid. At the highest intensity, the pulse should be tried to approach or equal with the anaerobic stimulation threshold, not exceed it. It means the training intensity about 90% from MHR.

Based on table 5 it can be concluded that significant differences between pretest and posttest of VO_{2max} caused by continuous trainings ($sig < 0,05$). It means that the continuous training influence significantly toward the increase of VO_{2max} . Moderate continuous training / MCT. After training 5 times/ week, for 5 weeks obtain increase of VO_{2max} and decrease of erythrocyte osmotic fragility which means the increase of erythrocyte membrane durability [3].

Suitable with the name, the interval training is a training system intermitted with interval of break time. Such as, run break-run-break-run again-break again etc. With this interval training the body will adapt well to the nervous system or metabolism system. Several advantages of interval trainings: faster in improving the potential energy then other training and the training program can be implemented anywhere and no need special instruments. To get optimum benefit from interval training, then the training intensity should be sufficient in stimulating the aerobic threshold value to make physiological adaptation.

[8] explained that interval training is training system done alternately between work interval and low intensity activity (interrupt period) in a training. [4] explained that interval training is a physical training system, where the physic is charged with the regular and repeated load with sufficient interrupt period.

[4] explained advantages of interval training: 1) careful in controlling the strain occurred. 2) as systematic approach day by day, enable and easy to observe progress. 3) faster in improving the potential energy than other training condition. 4) the program can be implemented everywhere and no need special instruments.

Five principles done for interval training explained by [4] as follows 1) the size and distance of work interval. 2) repetition amount in each training. 3) interrupt interval or time between work interval 4) activities type during interrupt interval 5) training interval per week.

According to [4], there are three ways to determine the work intensity in arranging work interval 1) method to measure pulse, at male or female less than 20 years old, the pulse 180 to 190 pulses per minute during work interval become the indicator of active work 2) repetition method, the method based on the work interval, the work interval amount or repetition amount each training 3) method of fast run, the method determine the work interval by calculating the run traveling time in various run distance done.

Based on table 5. Also can be concluded that there was significant differences between pretest and posttest caused by interval intensity from moderate to sub maximum toward $\dot{V}O_{2max}$. It proves that interval training significantly improve the $\dot{V}O_{2max}$. High intensity interval training at the male students during 8 weeks, obtained the decrease of MDA content and increase of maximum aerobic capacity [14]. Chou et.al (2016), studied about *cycling aerobic interval training* (AIT). After training 5 times/ week, for 5 weeks, obtained the increase of maximum $\dot{V}O_2$ and the decrease of erythrocyte osmotic fragility which means the increase of erythrocyte membrane endurance. From the results proved that the interval training able to decrease the oxidative stress level, increase the antioxidant capacity, increase the erythrocyte membrane endurance, and increase the maximum aerobic capacity. [17] with a study entitled, the results showed that there was a significant effect of interval training on increasing VO_2 max. This is in line with [1] showed significant ($p < 0.05$) improvements in VO_{2max} , O_2 pulse, and Wingate-derived power output with HIIT. The magnitude of improvement in $\dot{V}O_{2max}$ was related to baseline $\dot{V}O_{2max}$.

In Table 5. Showed the delta results of VO_2 max between continuous and interval group showed no significant differences, obtained sig. $0,121 < \alpha = 0,05$. It showed that the continuous training and interval training equal in goodness so able to increase the $\dot{V}O_{2max}$. But if it is viewed from the increase of interval training for $\dot{V}O_{2max}$ of 13,46%, while for continuous training of 12, 93%. It showed that interval training has higher increase for VO_{2max} compared to the continuous training, but statistically not significant. Interval sprint training able to increase VO_{2max} of 4,2 to 13,4%, also occurs increase of aerobic increase [15]. Interval training method are better than the continuous traing method in increasing VO_2 max [12]. [6] conduct research about the influence of training intensify toward maximum VO_2 at young male. Trainings are divided into three groups: group 1: ~ 60-70% maximum $\dot{V}O_2$; group 2: ~ 80-92,5% maximum VO_2 ; and group 3: ~ 100-250% maximum VO_2 . From the research, no significant differences between the three groups. It showed training intensity does not influence significantly to the young groups in the increase of VO_{2max} . [6] based on research about the effect of high intensity and continuous training for the endurance at the male sample and active female. Treatment given for twelve weeks obtained increase of maximum VO_2 significantly between $36,8 \pm 4,5$ become $43,6 \pm 6,5$ [mL.min-1.kg-1], at the training group with high intensity and increase significantly at continuous training the endurance increase significantly from $38,8 \pm 5,0$ become $41,5 \pm 6,0$ [mL.min-1.kg-1]. At both group, no significant differences in the performance from half marathon.

V. CONCLUSION

The conclusions of the research are (1) continuous training influences significantly to the increase of VO_{2max} ; (2) interval training influences significantly to

the increase of $\dot{V}O_{2max}$; (3) no significant differences between influences of interval and continuous trainings toward VO_2 max increase.

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