Paper 1

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Section A: Environmental Science

Research Article

Warm Water influence in lowering the level of Fatigue

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Abstract: Active recovery is one method to reduce post-exercise blood lactic acid concentration. Active recovery performed in warm water has not been well-recognized. The objective of this study was to find the effect of active recovery in warm water on the reduction of post-exercise blood lactic acid concentration. This study employed separate sample pre-test post-test group design using 28 male healthy white Rattusnorvegicus rats aged 3-4 weeks, with body weight of 150-200 grams, they were selected randomly. Samples were divided into four groups, K0, K1, K2 and K3, to be subjected to blood lactic acid concentration measurement. The four groups received different treatment. K0 (control group) received no treatment, while the K1 group received momentary exercise program. K1 and K2 groups received treatments of momentary physical exercise and warm water recovery. The temperature for K1 was of 35-37 ºC and K2 was 33-35 ºC. Momentary physical exercise in this study was swimming activity in fresh water, which achieving 80% of maximum working capacity and a load of 9% of body weight. Recovery program, comprising swimming exercise without load for 5 minutes, was performed immediately after physical exercise. Result revealed that after active recovery in 35-37 ºC water, the concentration of lactic acid became 1,60 mMol/l and reach 2,1 mMol/l at 33-35 ºC water temperature. Data were processed using descriptive statistics and inferential statistics (normality test, homogeneity test, anacova test, LSD (least significant difference) test, and independent t test), with significance level of 5%. Independent T test revealed reduction of lactic acid concentration of 4,5 mMol/l in group receiving recovery treatment in warm water 35-37 ºC . Both group showed significant difference (p = 0.00) in that treatment. So

the treatment of active recovery in warm water can be alternative way to reduce levels of blood lactic acid and it need to develop further research in humans or by the method of applying warm compresses on the active muscle. The further research may applicate in environments with a wide range of temperature variation to find the optimal temperature in the recovery.

Keywords: lactic acid, post-exercise active recovery, warm water.

INTRODUCTION

There were a lot of clinics that provide warm water therapy in overcoming fatigue. Peni[1] say the water is a medium appropriate therapy for the recovery of muscles and joints are stiff or injury. Warm water temperatures of 37 - 31 °C a safe temperature to provide a relaxing effect, relieve pain, have a physiological impact to the body, the effects on blood vessels. In addition, exercise in warm water positively affect the heart muscle and lungs, breathing becomes better circulation. The 31^{0}C temperature affect tissue oxygenation thus preventing muscle stiffness, relieve pain [1]. Physical activity with high intensity and constantly can cause fatigue. Tiredness or fatigue can reduce a person's performance, it is necessary an effort to eliminate them. Fatigue is a factor which led to increased levels of lactic acid in the blood and muscles[2] .

Fatigue reducing that occurs then the lactic acid levels in the blood and muscle must be reduced to the normal sambang brick[3] . Lactic acid levels will decline when physical activity is stopped or redress[4]. Various studies analyze the form and movement of effective remedies to reduce levels of lactate, have been conducted by Kumaidah[5] and Prasad[6] . But have never done the effect of healing done in warm water and a review of aspects of fatigue. Perfect recovery will make a return to the original before doing the activity. Incomplete recovery between one exercise to the next physical exercise or between one game to the next game, will degrade the performance of an athlete [7]. Perfect recovery will make an athlete back to its original state as before the match.

METHODS

Research Design: This study was an experimental study with The Paired T test: pretest - posttest control group design. The object of this study were the rats that given treatment in the form of swimming exercise achieve submaximal work capacity[8,9] so that an anaerobic metabolism that occur and will produce lactic acid.

The study was conducted at a temperature of 37 °C - 35 °C because the temperature range considered safe and may cause vasodilation. To determine the effect of recovery in the warm water at the fatigue in this study used male rats (Rattus norvegicus) as the animals try to have blood drawn for blood lactic acid levels checked after swimming practice given moment in warm water with a temperature (35 °C - 37 °C).Minimum sample size used was 7 rats in each group, so that the total number of samples is 28 mouses, schematically, the design of this study can be described as follows:

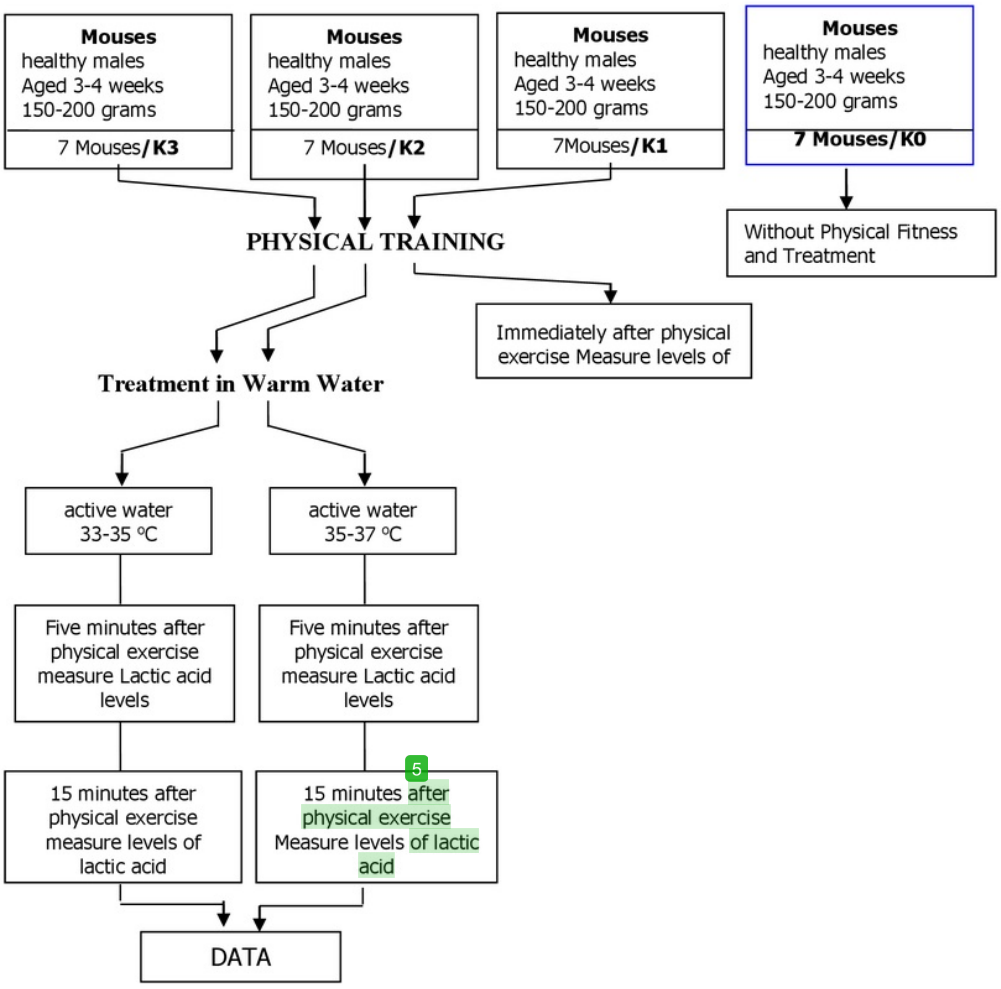
Information :

K0: pretest group (no exercise and treatment)

K1: The group pretest (exercise without treatment)

K2: Treatment group 1 (given the physical exercises in the water a moment later recovery Temperatures 35 - 37 °C).

K3: The treatment group 2 were given physical training in the water a moment later recovery Temperature temperature 33 - 35 °C). Independent variables: Recovery in warm water (35 °C - 37 °C) and recovery in water at room temperature (33-35 °C, the dependent variables was rat blood lactic acid levels; control variables: animal type, animal age, physical health test animals, animal cages, treatment of experimental animals (momentary physical activity and active recovery), the water temperature 35 - 37 °C and 33 -35 °C.



Kind of animal: This study used white male rats (Rattus norvegicus). The age of animal were 2-3 months and the weight of 2-3 adults ages approximately 150-200 grams were measured with scales Torbal (Torsion Balance). Materials of this Research were : a. Animals that white rats (Rattus norvegicus) Wistar certain criteria b. Fresh water (PDAM) c. Material examination of blood lactic acid levels. d. Tools and materials treatment of experimental animals is basin for swimming as well as tools ballast load test animals. There are many tools using in this study : a. Cage measuring 30 x 40 cm. b. Scales torbal (Thorsion Balance) for the body weight of rats c. Thermometer body with units of degrees Celsius (^{0}C) d. Drinking bottles for rodents. e. Points of food (pellets). f. Stopwatch (Casio HS-1000 Japan) with a level of accuracy. 0.01 sec. g.

Transferpette pipette brands RIR-2h. Temperature Controller (The temperature in the water). i. Accu trend Lactate (Accusport Boehringer) for pemerikasaaan lakat acid blood. j. Alcohol grading 70%. k. Softelix Accu-check for awl that injuries occur until blood can be dripped into the test strip so that lactic acid can be measured. l. Pens, paper and formulir test. This study was conducted in Surabaya Environmental Health Studies Program and the Laboratory of Biochemistry Faculty of Medicine Airlangga University Surabaya.Data were analyzed using SPSS for Windows XP series 13 which includes a statistical analysis as follows: Descriptive statistics, normality test distributions as determine whether the distribution of the data acquired is different from the normal data distribution. Normality test is done by non-parametric methods (Kolmogorov-Smirnov test). Done with a level of $\alpha = 0.05$, test Anacova weight as a moderator variable, and continued with LSD between treatment groups, t-test Independent test to determine the difference in value between the two groups.

RESEARCH RESULT

Blood samples of mice performed at the age of 2-3 months and weigh 150-200 grams, aiming to get the appropriate physical condition for treatment of physical exercise. Selected male rats as a sample intended for physical ability better than the male rats and female rats was not affected reproductive hormone cycles. How to select a sample: sample size obtained by a number of experimental animals, 28 rats were eligible (such as: gender, age, weight, healthy, and agile). Selection of the sample is done in order to obtain a homogeneous experimental animals. This is done with the consideration that experimental results will be generalized.

Measurement of blood lactic acid levels in K0 conducted to determine the initial conditions of the experimental animals, is used as a parameter to determine the response due to physical activity. From the measurement results lactic acid levels prior to the experimental animals are treated in the form of physical exercise, gained an average 2.0 mMol / L with a range between 1.6 mMol / L to 2.3 mMol / L. This is consistent with the levels of lactic acid in the blood of white rats a control group study was conducted BPOM (before doing the activity) is 2.29 mMol / dl . The results of data analysis lactic acid levels after the initial blood test animals tested homogeneity of variance showed a homogeneous, $p > 0.05$. After being treated in the form of physical exercise by swimming in water at room temperature and weighted in accordance with the weight of experimental animals, the blood lactic acid levels rise, the average result is 3.9 mMol / L, ranging from 3.5 to 4.7 mMpl / L. Increased levels of lactic acid can be seen from the graph below 1. It

Information :

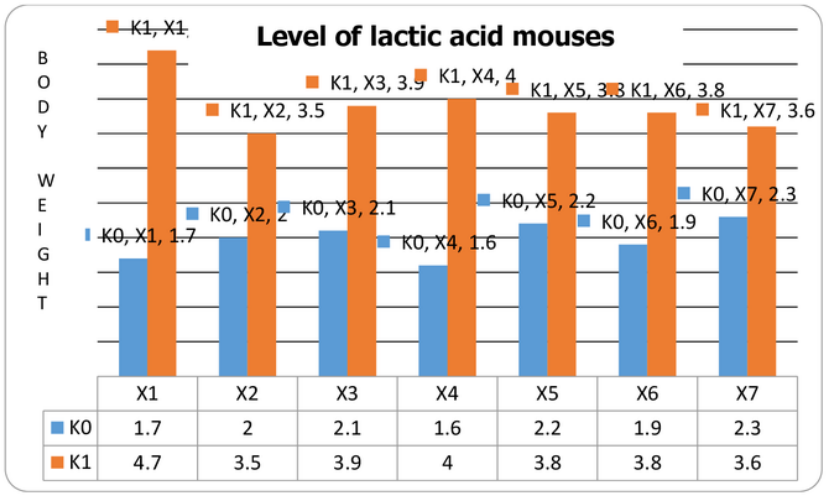
K0: Lactic Acid Levels before being given a physical exercise (r = 2.0)

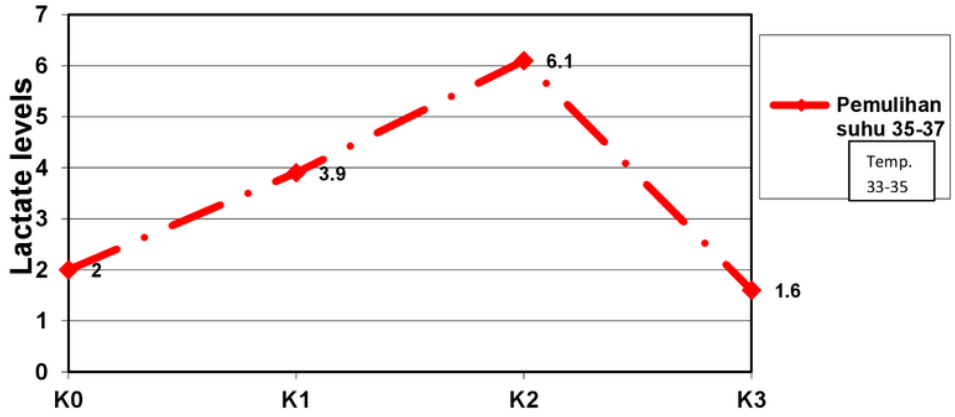
K1: lactic acid blood levels after physical exercise (r = 3.9)

Blood lactic acid levels after treatment (temperature 35-37 °C)

This study aims to determine differences effect of active recovery in the warm water temperature and the temperature 35-37 °C and 33-35 °C to decrease blood lactic acid levels after physical exercise given moment. In granting physical exercise, time and workload between the two groups was the same. If the results of the study there is a difference, it is due to the difference in treatment given. Not because of differences exercise. If the burden on the research results have a difference, it is due to the difference in treatment given. Not because of differences in training load.The results of mean lactic acid levels during 5 minutes after recovery at 33-35 °C temperature water has risen 6.10 mMol / L with a range between 5.5 mMol / L to 6.8 mMol / L, but 10 minutes later decreased to

1.60 mMol / L. Analysis of the results of measurements of lactic acid levels in this study are presented in graph 2





Graph.2: lactic acid levels in research.

Information :

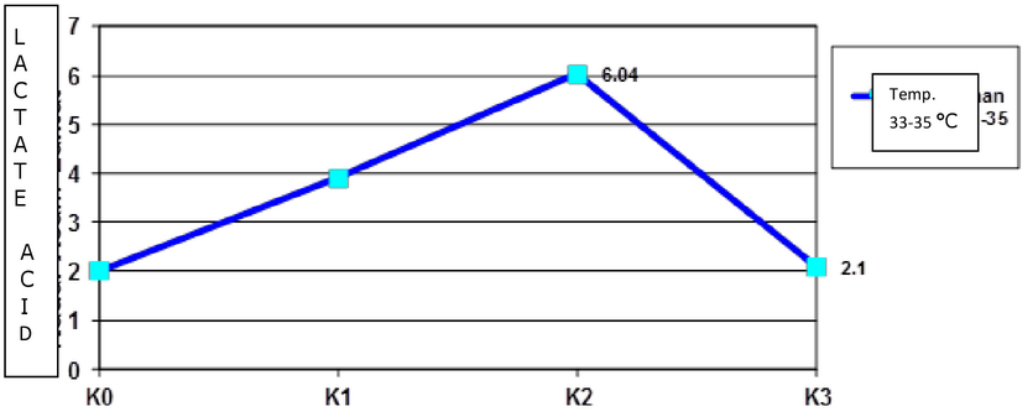
K0 group: Lactate levels were measured before activity

K1 Group: Lactate levels were measured immediately after exercise

K2 Group: Lactate levels were measured 5 minutes after physical exercise

Group K3: Lactate levels were measured 15 minutes after physical exercise

Blood lactic acid levels after treatment (temperature 33-35 °C): The results mean lactic acid levels during 5 minutes after recovery at 33-35 °C temperature water has risen 6.04 mMol / L with a range between 5.5 mMol / L to 6.7 mMol / L, but 15 minutes later decreased to 2.16 mMol / L. the results of measurements lactic acid levels in this study are presented in chart 3Lactate levels Lactate levels



Graph.3: lactic acid levels in research.

Information :

K0 group: Lactate levels were measured before activity

K1 Group: Lactate levels were measured immediately after exercise

K2 Group: Lactate levels were measured 5 minutes after physical exercise

Group K3: Lactate levels were measured 15 minutes after physical exercise

Descriptive Analysis: The results obtained moderator variable weight (grams) and the dependent variable blood levels of lactic acid (mMol / l). Descriptive statistical analysis was used to meet the requirements of normality test used to determine the effect of active recovery in warm water to decrease blood lactic acid levels. Here is the distribution of data based on the mean and standard deviation of weight and blood lactic acid levels experimental animals. Descriptive analysis of variables can be seen in Table 1.

The measurement data of animal weight ranges between 158-172 grams there is no increase or decrease. To see the significance of differences in the data of various treatment groups and several times observation, using the One-Way ANOVA.

Table-1: The mean and SD of weight and lactic acid levels study

Group	Variable	
	Weight (gram)	Lactate Levels Mol/L)
	Mean	Mean
K0 (before excercise)	158 ± 0,10	2,0 ± 0,18
K1 (after excercise)	170 ± 0,11	3,90 ± 0,45
K2 Pre Test (5')	163 ± 0,08	6,10 ± 0,81
Post Test (15')		1,60 ± 0,83
K3 Pre Test (5')	172 ± 0,23	6,04 ± 0,82
Post Test (15')		2,16 ± 0,45

Normality Test Results: As an essential condition test the meaningfulness of the differences between the various groups, the data obtained should be tested for normality of distribution with the normality test data using Kolmogorof Smirnov test as in table 2:

Table-2: Distribution Normality Test Results (n = 7) Variable levels of lactate, K0, K1, K2 and k4 in both treatment groups

Lactate Levels	Mean	K-SZ	P
Treatment 1			
K0	2,04± 0,18	0,739	0,645
K1	3.90 ± 0,45	0,567	0,905
K2	6,10± 0,81	0.622	0,834
K3	1,06± 0,83	0.567	0,905
Treatment 2			
Pre test 1	2,04± 0,18	0,739	0,645
Pre test 2	3.90 ± 0,45	0,567	0,905
Post test 1	6,04 ± 1,03	0,640	0,807
Post test 2	2,16± 0,81	0,392	0,998

Information :

K0: Lactate levels were measured before activity

K1: Lactate levels were measured immediately after exercise

K2: Lactate levels were measured 5 minutes after physical exercise

K3: Lactate levels were measured 15 minutes after physical exercise

The Results Of Kolmogorof Smirnov normality test, indicate that variable blood lactic acid levels in both treatment groups there was no significant difference with the normal distribution (p> 0.05).

ANOVA test pre-treatment homogeneity: Homogeneity test is performed to determine that the sample had the same initial conditions or between group 1 and group Pretest 2. Homogeneity test using a significance level of 0.05. When the value of the test is more than 0.05 (> 0.05), the data on these variables has a homogeneous variance. Summary of homogeneity test results can be seen in Table 3.

Table-3: Test Results Homogeneity variant (n = 7) Variable Weight and lactate levels in the Pre Test.

Variable	P
Lactate Levels	0,186
Weight	0,448

Table 3 shows the results of One Way Anova test of homogeneity that the weight factor and lactic acid levels between groups showed no significant difference with homogeneous variance values (p> 0.05).

Independent Sample T Test Analysis: Independent Test Results T to compare the mean difference (Post test 2 with post test 1) of recovery lactate levels between groups active in warm water and in cold water. The difference can be summarized in Table 4:

Table-4: Results of independent samples t test between groups decreased levels of lactate recovery hot water and room temperature water group

Lactate Levels	Mean± SD	t	P
Treatment in Temperture 35-37 ^{O}C	2,757 ± 0,767	9,310	0,000
Treatment in Temperture 35-37 ^{O}C	-2,171 ± 1,171	9,310	

Independent T-test using a significance level of 0.05 (p = 0.05), the p-value T Independent test results is less than 0.05 (p <0.05), it can be concluded that there are significant differences between active recovery in water temperature 35-37 °C with active recovery at water temperature of 33-35 °C.

DISCUSSION

This study aims to determine the effect of active recovery in the warm water temperature (33 - 35 °C) and (35 - 37 °C) to decrease blood lactic acid levels after physical exercise shortly. This research is a kind of experimental laboratory, with consideration of the experimental method is one of the appropriate research methods to investigate the causal relationship [10]. The study design is the most often used in experimental research in the field of medicine and health.

Blood Lactic Acid Levels Before Physical Fitness (K0): Variable blood lactic acid levels early animal show a normal distribution and homogeneous, meaning that data should be analyzed with parametric tests. From research conducted showed that the average blood lactic acid levels early experimental animals ranged from 1.6 to 2.3 mMol / l with a mean of 2.0 mMol / l as shown in Table 4. Measurement of blood lactic acid levels in K0 conducted to determine the initial conditions of the experimental animals, is used as a parameter / control group to determine their response as a result of physical activity. The results of data analysis lactic acid levels after the initial blood test animals tested homogeneity of variance showed a homogeneous, p> 0.05, (Table 4) thus showing the condition of each individual has equal value, the event of differences in levels of blood lactic acid after being given treatment is actually due to the effect of a given treatment in experimental animals.This is in accordance with the amount of blood lactic acid levels in healthy people and in a state of rest ranges[11] between 1-2 mMol / l . Likewise, lactic acid levels in the blood of white rats a control group study was conducted BPOM (before doing the activity) is 2.29 mMol / dl .

Lactic acid levels immediately after exercise (K1)

This study uses a momentary physical exercise in this case the experimental animals treated pool with appropriate load weight (9% weight)[8, 5] with the following considerations:

1. In this study using the momentary physical exercise is anaerobic, which exercises with high intensity close to maximum, and only last a short time or no more than 2-3 minutes, strenuous physical exercise intensity according Bompa[12] , with provision expenses of 9% weight.

2. Physical exercise is carried out in a short time and not too heavy, not cause of injury that can cause tissue damage[4].

This study, the mice were given the test in the form of an outdoor exercise in the water, visible blood lactic acid accumulation. Rats swim as strong as an attempt to survive (survive) in the water because the mice is not a water animal. This situation causes the metabolism that occurs is anaerobic. Under the circumstances there is a reduction anaerobic ATP and accumulation of lactic acid as a metabolic waste products in the muscles. The results mean rat blood lactic acid levels in the group K1, immediately after exercise presented in Table 4 is 3.90 ± 0.45 mMol / l. This proves the existence of an increase in blood lactic acid levels as a result of anaerobic metabolism after animals try to physical exercise shortly. Exercises are performed with maximum strength will cause a build up of lactic acid in the muscles.Increased plasma levels of lactic acid in muscles during strenuous activity or due to the very high energy requirements, by increasing energy needs of about 100-fold compared to the rest condition. Under conditions of very heavy activity energy needs derived from anaerobic metabolism. In a state of anaerobic metabolism of glucose that occurs is not perfect with the final result of 2 ATP plus waste products such as lactic acid. Production of the remainder in the form of lactic acid, after dissociating into lactate and H + is a strong acid. Increased H + is very influential on the appearance of the skeletal muscles fatigue. Skeletal muscle fatigue caused by an increase in H + 2 is evidenced by the fact that:

1. Research in human muscle fatigue showed a very strong connection a decrease in muscle contraction strength comparable to a decrease in pH (increased acidity) of muscle tissue.

2. Research on skeletal muscle fibers in a state of acidosis describe muscle cells will occur reduction isometric strength and speed of muscle contraction. Acidosis muscle cells would reduce the ability of muscle contraction to cause fatigue.

According to Fox and Bowers[2] exercises performed in a short time with high intensity close to maximum, and only last a short time or no more than 2-3 minutes, then the dominant energy system is the anaerobic system. Shortage / oxygen debt as a result of the activities that have been made will be fulfilled completely about 5 minutes after activity[12]. During a lack of oxygen, a person must perform a recovery with active rest. The recovery process will run faster with active rest, to conduct an active break, then the lungs keep working at maximum conditions. This causes a lack of oxygen in the body will be filled with as soon as possible, which is between 1-3 minutes early after doing the activity. Furthermore, the condition of the body will be completely recovered normal after resting for 60 minutes[7].

Lactic acid levels 5 minutes after recovery (K2 and K3): Exercise in general can increase blood levels of lactic acid. High concentration of lactic acid that can cause adverse impacts of the body. Blood lactic acid levels that exceed 6 mMol / 1 may interfere with the working mechanism of muscle cells to the level of coordination of movements[11]. Lactic acid is also a cause of fatigue therefore wherever possible be returned to the state before the exercise, namely to the low levels Soekarman[4] .The average value of lactic acid levels after recovery 5 minutes, for a group in the warm water temperature 35-37 °C is 6.10 mMol / l, while for the group in the water temperature of 33-35 °C is 6.04 mMol / l (table 5.1) Reason researchers to measure blood lactic acid levels after recovery five minutes, is that the peak blood lactic acid levels occur 5 minutes after intense exercise[13] . This increase occurred due to lactate formed during physical activity, new diffuses into the blood after 5 minutes, therefore blood lactic acid levels rose sharply at the time [14].Blood lactic acid levels in group K1 (recovery in water temperature 35-37 °C) higher than in the group K2 (33-35 °C temperature water recovery) for the active recovery in water 35-37 °C greater vasodilation occurs so that the supply of oxygen to skeletal muscle increases and will bring almost all of the muscles of lactic acid diffuses into the blood, so that lactic acid in the blood after 5 minutes of recovery in the warm water

reaches the maximum number. As seen in the graph 5.1. Lactic acid levels in the water group 35-37 °C post test 1 (5 min) peaked while the room-temperature water has not yet reached its peak.

Lactic acid levels 15 minutes after recovery (K2 and K3): The mean lactic acid levels 15 minutes after the restoration is 1.60 mMol / l for group 35-37 °C temperature water and 2.16 mMol / l for group 33-35 °C temperature water. This indicates that after being treated recovery at temperatures different environments, from the state of homogeneous (lactate in the beginning and weight) as well as the training load of the same (80% of working capacity maximum) weight, lactic acid levels in the group of water recovery 35 -37 °C to be lower than the recovery group at 33-35 °C temperature water. It is understandable, that physical exercise releases energy in the form of heat. When the body temperature increases the metabolic rate will increase with comparable speed. According to Ganong[15], , which became the main source of body heat is skeletal muscle contraction. Landau said that after physical exercise, the metabolic rate increased by 5-20 times higher than normal, for a relatively short period of time. After a recovery for 5 minutes in a warm environment tempeatur there will be vasodilatation. Skin temperature is different from the core temperature, therefore the increase and decrease in skin temperature is influenced by the temperature of the surrounding environment, and is associated with convection to the surrounding environment [14].

Decreased levels of lactic acid in the blood of active recovery in warm wáter: Value decrease blood lactic acid levels 15 minutes after physical exercise in water 35-37 °C group was 4.5 mMol / l whereas in the group 33-35 °C temperature water is 3.88 mMol / l. The results of Independent sample T test analysis showed no significant differences ($p < 0.05$). However, the decline is not enough to restore the levels of lactic acid as the normal state[11] of about 1-2 mMol / l . In general, to eliminate 95% of lactic acid heap takes approximately 1 hour and 15 minutes after maximal exercise. There are a few organs capable of oxidizing lactic acid, but striated muscle that holds the greatest role. Most of lactic acid oxidation occurs in the striated muscle contractions are slow. This is the reason why the decrease in lactic acid more rapidly in active recovery when compared with the full break [2]. To clean the blood lactic acid levels in the body more quickly by doing light activities than without doing any activity[2]. In active recovery occurs in warm water vasodilation, both the arteries and veins. In the arteries, which supply oxygen to muscle tissue increases, so the availability of needed oxygen can change into aerobic anaerobic conditions, thus oxygen debt (oxygen debt) in this case are met. When a person starts breathing oxygen after a period of anaerobic metabolism, lactic acid is converted back to pyruvic acid and NADH plus H +, most of which will soon be oxidized to form a large amount of ATP. While vasodilation in the veins, will facilitate the cleaning of lactate from muscle tissue to be converted into pyruvic acid back that occurs in the liver with the help of lactate dehydrogenase

During recovery in the warm water, the body of sufficient oxygen supply so that it can be used for the process of metabolism in the muscles together with pyruvic acid in the Krebs cycle through the process of electron transport system[14] (Guyton & Hall, 1995). Of the Krebs cycle and the electron transport system will obtain energy used to meresintesa ATP that has been used during the exercise. Thus, a large amount of lactic acid formed during anaerobic glycolysis process is not lost from the body, until the oxygen available again, lactic acid can be converted back to ATP or energy. Once there is enough energy in the muscles, things were refreshed and ready to perform back exercises. the research also proved that with active recovery can shorten the recovery time. According to research conducted body temperature and increased muscle during exercise will affect the metabolism and muscle function. The study was conducted in rats trained on a treadmill in a different environment, cold acclimatization will increase the levels of muscle mitochondria and measured levels of cytochrom-C oxidase. Changes in temperature can affect the levels of mitochondria in

various ways, such as changes in the body temperature during exercise can improve: the supply of oxygen from the blood to the muscle mitochondria, use susbtrat, plasma epinephrine concentrations, blood pressure and oxygen consumption in producing ATP. Biochemical reactions involving mitochondrial respiration depends on the availability of oxygen. Increased delivery of oxygen and its use during exercise will improve mitochondrial respiration, therefore the temperature increases during exercise can increase levels of muscle mitochondria. The increase of temperature in addition to increasing the supply of oxygen to the blood, it can also improve the performance of the enzyme (lactate dehydrogenase, piruvatkarboksilase, phosphoenolpyruvate karboksikinase) that contribute to the metabolic processes of ATP causes the temperature rise as much as 10 °C, causing liveliness to 2 times greater (Q10 = 2), At the optimum temperature of the reaction is most rapid. Enzymes in the human body has an optimum temperature[16] of around 37 °C . According to Ganong[15] heat arising in the human body is the result of muscle activation, assimilation of food and vital processes that support your basal metabolism rate. As reported for a drop in temperature 2-5 °C, VO2 max was reduced by 10-30 % and the accumulation of lactic acid in the blood occurs at a low workload at that temperature. Recovery is carried out in warm water will not directly affect the decrease in the accumulation of lactic acid in the blood as a result of the exercise, but rising temperatures act as a factor that can cause vasodilation and improve the performance of the enzymes in the metabolism of formation (ATP) energy. Thus, the hypothesis proposed in this study has proven that decreased levels of blood lactic acid after physical exercise shortly with active recovery in warm water (temperature 35 °C - 37 °C) and temperature (33 °C - 35 °C) may reduce fatigue.

CONCLUSION

1. Recovery active in warm water (temperature 35 °C -37 °C) to lower blood lactic acid levels of white rats (Rattus norvegicus) after physical activity shortly.
2. Recovery active in warm water (temperature 33 °C -35 °C) decrease blood lactic acid levels of white rats (Rattus norvegicus) after physical activity shortly.
3. Decreased blood levels of lactic acid after physical exercise shortly with active recovery in warm water (temperature 35 °C - 37 °C) and temperature (33 °C - 35 °C) may reduce fatigue.

SUGGESTION

Based on the implementation of the research and the research that has been investigated is obtained, the researchers express some suggestions as follows:

1. In this study, treatment of active recovery in warm water in experimental animals (rats), shown to reduce levels of blood lactic acid faster, hence the need to develop further research in humans or by the method of applying warm compresses on the active muscle.
2. Form a recovery in this study was active recovery with a swim without the burden conducted in experimental animals in warm water environments, further research may dilakukanan in environments with a wide range of temperature variation to find the optimal temperature in the recovery.

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