EXERCISE RATIO 1:2; CHANGES OF ANAEROBIC THRESHOLD AND LACTATE ACID LEVEL

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ABSTRACT
Training is a form of physical exercise that can improve physical fitness if done with correct frequency and intensity. Regular and measured training requires various training programs, such as interval training, circuit training, continuous training, combination training/exercise, or weight exercise, each of which has measurable exercise ratio to individual needs. Regular and measured training will result in increased work of respiratory system, cardiovascular system, strengthen skeletal muscles and endurance. The purpose of this research is to analyze the effect of exercise ratio 1:2 on changes of anaerobic threshold and lactate acid level in students of Physical Education, Health, and Recreation Study Program, Sport Education Department, Faculty of Sport Sciences, Universitas Negeri Yogyakarta (PJKR FIK UNY). Research method used was by quasi-experimental. Research design applied pretest-posttest group design, with quantitative research type. Data collection for the variables studied was done by test instrument anaerobic threshold test using Fitmate version 2.2, Wellness Technology a Division of Cosmed and treadmill, lactate acid level test using Accutrend Plus. Research results indicate that they are three conclusions; the first exercise ratio 1:2 gives significant effect on anaerobic threshold changes of PJKR FIK UNY students. The second, exercise ratio 1:2 gives significant effect on lactate acid level changes of PJKR FIK UNY students. The third, exercise ratio 1:2 gives significant effect on changes of anaerobic threshold and lactate acid level of PJKR FIK UNY students.

Key words: Exercise Ratio, Anaerobic Threshold, Lactate Acid

INTRODUCTION
Nowadays, sports in modern era become the needs of all humans to improve their health and fitness level. Achieving fitness by training habitually, regularly, directed, continuous and measurably influences individual physical condition. Sports are beneficial for maintaining health and disease, this is also revealed by McKinney et al (2016,p.131) who states that high level of physical activity and cardiorespiratory fitness can reduce development of chronic diseases such as hypertension, diabetes, stroke, and cancer, besides it can also improve cognitive function and psychosocial health. Physical fitness is influenced by level of success in increasing speed, agility, strength, explosive power, endurance, balance, coordination, reaction, and flexibility (Bompa and Haff, 2009, p. 65). Furthermore Moore et al (2012, p. 841) states that doing sports continuously will improve cognitive, affective, and psychomotor abilities. Sport seems to be progressing in present development, inseparable from success of community in sporting society and promoting sports which are supported by application of science and technology in sports. Researchers results show that sports have been successful with the application of science and technology in every kind of sports, health sports, and recreational sports, including proper training must require systematic training program and continuous training as revealed by Penggalih et al. (2015, p.219) arguing that training/ training is a form of physical training that can improve physical fitness if done with right frequency and intensity. Regular and measured training requires training program. Types of training that can be done are several ways, such as interval training, circuit training, continuous training, combination training, or weight training, each of which has measured training ratio to individual needs. Regular and measured training will result in increased work of respiratory system, cardiovascular system, strengthen skeletal

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muscles and body endurance. Results of research by Candra et al. (2016, p. 333) show that aerobic training performed with proper intensity, duration and frequency can improve athletes’ performance and achievement, thus slowing fatigue during training. Another opinion from Tanzila et al (2017, p.47), explaining there is the influence of high intensity interval training on pulse rate significantly in high-activity communities. In accordance with Sandi's research result (2016,p. 1) which states that physical training causes an increase in pulse frequency. This increase is caused by increase in the need for blood that transports oxygen (O2) to active body tissues, transporting waste materials such as carbon dioxide (CO2) and other metabolic byproducts. If physical training is done regularly and continuously for a long period of time, there will be decrease in the frequency of resting pulses. Work ratio given to an training will affect body anatomically and physiologically, such as muscle strength, muscle reaction speed, muscle endurance, muscle stabilization, heart- lungs resistance, muscle explosive power, and muscle coordination. The ratio of this comparison is training of time between training and rest. The ratio of training given to achieving fitness can be seen from various problems including: (1) quality of the person in training that affects fatigue and can survive fatigue threshold, (2) irregular levels of rest can affect training, (3) unfocused concentration that affects muscle fatigue in training, (4) metabolic system and irregular nutritional patterns reduce body function during training. This statement is supported by Ghosh (2004, 24) that training at or slightly above anaerobic threshold intensity increases aerobic capacity and level of anaerobic threshold. Furthermore, Whyte et al (2005, p.93) states that trained people can maintain their aerobic activity around 80%, while those who are not trained or inadequate can only maintain aerobic activity around 40-50%. Anaerobic threshold is the level of oxygen consumption where there is a rapid and systemic increase in blood lactate concentration, one form of training is High Intensity Interval Training (HIIT), which is training with the load above anaerobic threshold in short time and interspersed with active recovery period (Vidiari, 2017, p. 62.). Based on the problems above, researchers were inspired by process of figuring out the effect of circuit training ratio 1:2 on changes in anaerobic threshold and lactate acid level. The reason why researchers focused on the problems above was because of the training ratio revealed by Bompa and Buzzichelli (2015. p. 46) that shorter work-rest intervals (such as 1:1 - 1:3) will selectively target the oxidative system, while those that longer (1:12 - 1:20) targeting the phosphate system. Bompa and Buzzichelli (2015, p. 43) explain in their book that anaerobic threshold training can be done with repetition duration 1-10 minutes, number of repetitions 3 - 40, rest interval 1:03 - 1:1, 4-6 sets of intensity maximum 90-100%, but the results of the study had not been conducted to find out whether it was true that the statement above was suitable for changes in anaerobic threshold and lactate acid level. Results of several observations that some problems occurring in students of Physical Education, Health, and Recreation Study Program, Faculty of Sport Sciences, Universitas Negeri Yogyakarta (PJKR FIK UNY) include: (1) students of 2nd semester of PJKR FIK UNY have never been given circuit training with 1:2 ratio to determine changes of anaerobic threshold; (2) students of 2nd semester of PJKR FIK UNY have never been given circuit training with ratio 1:2 to determine lactate acid level; (3) students of 2nd semester of PJKR FIK UNY still cannot manage healthy lifestyle, especially diet and rest adjustments, this is based on the results of interviews with several students who said that their eating and rest patterns are less regular due to adaptation to new environment; (5) students of 2nd semester of PJKR FIK UNY are still too much full material and lecture practice so that they lack programmed trainings on average in 3 courses a day. Problems of observation and prerequisite observation results above give inspiration for researchers to examine in depth "Effect of Circuit Training Ratio 1:2 on Changes of Anaerobic Threshold and Lactate Acid Level". The research firstly at analyzing effect training ratio 1:2 on changes of anaerobic threshold; secondly, analyzing effect on training ratio 1:2 on lactate acid level; and thirdly, analyzing effect training ratio 1:2 on changes of anaerobic threshold and lactate acid level

**METHODS**

**Research Design**

The research used quasi-experimental method which aimed to analyze the effect of circuit training ratio 1:2 on changes in anaerobic threshold and lactate acid level of 2nd semester students of Physical Education, Health, and Recreation Study Program, Faculty of Sport Sciences, Universitas Negeri Yogyakarta (PJKR FIK UNY). Research design used pretest-posttest group design with quantitative research type (Creswell, 2012, p.297). The research was conducted in February to June 2018.

Giving the training ratio 1:2 means that once doing work in this case is doing circuit training consisting of 7 posts including shuttle run, sit up, push up, half squat jump, back up, squatsrush, and jumping jacks for 3 sets and rest periods for twice working time.

The training program was done for 16 weeks, 3 times every week and repetitions week 1 to 2, 50% of 1 RM; week 3 to 4 60%, week 5 to 6 70%.

**Research Subjects**

Targeted population of the research was of 2nd semester students of Physical Education, Health, and Recreation Study Program, Faculty of Sport Sciences, Universitas Negeri Yogyakarta (PJKR FIK UNY). Sampling technique was based on purposive sampling. These criteria included 1) 2nd semester PJKR students, 2) aged between 17-20 years old, 3) not in sick condition, 4) not injured, 5) male sex, 6) not professional athlete , 7) not undergoing training program, 8) not undergoing training camp, 9) willing to be research subject, 10) willing to follow research process. Research samples that met the criteria were 10 students.

**Variable Operational Definition**

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This research has 1 independent variable which is circuit training ratio 1:2 and 2 dependent variables including changes in anaerobic threshold and lactate acid level. Circuit training ratio 1:2 means 1 time doing work in this case doing circuit training consisting of 7 posts including shuttle run, sit up, push up, half squat jump, back up, squathrush, and jumping jacks for 3 sets and rest periods twice working time. Training is performed for 16 treatments (6 weeks), 3 times a week frequency, repetition in week 1-2 50% of 1 RM; week 3-4 60%, week 5-6 70%. Rest between repetitions is 2 times of the length of working time while resting between sets (length) that is the total working rest length of each post. Anaerobic Threshold change in question is the time of anaerobic threshold when running on treadmill with test run 12, maximum test measured by using Fitmate version 2.2. Wellness Technology a Division of Cosmed. Lactate acid level was result of carbohydrate metabolism without using oxygen. Lactate acid referred to in this research was level of lactate acid formed when running on treadmill with test run 12, maximum test. Measurements were made using Accutrend Plus in mmol unit in same heart rate condition between initial test and final test.

**Instruments and Data Analysis Technique**

1. **Instrument**
   - Instruments used in this research include for measuring:
     a. Anaerobic Threshold Change
     - Anaerobic threshold change was by using Fitmate version 2.2, Wellness Technology a Division of Cosmed. When measuring anaerobic threshold, it was also equipped with other supporting tools such as treadmills.
     b. Lactate Acid Levels
     - Lactate acid levels are measured using Accutrend Plus.

2. **Data Analysis Technique**
   - Data that had been obtained, then analyzed by using SPSS Statistics 24 program with following steps:
     a. Normality Test with Kolmogorov Smirnov
     b. Homogeneity test with Levene test
     c. Test the Hypothesis with T-Test

**RESULTS**

The data described was the data taken from results of reduction (difference) of post test (after) with pre test (before). The data obtained can be described one by one as follows:

**Anaerobic Threshold**

The results of the anaerobic threshold measurement test data with number of samples n = 10 performed before and after doing the training, the training ratio 1:2 can be seen in the following table:

<table>
<thead>
<tr>
<th>Anaerobic Threshold</th>
<th>Min</th>
<th>Max</th>
<th>Std. Dev</th>
<th>Mean</th>
<th>95% Confidence Interval for Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60</td>
<td>180</td>
<td>42.54</td>
<td>111.0</td>
<td>80.57 to 141.43</td>
</tr>
</tbody>
</table>

The description of the results of anaerobic threshold measurement data in Table 1 shows that training ratio 1:2 has minimum value of 60, maximum value 180, average value (x̄) of 111.0 and standard deviation of 42.544.

**Lactate Acid Level**

Data of measuring test results of lactate acid level with number of samples n = 10 were applied before and after doing the training, training ratio 1:2 can be seen in the following table.

<table>
<thead>
<tr>
<th>Table 2. Lactate Acid Data Measurement</th>
</tr>
</thead>
</table>

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Description of measurement data results for lactate acid level in the table above shows that the training ratio 1:2 has minimum value 4, maximum value 7, average value ($\bar{X}$) is 5.01 and the standard of deviation is 0.956.

**Hypothesis Testing**

Before the data were analyzed, prerequisite test was conducted first. The prerequisite test was done by conducting normality test. The prerequisite test performed to meet the data analysis by using Manova technique done by the normality test by Shapiro Wilk’s technique ($p> 0.05$

a. Anaerobic Threshold Normality Test

Then, the result of the normality test of training ratio 1:2 on anaerobic threshold is presented as shown in the following table.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sig.</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaerobic Threshold</td>
<td>0.249</td>
<td>Normal</td>
</tr>
</tbody>
</table>

Anaerobic Threshold

Result of the anaerobic threshold prerequisite test analysis in the table above shows that training ratio 1:2 is sig. 0.249 ($p> 0.05$), it can be said that data with ratio 1:2 is normally distributed.

b. Normality Test on Lactate Acid

The results of normality test of training ratio 1:2 on lactate acid test results are presented in the following table.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Ratio</th>
<th>Sig.</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactate Acid</td>
<td>1:2</td>
<td>0.495</td>
<td>Normal</td>
</tr>
</tbody>
</table>

Analysis result of lactate acid prerequisite test in the table above shows that training ratio 1:2 is sig. 0.495 ($p> 0.05$), it can be said that data with training ratio 1:2 is normally distributed.

c. Difference Test (Paired t Test)

The following is explained the result of difference test results of training ration 1:2 data for changes in anaerobic threshold and lactate acid level as in the following table.
Table 5. Paired Samples Correlations

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest AT – Posttest AT</td>
<td>-111,00000</td>
<td>42,54409</td>
<td>-8,251</td>
<td>9</td>
<td>.000</td>
</tr>
<tr>
<td>Lactate Acid Pretest - Lactate Acid Posttest</td>
<td>5,01000</td>
<td>.95621</td>
<td>16,569</td>
<td>9</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 6 Paired Samples Test

Hypothesis test that had been done which can be seen in Table 5 and Table 6 shows that the change in anaerobic threshold showed that the correlation was obtained at 0.544 while the t value obtained was 8.251 with the Sig. 0.000. Because the value of Sig. 0.000 <0.05, so Ho was rejected, so it could be concluded that the circuit training ratio 1:2 can increase the anaerobic threshold change at $\alpha = 5\%$.

Hypothesis test on the effect of circuit training ratio 1:2 on lactate acid level which could be seen in Table 5 and Table 6 indicated that the lactate acid level showed correlation of 0.373 while the t value obtained was 16.569 with the Sig. 0.000. Because Sig. value 0.000 <0.05, so Ho was rejected, so it could be concluded that circuit training ratio 1:2 could make lactate acid level better at $\alpha = 5\%$.

DISCUSSIONS

Physiological process occurring when conducting circuit training with ratio 1:2 on anaerobic threshold is stated significant. Syaifuddin (2011, p.357) states that human body when doing training or activities continuously will result in changes in chemical energy in body cells to convert chemical energy into mechanical energy, osmotic energy, electrical energy, and heat, so that research subjects who are continuously trained in their bodies will be able to adapt not to experience fatigue which means that oxygen level during training can be stable. Above statement is strengthened by Antunes research results (2015, p.1) at Federal University of Rio Grande Dosul, Brazil in 12 active women given aerobic training have achieved significant improvement when practicing maximally by prioritizing cardiorespiration directly related to muscle mass involved
in the training. Reinforced by the research results in Denpasar, Bali, Indonesia for 24 running extracurricular students by Vidiari (2017.p.62) arguing that training with over anaerobic threshold weight is stated to be significant. Lactate acid is decreased because burning process cannot be re-processed into energy, so the dominant one will use aerobic energy system to produce energy/power so that it can do training again. Trained athletes anaerobically will release lactate acid by 80% compared to athletes performing aerobic exercise by 75%, so that trained athletes in anaerobic training will not feel significant fatigue. (Green, et al., 2014.p.329-338).

This is in accordance with research results o from Grossi et, al (2012.p.161) stating that the best training for athletes is by using anaerobic training to produce high lactate threshold. Flora (2015.p. 40) says that anaerobic physical training results in increased plasma lactate level and decreased levels of lactate in heart muscle tissue. Circuit training with ratio 1:2 is a training with high intensity and availability of recovery. With programmed and intensive training, physiological adjustments will occur. The recovery given that is fulfilled will re-form Adenosine Tri Phosphate (ATP) - Phosphocreatin (PC) that has been used. As a result of adaptation process that occurs, then, the formation of lactate acid will decrease or slow. Programmed training will be able to reduce lactate acid level faster because the distribution of lactate acid from various muscles will be channeled to other parts of muscle quickly. When doing the training, blood vessels will work to channel blood to muscles that contract so that it will automatically reduce lactate acid level in contracting muscles. System reconstitution of lactate acid means removing the excess lactate acid collected in all body fluids. This is very important because lactate acid causes extreme fatigue. When adequate amounts of energy are available from oxidative metabolism, removal of lactate acid is achieved in two ways: (1) small portion of it is converted back into pyruvic acid and then oxidized metabolically by all body tissues. (2) The remaining lactate acid is converted into glucose, especially in liver, and glucose in turn is used to replenish muscle glycogen reserves. (Guyton, 2011, p.1034)

CONCLUSIONS
Based on the research results, it can be summed up that there are The first is that exercise ratio 1: 2 gives significant effect on anaerobic threshold changes of PJKR FIK UNY students. Secondly, Exercise ratio 1:2 gives significant effect on lactate acid level changes of PJKR FIK UNY students. Thirdly, exercise ratio 1:2 gives significant effect on changes of anaerobic treashold and lactate acid level of PJKR FIK UNY students.

CONFLICT OF INTEREST
This academic work made is no conflict of interest either financially, making decisions or engaging with other parties. This work is also not yet and will not be published in other journals or other scientific forums.

ACKNOWLEDGEMENTS
On this opportunity, the researchers would like to express the gratitude to the Dean of Faculty of Sport Sciences, Universitas Negeri Yogyakarta who has given permission to do research and facilitate the use of facilities and infrastructure. The acknowledgments are also addressed to the International Conference in Health Science (ICHS) committees, which have provided opportunities for researchers to present this scientific ideas.

ETHICAL CLEARENCE
Ethical Clearance done by explaining to research subjects related to research background, time of research, treatment of research subjects, objectives, benefits and impacts that will occur after the research process is conducted. The researchers also explain the rights and obligations to be obtained. After the research subjects understood, they then filled out the voluntary consent statement (Informed consent) with no element of coercion.

REFERENCES