

## Measurement of Anaerobic Capacity Based On Fatigue Index for Pencak Silat Athletes on Combat Category

Nur Subekti<sup>1</sup>, Agam Ahmad Syaukani<sup>2</sup>, Muhad Fatoni<sup>3</sup>

<sup>1,2,3</sup>Program Studi Pendidikan Olahraga, Universitas Muhammadiyah Surakarta  
Jl. A. Yani, Tromol Pos 1, Pabelan

### Abstract

*Purpose:* This research aims to investigate anaerobic capacity for pencak silat athletes in combat category based on fatigue index.

*Methodology:* The method used in this study is descriptive quantitative. Fifteen athletes from sport education undergraduate program were recruited in this study. Their background was all from combat category. They were part of varsity team enrolled in university training center and preparing for provincial college sport competition. The data for anaerobic capacity were collected using Running-based Anaerobic Sprint Test (RAST) with validity level of 0.897 and reliability level of 0.919.

*Results:* The results suggested that in terms of anaerobic capacity level, there are 4 athletes (26.67%) categorized as good, 8 athletes (53.33%) categorized as average, and 3 athletes (20.00%) categorized as poor. Based on the measurement being administered, majority of samples on this study attributed to average level of anaerobic capacity..

*Applications/Originality/Value:* Given that pencak silat is sport in which dominant with anaerobic movement, coaches should prioritize anaerobic training to improve anaerobic capacity which may lead to success in combat.

### BACKGROUND

*Pencak silat* is one of the branches of martial arts which in its movement patterns is very complex both in terms of the physical components needed, as well as in terms of technique, tactics and mentality. There are four (4) categories that are competed in pencak silat namely; combat, single, double and team. This article focuses on the combat category, where in the combat category in martial arts a fighter is required to make movements with a fast tempo, precise and has a measured power. The competition category is carried out in three (3) rounds, each round having a duration of 2 minutes (clean / dirty). In one round, a fighter makes physical contact (attack) with his opponent an average of 12-15 times a breakthrough and each break is on average done with a duration of 2-3 seconds (Sumetri, 2008).

This shows that, to win points in the martial arts competition match category, a fighter is required to make physical contact or defensive movements repeatedly with a changing tempo and a specified time limit and be able to set the body's recovery time in a short time. Thus a fighter will have a great dependence on anaerobic glycolysis to provide energy needs during the competition (Aziz, Benedict, & Teh, 2002).

If it is associated with the energy system of martial arts match, the energy system used is more dominant using anaerobic endurance system. The athlete's performance is influenced by several factors such as physical fitness, skills, physical traits, anthropometric aspects, and psychological (Herman, 2011). Thus a martial arts athlete is required to have intelligence in managing energy by considering the predominant energy system in the martial arts competition.

Previous research conducted by Awan Hariono stated that in the martial arts competition the match category requires anaerobic/ lactic/ phosphocreatin energy system of around 73.75%,

a lactic anaerobic energy system of 16.25% and an aerobic system of around 10%, so that the energy system used during the competition in pencak silat more dominant uses phosphocreatin energy metabolism system (ATP-PC) (Hariono, 2006). Characteristics of the competition for martial arts category include kicking, punching, falling, dribbling and kicking quickly and with maximum force. This is according to (Kriswanto, 2015) who states that anaerobic exercise is a sport that emphasizes muscle strength with high explosive power and usually lasts for a short time. The movements performed in this sport require speed, strength, and power. Anaerobic performance is influenced by many factors, such as body composition, age, gender, muscle fiber composition, strength and exercise (KIn-Isler & Kosar, 2006).

Anaerobic capacity assessment is needed by a coach as information and monitoring stage for the improvement of the training process about the athlete's fitness status (Inbar, Bar-Or, & Skinner, 1986). Individuals with good anaerobic capacity increase are automatically able to produce high energy thereby delaying the onset of muscle fatigue and being able to continue training with high intensity (Heller et al., 1998).

Based from this, the authors think it is necessary to know about the capacity of anaerobic martial arts athletes of the match category through tests and evaluations and measurements in sports. The lack of research or references that discuss the anaerobic energy system in martial arts sports becomes the background of this research. The aim of this research is to find information and description about the anaerobic capacity of martial arts athletes in the match category of student groups based on the fatigue index. The results of this study are expected to be particularly useful for pencak silat sports trainers as a reference in developing training programs to be more effective and efficient in terms of improving physical condition, so as to improve achievement.

## RESEARCH METHOD

This research design is a descriptive-quantitative study, to find out the capacity of anaerobic martial arts athletes in the dueling category based on the fatigue index. Measurement of anaerobic capacity (anaerobic power) of researchers using *Running-based Anaerobic Sprint Test* (RAST) (Mackenzie, B, 1998). The purpose of this test is to measure anaerobic endurance with validity = 0.897 and reliability-test results = 0.919.

The population of this research is pencak silat athletes in the Sports Talent Interest Program (MBO) of pencak silat in the Sports Education Study Program, Muhammadiyah University, Surakarta. The selected sample is 15 athletes of the match category who are conducting training centers in preparation for the 2019 Provincial Student Sports Week. Running-based Anaerobic Sprint Test (RAST) is a sprint-based running test instrument developed to test the athlete's anaerobic performance (Draper & Whyte, 1997). RAST can replace the Wingate test to predict anaerobic power and capacity (Zacharogiannis, Paradisis, & Tziortzis, 2004). Each athlete is weighed before the test and warm-up for a five minute period followed by three minute recovery. The test consists of six sprint runs with intermittent 35m sprints. Each sprint represents a maximum effort with 10 seconds allowed between each run for rotation. The power output and fatigue index are calculated using the following equation: 1) Power:  $\text{Weight(kg)} \times \text{distance (m)}^2 / \text{waktu (s)}$ ; 2) Fatigue index:  $(\text{maximum power} - \text{minimum power}) / \text{total time during 6 sprints}$ . Reliability test ( $r = 0,919$ ).

In this study the data obtained from the anaerobic running test (RAST) were body weight and the results of 6 sprint anaerobic sprint tests (time) with a 10 second interval interval of 15 athletes. Furthermore, the data is converted using RAST Calculator. To determine the anaerobic capacity based on the tired index, it is done using the RAST calculator (Mackenzie, B, 1998). The data

analysis technique used is quantitative descriptive statistics. To facilitate the classification of this research data, knowing the anaerobic capacity is used norm reference assessment (PAN) because the athlete's assessment is associated with the results of the assessment of all athletes conducted with the same tool that will be made into 3 categories, namely high category, medium category, and low category. According to Syarifudin (2002) The statistical formula is divided into 3 categories; good, moderate and poor with the detail as the following:

Good :  $X \geq M + SD$

Moderate :  $M - SD \leq X < M + SD$

Poor :  $X < M - SD$

## RESULT

The first data analysis of the 15 study participants was carried out using the RAST Calculator by entering weight data and the results of 6 sprint anaerobic test runs with a distance of 35 m intervals of 10 seconds. The summary of RAST result data to determine the capacity of anaerobic with fatigue index is shown in Table 1 and Table 2.

**Table 1.** Anaerobic Capacity Data Based on Fatigue Index

No	Sample	Fatigue index
1	X 1	2.30
2	X 2	6.25
3	X 3	2.70
4	X 4	4.36
5	X 5	6.07
6	X 6	2.28
7	X 7	4.49
8	X 8	6.02
9	X 9	3.09
10	X 10	3.62
11	X 11	4.29
12	X 12	2.90
13	X 13	6.19
14	X 14	2.51
15	X 15	3.17

**Table 1** shows data on the results of anaerobic capacity tests of 15 athletes who took the RAST run test. In Table 2 we can see that anaerobic capacity has a minimum value of 2.28, a maximum value of 6.25, averaging 4.0162, a median of 3,623, a mode of 2.28, and a standard deviation of 1.4956. The results of descriptive analysis for anaerobic capacity variables are shown in **Table 2**.

**Tabel 2.** Descriptive Statistic for Anaerobic Capacity

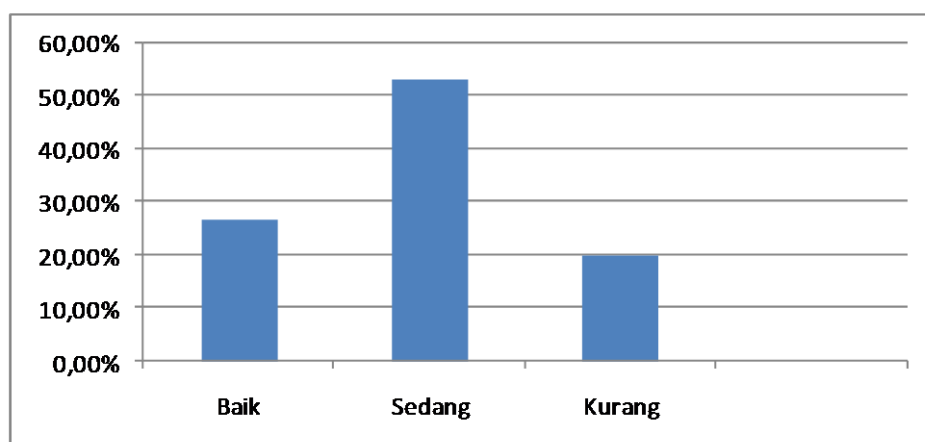
Statistic	Score
Mean	4.0162
Median	3.6230
Mode	2.28
Standar deviation	1.49557
Minimum	2.28
Maximum	6.25

Next, a statistical analysis was carried out to determine the distribution of anaerobic capacity categorization of all participants with an assessment referring to the norm (PAN) which was divided into 3 categories, namely the high category, medium category, and low category. The summary description of the anaerobic capacity distribution data is presented in **Table 3**.

**Table 3.** Anaerobic capacity classification

No	Category	Interval	Frequency	Percentage
1	Good	$X \geq 5.51$	4	26.67%
2	Moderate	$2.52 \leq X < 5.51$	8	53.33%
3	Poor	$X < 2.52$	3	20.00%
<b>Total</b>			<b>15</b>	<b>100%</b>

From the data in Table 3, information is obtained that as many as 4 athletes (26.67%) have good category of anaerobic capacity, 8 athletes (53.33%) moderate category anaerobic capacity, and 3 athletes (20.00%) low category anaerobic capacity. If seen from the frequency of each category of Anaerobic Capacity, it can be seen that the capacity of anaerobic capacity of pencak silat athletes is dominant in the medium category. To clarify the anaerobic capacity data categorization table above, the next one will be presented below:



**Gambar 1.** Classification of anaerobic capacity

## DISCUSSION

This research was conducted with the aim to know the capacity of Anaerobic martial arts athletes in the dueling category based on fatigue index. In this study the instrument to measure the Anaerobic capacity of researchers uses the running-based Anaerobic Sprint Test (RAST).

For athlete in combat category they are required to have good stamina in the match. Athletes with a good stamina can be ascertained the anaerobic capacity is also high. Predominant energy system in the martial arts competition category is more using anaerobic system but still balanced by the aerobic system. According to (Hariono, 2006), prediction of predominant energy in the martial arts category of the match category requires anaerobic alactic / phosphocreatin energy system around 73.75%, 16.25% lactic anaerobic energy system and aerobic system around 10%, so that the energy system used during competition in pencak silat is more dominant using phosphocreatin energy metabolic system (ATP-PC).

The results of this study indicate that, as many as 4 athletes (26.67%) have good category of anaerobic capacity, 8 athletes (53.33%) moderate category anaerobic capacity, and 3 athletes (20.00%) low category anaerobic capacity. This shows that the anaerobic capacity of UMS martial arts athletes is still in the medium category.

Judging from the implementation, it is known that the match category pencak silat is done in 3 (three) rounds with the duration of each round time being 2 minutes clean and resting for 1 minute. The total performance of the match will be 8 minutes (6 minutes of the match and 2 minutes of intermission breaks). By looking at the time span, because the implementation is more than 2 minutes, the energy system used in the martial arts competition aerobic energy system match category.

In the martial arts competition rules the combat category when there is physical contact or attack, where attacks are only allowed to be carried out a maximum of 4 (four) consecutive attacks. The average duration of time to attack for approximately 2-3 seconds. So that the energy system used during an attack is an anaerobic energy system. In the rules of the match also explained, to obtain the highest value / number, a fighter is required to be able to carry out attacks on the opponent's target with high quality (accuracy and power) measured repeatedly in each round (2 minutes). Provision of attacks that get a value that is attacks carried out quickly, precisely and powered into the target of a predetermined opponent (body protector) without obstructed opponent's body parts such as evasion or avoidance and supported by good stance, right distance and correct trajectory of the motion.

Based on the energy system used, the physical condition factor in the form of endurance is a very important factor in the sport of pencak silat, especially the combat category. Not only cardiovascular endurance, but muscle endurance is also needed in pencak silat. Energy system is a capacity needed in doing work, where the energy capacity used is the result of the multiplication of energy with the distance obtained (Bafirman, 2013). In carrying out activities such as training and competitions, one very important requirement that must be met is the energy capacity (Bompa, 1999). While the muscle is an active means of movement which is the main role in doing a form of movement. To be able to do a movement properly and perfectly, muscles need a good energy capacity too, physiologically can be interpreted as the capacity or ability to carry out work activities (Syafudin, 1999)

## CONCLUSION

Through the process of data analysis and discussion of research results, it was concluded that the anaerobic capacity possessed by martial arts athletes in the POMPROV 2019 UMS competition

category was assessed based on the fatigue index included in the medium category with a percentage of 53.33%. The research data was taken through tests and measurements of running anaerobic sprint tests (RAST) of 15 athletes who joined in this study as research subjects as well as evaluating test results using the RAST Calculator. The anaerobic capacity of 15 match category athletes based on the fatigue index shows that the average is still in the moderate category.

The dominant energy system in the martial arts competition category is anaerobic. Therefore, these results can be used as a description and reference to trainers in developing short-term training programs, especially in the preparation of Central Java POMPROV in 2019. In addition, the results of research can also be used as an evaluation material for programs that have been carried out previously, especially in this case the program to increase anaerobic capacity.

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