IOP Conf. Series: Materials Science and Engineering **434** (2018) 012157 doi:10.1088/1757-899X/434/1/012157

Anaerobic capacity and blood lactate level of former elite athletes

N Nasuka*, I Santosa, A Setiowati and F Indrawati

Sport Faculty of Universitas Negeri Semarang, F building UNNES campus, Sekaran, Gunungpati, Semarang, Indonesia, 50229

*nasuka@mail.unnes.ac.id

Abstract. Elite athletes have been exercise regularly for several years with heavy training loads. The former elite athletes commonly decreased or stop their exercise that might decrease their anaerobic capacity. Eighteen male former elite athletes and nineteen non elite athletes participated on this research. The running based anaerobic test (RAST) was done to investigate anaerobic capacity included Maximal Power, Minimal Power, Velocity and Fatigue index. The blood lactate levels were measured two minute after RAST. The rate of maximal power of former elite athlete 387.3 watts, minimal power 242.2 watts, fatigue index 3.67 and blood lactate level 7.20. The rate of maximal power of non elite athlete was 445.8 watts, minimal power 282.4 watts, fatigue index 4.57 and blood lactate level 7.01. There were no differences of maximal power (p=0.251), minimal power (p=0.166), fatique index (p=0.203) and blood lactate level (p=0,878). The velocity and body mass index were difference between former elite athlete and non elite athlete (p=0.000). There was no different of the anaerobic capacity and blood lactate level between former elite athlete and non elite athletes. The age, mass body index and less exercise may influence the decreasing of anaerobic capacity of former elite athlete.

1. Introduction

Elite athletes represent as a group of individuals who participate in national or international competition of sport. Elite athletes have been exercise regularly for several years with heavy training loads. Sport activity and regular training associated with physiological structure. Complex exercise affected on decreasing of body fat, increasing of skeletal muscle mass and increasing of the cardio respiration function [1], and in turn.

The peak performance of athletes does not last a lifetime. The performance reach the peak and then decline. Detraining for several week increased body fat and weight, and decreased metabolic rate and VO2max of athletes [2]. Study on former swimmer showed the increasing of time, its mean declined of performance. Age, sex and exercise duration interact to determine the decline of swimming performance [3]. The, study on marathoners, showed the difference appear, that were U-shaped of performance age related [4].

Anaerobic capacity, heart rate and blood lactate level were influence by the exercise [5]. The former elite athletes commonly decreased or stop their exercise after they retire as professional athlete. Some of they stop because get an injury during active athlete [6]. Work in the difference field was another reason. These condition might decrease their anaerobic capacity. This research aim to investigate the anaerobic capacity and blood lactate level of former athletes compare with the non elite athletes. Anaerobic capacity is defined as the maximum amount of adenosine triphosphate that can be

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

resynthesized via anaerobic metabolism during maximal exercise. Running–based Anaerobic Sprint Test (RAST) useful to determine anaerobic capacity of soccer [7, 8, 9, 10], basketball [11], but not in sprinter [12]. RAST were choose to determine their anaerobic capacity, beside blood lactate.

2. Methods

2.1. Subject

Eighteen male Indonesian former elite athletes and nineteen non elite athletes recruit to participate on this research. The inclusion criteria of former elite athlete participants were: have one or more medal of national/international competition, more than 30 years old, health and agree to participate. The non elite athletes were student of sport faculty Universitas Negeri Semarang, agree to participate on research. The subjects were informed about the experimental procedures and possible discomforts associated with the study. All participants signed the agreement letter of research. Recruitment of participants was done by individual approach.

2.2. Running based anaerobic sprint test

The running based anaerobic sprint test (RAST) was done to investigate anaerobic capacity included Maximal Power, Minimal Power, Average Power, velocity and Fatigue index. All participants were exam their health before running test. The participants were undertaken a10-15 minutes warm up session. The RAST consisted of six 35 meter maximal runs separated by a period of 10 seconds of passive recovery. The record time was determined every effort located at the beginning and the end of the route.

The power, velocity and fatigue index were calculated by the equation followed.

$$Power = (w \times d^2)/t^3 \quad (1)$$

$$Velocity = d/t \quad (2)$$

$$Fatigue\ index = (max\ power - min\ power)/total\ t \quad (3)$$

Whereas w = body weight, d = distance (35 m), t = time to finish one route (35 m). Maximal power was the highest value of power. Minimal power was the lowest value of power, and the average of power was sum of six power was divided 6.

2.3. Blood lactate measurement

The blood lactate levels were measured two minute after the subject completed running test. Accutrend Plus strips for BM Lactate (Roche) useful to measure the blood level.

2.4. Statistical analysis

Experimental data were presented as mean and standard deviation. The normality data verified with Kolmogorov-Smirnov test. Lavene's test conducted to exam the homogeneity of data. The difference of maximal Power, Minimal Power, velocity, Fatigue index and blood lactate level were exam by T test.

2.5. Ethic

All procedure of study didn't violate the Declaration of Helsinki. The agreement of all procedures was given by Ethic Committee of Health and Medical Research of Universitas Negeri Semarang.

3. Result and discussion

3.1. Result

The study was done at athletic field of Sport Faculty Universitas Negeri Semarang. A medical team supervised during the research to prevent undesirable health condition of athletes. Table 1 present the

characteristic of subject, included the age, height and body mass index. The former elite athlete are higher than non elite athletes, but they tend overweight.

Table 2 present the RAST and blood lactate level, showed the difference of velocity but not Maximal power, Minimal power, Average power, fatigue index and blood lactate. The former elite athlete are slower.

Table 1. Characteristic of former elite athlete and non elite athlete.

	Former elite athlete (n=17)	Non elite (n=19)
Age (year)	34.14 ± 5.574	20.22 ± 1.574
Height (cm)	172.18 ± 7.510	171.26 ± 6.384
Body Mass Index	27.09 ± 4.559	21.04 ± 2.898

Table 2. The RAST test and blood lactate level of former elite athlete and non elite athlete.

	Former elite athlete (n=17)	Non elite (n=19)	T test (p)
Maximal power (watts)	387.3 ± 141.57	445.8 ± 156.86	0.251
Minimal power (watts)	242.4 ± 77.94	282.4 ± 90.11	0.166
Average of Power (watts)	305.5 ± 94.84	349.5 ± 106.82	0.203
Velocity (m/sec)	5.05 ± 0.680	5.81 ± 0.415	0.000
Fatigue index	3,67 ± 2.82	4.57 ± 2.83	0.348
Blood lactate	7.20 ± 3.94	7.01 ± 4.00	0,878

3.2. Discussion

The main purpose of thie study was to investigate the anaerobic capacity of former elite athlete. Our finding of present study describe that the anaerobic capacity of the former elite athletes decreased but not lower than non elite athletes, although the non elite athletes were younger. This result suggested that the elite athletes had higher performance compare with the non elite athlete at the same age. Many factors affected the performance of athlete, included age, kind of sport and exercise. understand that peak performance relationship to age in elite athlete.

It is establish knowledge the association between age and the function of organs system. By the aging, the function of cell, tissues and organs would be decrease physiologically. Previous study showed the association between physical performance and age and gender in swimmer [3,13,14], triathletes [15,16], runners [17] and marathoners [4]. Physiological function of organs will be decline followed increasing of age. The elite formers athletes were older than the non elite athletes, so understandable if their performance didn't difference compare with the non elite athlete.

High body mass index associated with the cardiocular disease. Although a previuos cross-sectional study investigated 3687 participants found the health of former collegiate athletes as well [18], the power and velocity of the former elite athlete were low. Greater body mass index tend occur the aortic stiffness in young men. Aortic stiffness associated with lower levels of relative VO2peak [19]. The greater body mass index were found in former elite athletes might associated with the lower value of their power and velocity.

The low anaerbic capacity of former elite athletes might related with their exercise, frequent and load. Decreasing of exercise for along time might Five weeks reduction training and training cessation affected on decreasing of maximal oxygen uptake (VO2max), and increasing of heart rate in kayaking

athletes [20]. Physical inactivity everyday life is threatening the health and physical condition of the human body, and elevating the risk of cardiovascular disease. The fatigue index of the non elite athletes, that were the student of Sport Faculty of UNNES, less than 10. This result was higher than than previous study on Physical Education and Sport of East Sarajevo and Nikšić student, that was more 17 watts/sec [21].

Anaerobic capacity is defined as the maximum amount of ATP that can be resynthesized via anaerobic metabolism during maximal exercise. The fatigue index is a concept of the development of fatigue during anaerobic exercise that can used to predict the athlete's endurance. Fatigue muscle was primary caused by acculation of hydrogen ions and corresponding acidosis. During exercise, blood lactate and muscle rise to very high level and released hydrogen ions. Many factor influenced the fatigue index such as the availability of ATP, metabolic process and the muscle structure, kind of exercise, hypohidration [22]

Analysis of lactate is often used in exercise or physical training. The transport of lactate in skeletal muscle is facilitated by two known monocarboxylate transporters 1 (MCT1) and 4 (MCT4). Low train for several week exposure to MCT1 and MCT4 [23]. Elevated MCT1 and MCT4 contents were associated with a reduction of blood lactate concentration at the end of supramaximal exercise [24]. MCT1 transporter facilitated lactate influx into the muscle and its subsequent oxidation [24]. MCT1 transporters also role in removal lactate from the cell depending on lactate concentration [25, 26]. Lactate level of the blood reflected the balance of lactate production and use of the body. The excess of lactate production increased the level of blood lactate. Increasing of muscle activity caused hypoperfusion of tissue, and than decreased oxygen delivery. But, the intermittent training for several weeks decreased the blood lactate level [27]. The same level blood lactate of former elite athlete and on elite athlete suggested the role of exercise factor. The decreasing exercise of former athletes elevated their blood lactate level as high as the non elite athlete.

4. Conclusions

The former elite athletes commonly decline their competency after they stop or decrease yhe regular exircise. There was no different of the anaerobic capacity and blood lactate level between former elite athlete and non elite athletes. It mean that the anaerobic capacity of the former elite athletes decreased but not lower than non elite athletes. The former elite athletes have been not in peak performance. The age and less exercise may influence the decreasing of anaerobic capacity of former elite athlete. They are also slower because of the increasing of body mass index.

References

[1] S Kim 2017 *J. Phys. Ther. Sci* **29**:1297–1300
[2] M J Ormsbee and P J Arciero 2012 *Journal of Strength and Conditioning Research* **26**(8):2087-95
[3] J A Donato, K Tench, D H Gluech, D R Seals, I Eskurza and H Tanaka 2003 *J Appl Physiol* **94**: 764–769
[4] B Lara, J J Salinero and D J Coso 2014 *AGE* **36**:1003–1008
[5] E Gür 2012 *European Journal of Experimental Biology* **2**(5):1854-1861
[6] K Friery 2008 *Journal of Exercise Physiology online* **11**:26-45
[7] M M Sales, R A V Browne, R Y Asano, R R V Olher, J F V Nova, Moraes, and H G Simões 2014 *Rev Andal Med Deporte* **7**(3):106-10
[8] D Pekas, N Trajkovic and T Kristicevic 2016 *Sport Science* **9**: 88-92
[9] D A Keir, F Theriault, and O Serresse 2013 *Journal of Strength and Conditioning Research* **27**, 6: 1671-1676
[10] K Burgess, T Holt, S Munro, and P Swinton 2016 *Journal of Trainology* **5**:24-29
[11] M Balčiūnas, S Stonkus, C Abrantes, and J Sampaio 2006 *Journal of Sports Science and Medicine* **5**: 163-170
[12] J G Adamczyk 2011 *Pol. J. Sport Tourism* **18** : 214-218

[13] V Bongard, A Y McDermott, G E Dalall and E J Schaefer 2007 *AGE* **29**:77–85
[14] B Kechtle, P T Nikolaidis, S Königq, T Rosemann and C A Rüst 2016 *AGE* **38**:18
[15] C A Rust, B Knechtle, P Knechtle, T Rosemann and R Lepers 2012 *Open Access Journal of Sports Medicine* **3** : 175–82
[16] M Stiefel, B Knechtle, C A Rust, T Rosemann and R Lepers 2013 *Extreme Physiology & Medicine* **2**(27)
[17] H Tanaka and D R Seals 2003 *J Appl Physiol* **95**: 2152–2162
[18] Z Y Kerr, J D DeFreeze and S W Marshall 2014 *The Orthopaedic Journal of Sports Medicine* **2** (8)
[19] S M Moore, A J Berrones, J L Clasey, M G Abel, and B S Fleenor 2016 *Vascular Medicine* **21**, (6):497 – 505
[20] J G Pallares, L Carasco, A Diaz, and L S Medina 2009 *Journal of Sports Science and Medicine* **8**:622-28
[21] R Pavlovic, K Indrisovic, G Bosnjak, and M Pupis 2016 *International Journal of Science Culture and Sport* **4**(3)
[22] M N Naharudin, and A Yusof 2013 *PLoS One* **8**(10)
[23] S A Clarks, R J Aughey, C J Gore, A G Hahn, N E Townsend, T A Kinsman, C M Chow, M J McKenna, and J A Hawley 2004 *J Appl Physiol* **96**: 517–525
[24] C Juel and A P Halesstrap 1999 *J Physiol* **517**: 533-642
[25] C Thomas, S Perrey, K Lambert, G Hugon, D Mornet and J Marcier 2005 *J Appl Physiol* **98**: 804–809
[26] A Bonen, K J McCullugh, C T Putman, E Hultman, N L Jones, and G J Heigenhauser 1998 *Am J Physiol Endocrinol Metab* **274**: E102–E107
[27] D N Sari, S Endardjo and D I S Santosa 2013 *Med J Indones* **22**(3)