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The Differences in Heart Rate Response Dynamics through Weight Training Exercises of the ACE Gene Polymorphism of PPLP Athletes

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ABSTRACT

An effort to realize the achievement of an athlete is not an easy thing. It requires an athletic training process that must be considered to improve the physical condition. Athletes have the variation of the angiotensin-converting enzyme (ACE) gene Insertion-Deletion (I/D) related to heart beats. It has implication for cardiovascular fitness. This research aims at finding out the information about the role of ACE Gene Polymorphism on heart beats. This comparative study was conducted on 66 subjects. There were 42 males and 23 females. The subjects were selected using consecutive sampling. Examination of ACE gene insertion-deletion polymorphism was carried out using Polymorphisms Chain Reaction (PCR). The heart rate is established before loading for 3 minutes. The results showed that there are differences in resting heart rate in athletes with ACE gene insertion-deletion polymorphism of the loading exercise using YMCA bench test (p = 0.000). Heart rate after 1 minute up and down the bench or YMCA test is (p = 0.000). Heart rate after 2 minutes up and down the YMCA bench is (p=0,000). Heart rate after 3 minutes up and down the bench or YMCA is (p=0,000). Heart rate after the 1-minute break from up and down the bench or YMCA is (p=0,000), Heart rate after 2 minutes break from up and down the bench or YMCA is (p=0,029). Heart rate after 3 minutes break from up and down the bench or YMCA is (p=0,151). Therefore, it can be concluded that there are differences in heart rate response to genotype II and non-genotype II to the loading exercise using the bench test (YMCA), except in heart rate after 3 minutes of rest.

KEYWORDS: ACE gene insertion-deletion polymorphism, heart rate, Exercise.

INTRODUCTION

Humans and sport are an integral and inseparable part, and each person will be exercising for various purposes. The present era, humans particularly athletes exercise to get the achievement because it represents their ideals. The crowning achievement in sport is a complex effort because it is influenced by many factors. The availability of sufficient energy is one of the important factors that determine the success of an athlete in reaching the crowning achievement [1]

One of the parameters used to measure the functional capacity of the cell is the maximum volume of oxygen (VO2). Oxygen is taken from the air to be consumed by the mitochondria through distribution mechanism involving the respiratory system that will capture oxygen from the atmosphere. It is then transported by a carrier of oxygen to the cell system, mainly by hemoglobin and cardiovascular system which will pump blood to reach the cells in the body through the blood vessels [2]

Genetic markers that contribute to the potential formation of the performance athlete is a candidate for ACE gene. It is the regulation of the physiology of the heart and blood vessels. The I allele is a genetic marker that may be associated with the performance athletes [3]

An effort to realize the achievement of an athlete is not an easy thing. It requires a training process that must be taken seriously. In addition, a scientific approach should be implemented to improve, develop and maintain the achievements. In order to achieve these objectives, the athletic training program should be carried out with the right intensity, duration, frequency, type and progression [4]

Athletes have the variation of ACE gene Insertion-Deletion (I/D) polymorphism related to heart beats. Rigat et al. reveal that the ACE gene insertion-deletion polymorphism affects the concentration of ACE in the blood. In addition, it affects blood pressure. Changes in blood pressure are influenced by changes in angiotensin II, aldosterone or vasoactive substances [5]

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Increased levels of ACE in the blood is influenced by genetic factors in which one of the ACE gene polymorphism which is the most widely studied is I/D polymorphism in the form of insertion (I) and deletion (D) in the sequence of DNA 287-bp in intron 16 of ACE gene located on chromosome 17. The ACE gene polymorphism consists of three genotypes, namely homozygote DD, heterozygote ID and homozygote II. Correlation between genotype and plasma ACE levels shows a significant correlation between D allele and the concentration of ACE in which the highest level of ACE is genotype DD. Genotype ID is the lowest in genotype II. The ACE gene I is one of the genes that is most intensely studied because it plays a key role in the renin-angiotensin system (RAS). ACE enzyme catalyzes the conversion of angiotensin I to angiotensin II. The ACE gene is located on chromosome 17q23 and consists of 26 exons and 25 introns [6]

Athletes who have the DD genotype showed higher ACE levels so that it can improve the angiotensin II. It can stimulate increased activity of eritropoetik that is important in endurance athletes to improve performance of athletes [7]

ACE gene Insertion-Deletion (I / D) polymorphism from the D allele is associated with an increased level of angiotensin II in serum and an increase production of aldosterone but a reduction in part of Bradykinin is a vasodilator. Some worse conditions of prognosis are found in homozygous of D alleles whereas the I allele is connected with endurance performance in long-distance runners, paddle and mountain climbers [8]

Weight training is an indication of muscle strength and physical endurance. The weight training can describe the functional capabilities and capacity of the body, the functional changes in relation to health, namely an increase in the ability of the cardiovascular, endocrine and adaptation serum lipids, increase lean body mass, increase the strength of tissues including bone and a decrease in physiological stress. The weight training with proper stimulation will provide an overview of the physical, physiological or adaptive performance. Weight training beyond the level of physical performance with excessive stimulus will have some degree of force, namely intensity, frequency and duration. The strength level of the intensity is related to the level of performance where the energy is expended and the duration is a measure of the force level or an estimate of how much total work is conducted while the strength level of the frequency is related to how many repetitions can be performed [9]

With increasing physical activity, the need for oxygenated blood will increase. This requirement will be affected by heart by increasing blood flow. It is also responded by the diameter of the blood vessel by dilating the blood vessels (vasodilation). Hence, it will have an impact on an individual's blood pressure. Blood pressure will increase, for example during the hard aerobic exercises, systolic blood pressure can be increased to 150-200 mm Hg from the systolic pressure when the athlete take a rest. It is 110-120 mmHg. On the contrary, immediately after aerobic exercise is completed, the blood pressure will drop to below normal and lasts for 30-120 minutes [10]

YMCA test is one type of heart stress tests for the detection of cardiovascular fitness. The faster the heart adapts (back to normal), the better the body fitness is. YMCA test is an accurate way to assess aerobic fitness to complete the test and measure maximum heart rate and oxygen consumption [11]

Physiological adaptation to physical work can be divided into acute and chronic adaptation. Acute Adaptation is the adjustment of the body that occur when the work is performed. Chronic adaptation is the result of changes in the body by a physical exercise program period. Physical work means that there is a charge for the body. It would result in an adjustment mechanism of the organ depending on age, ambient temperature, light weight of the load, the length, how does the job and the number of organs involved during the physical work [12]

Hagberg reveals that the ACE gene Insertion-Deletion (I / D) polymorphism influences maximal oxygen (VO2 Max) consumption and hemodynamics at the maximum level of physical activity. Genotype II has VO2 Max that is higher than genotype DD. Likewise, genotype II has VO2 Max level that is greater than the genotype ID [13].

Weight training with YMCA bench test is one of the factors that trigger the response of the body stress during exercise that gives the dynamical response of the heart rate and blood pressure. The young athletes in PPLP of South Sulawesi consist of nine sports. There are 17 football athletes. There are 16 takraw athletes. There are 12 karate athletes. There are eight martial arts athletes. There are eight paddle athletes. There are eight boxing athletes. There are four taekwondo athletes. There are 4 sand volleyball athletes. The total of the athletes is 85.

The young athletes have the variation of the angiotensin-converting enzyme (ACE) gene Insertion-Deletion (I/D) related to heart beats. It has implication for cardiovascular fitness. Therefore, the researchers intend to find out “the comparison of the dynamic response of heart rate and blood pressure to weight training in athletes with ACE gene Insertion-Deletion (I / D) polymorphism ".

MATERIALS AND METHODS

This research was quantitative research using a comparative approach. This study revealed the differences in the response of the heart rate variation of the genotype II, ID, DD through YMCA test. This research was

conducted in PPLP South Sulawesi starting from January 2015 until April 2014 to athletes who met the inclusion criteria. It means that the athletes have some criteria. They are actively in the learning process in the semester. They have an average age of 13-19 years. In addition, they are willing to participate in this study by signing the informed consent that has been issued by the Ethics Committee. Samples are entire populations who meet the inclusion and exclusion criteria taken by consecutive sampling. The number of samples is 66 athletes.

The data were collected by the researchers using some materials and tools. They were approval sheet for the respondents, notebook, tool for measuring heart rate namely Polar Heart Rate. The data for ACE gene Insertion-Deletion (I / D) polymorphism were collected by the trained laboratory personnel using PCR. The characteristics of the samples were processed using SPSS for windows. Multivariate analyzes (General Linear Model) was used to assess differences in heart rate response to genotype II and non-genotype II.

RESULTS

Characteristics of the Sample

Table 1 shows the characteristics of the athletes who became the sample for this study. Most athletes aged between 16-19 years were 53 (79.8%) and 13-15 years were 13 (19.7%).

Table 1. Characteristics of the age

Age	Frequency	Percent
13 – 15	13	19,7
16 – 19	53	79,8
Total	66	100

Table 2 is based on gender. It shows that most of the athletes were 43 males (65.2%) and 23 females (34.8%).

Table 2. Characteristics of Gender

Gender	Frequency	Percent
Males	43	65,2
Females	23	34,8
Total	66	100

Table 3 is based on the athlete's body mass index. There are 52 normal athletes. There are seven thin athletes. There are three fat athletes. There are three very skinny athletes. There is one obese athlete.

Table 3. Characteristics of the Body Mass Index

body mass index	Frequency	Percent
<17	3	4,5
17 – 18,5	7	10,6
18,5 – 24,9	52	78,8
25 – 29,9	3	4,5
30 – 34,9	1	1,5
Total	66	100

Table 4 is based on characteristics of sport. There 15 (22, 7%) takrow. There is 11 (16, 7%) karate. There are 10 (15, 2%) football. There are 7(10, 6%) paddle sports. There are 6(9, 1%) athletics. There are 6(9, 1%) martial arts. There is 4(6, 1%) taekwondo. There are 4(6, 1%) boxing. There is 3(4, 5%) sand volleyball.

Table 4. Characteristics of sport

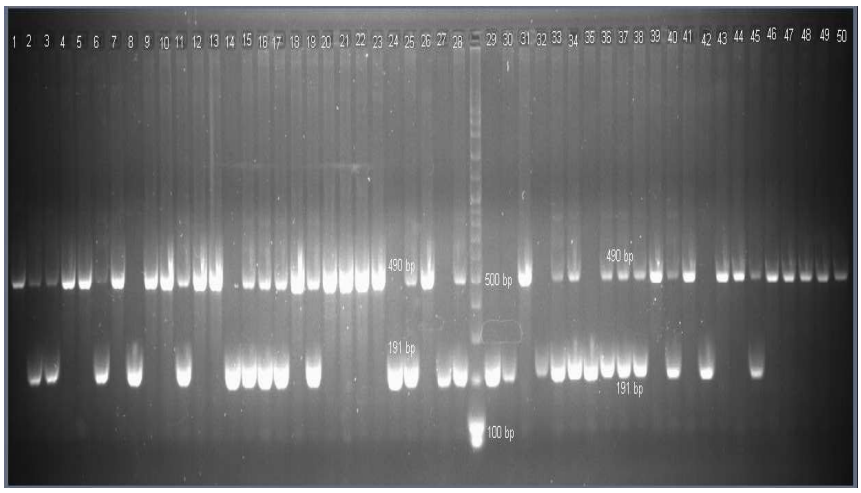
sports	Frequency	Percent
athletics	6	9,1
paddle sports	7	10,6
Karate	11	16,7
martial arts	6	9,1
football	10	15,2
takrow	15	22,7
taekwondo	4	6,1
boxing	4	6,1
sand volleyball	3	4,5
Total	66	100

Table 5 shows the characteristics of genotype I/D ACE gene. Non-genotype II is 37 (56.1%). Genotype II is 29 (43.9%). Visualization of the results of PCR on the research subjects is described in figure 1.

Table 5. Characteristic genotype variation

Genotype	Frequency	Percent
II	29	43,9
Non II	37	56,1
Total	66	100

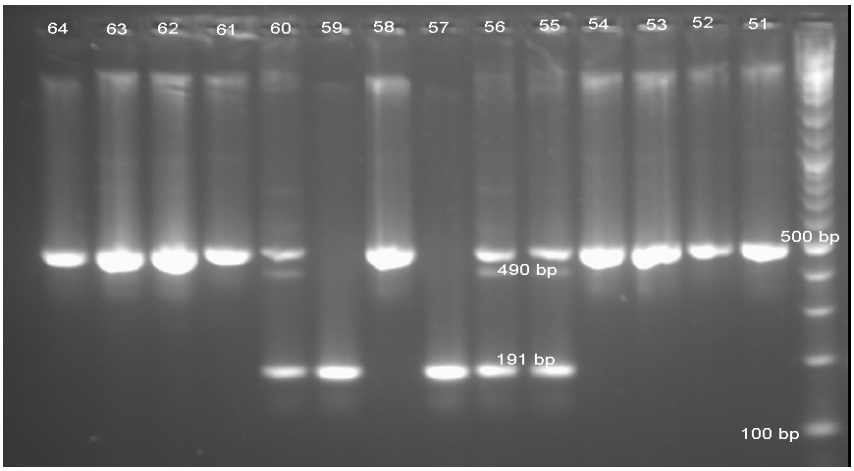
Figure 1. Visualization of PCR examination results on the subjects of research (A1-A50)



Multivariate Analysis

Figure 2 shows the description of the athlete's heart rate against the weight training using YMCA test of genotype II and non-genotype II. Table 3 shows the resting heart rate (ND0), heart rate star (NDS), 1 minute heart rate up and down the bench or YMCA test (ND1), heart rate 2 minutes up and down the bench or YMCA test (ND2), heart rate 3 minutes up and down the bench or YMCA test (ND3). Through the general linear models test, the p-value is 0,000. The value of p <0.05 so that there is a difference between genotype II and non-genotype II. At the heart rate 1 minute after the break of up and down the bench or YMCA test (NDi.1), the p-value is 0.001, then there are differences in heart rate between genotype II and non-genotype II. At the heart rate 2 minutes after the up and down the bench or YMCA test (NDi.2), p-value is 0.051, because p≥0,05 value, then there is no differences in heart rate score between genotype II and non-genotype II. At the heart rate 3 minutes after the up and down the bench or YMCA test (NDi.3), p-value is 0.217 because the value of p> 0.05, then there is no difference between genotype II and non-genotype II.

Figure 2. Visualization of PCR examination results on the subjects of research (A54-A64)



DISCUSSION

In this study, it shows that there are some significant heart rate differences between genotype II and genotype Non II, namely resting heart rate (ND0), heart rate star (NDS), 1 minute heart rate after up and down the bench or YMCA (ND1), 2 minutes heart rate after up and down the bench or YMCA (ND2), 3 minutes heart rate after up and down the bench or YMCA (ND3) and 1 minute after the break of up and down the bench or YMCA test (NDi.1). In this study, it is found that athletes who have the genotype II has the heart rate response score that is lower than genotype non-genotype II.

These results are consistent with the results of studies reporting that subjects who carry D allele (genotype ID, DD) has a higher ACE levels than subjects who did not carry D allele (genotype II). The angiotensin-converting enzyme will change angiotensin one into angiotensin 2. Therefore, subjects who carry D allele would theoretically have levels of angiotensin two which is higher than angiotensin 1 [14]

Angiotensin-converting enzyme differs among individuals. It is caused by the presence of a polymorphism in the ACE gene. Subjects who carry the D allele had higher levels of ACE than the I allele. Hence, it is assumed that it has higher levels of angiotensin II [15]

The essential role of the renin-angiotensin system (RAS), especially angiotensin 2 underlies the increase in blood pressure in patients with hypertension. The increasing angiotensin two will lead to functional and structural changes in the vascular system. Changes that occur as a result of a rise in angiotensin 2 is the increased levels of aldosterone which causes retention of NaCl and water as well as the activation of the sympathetic nervous system [16]

The study followed-up for 6 years conducted in 684 normal, healthy and free of symptoms of cardiovascular disease showed that those with the DD genotype finally 18.3% had hypertension, 4.7% genotype ID suffering from hypertension while only 1 genotype II, 6% who ultimately suffer from high blood pressure. It demonstrates the significant role of I / D ACE gene polymorphism in blood pressure [17]

It shows the higher levels of Angiotensin II will provide effects on arteriolar vasoconstriction in peripheral blood vessels. Therefore, perfusion of oxygen and nutrients needed in the process of metabolism to produce ATP are disrupted. Deficiency of oxygen and nutrients in skeletal muscle will deliver afferent impulses to control cardiac center in the medulla oblongata to stimulate the activity of the sympathetic nerves that release the neurotransmitter epinephrine which have implications for the increase in power and frequency of contraction of the heart or inotrope effect and kronotrop.

CONCLUSION

The researchers conclude that there are differences in heart rate response to genotype II and non-genotype II. They are known for the weight training with up and down the bench or YMCA test. The heart rate in genotype Non II is higher than genotype II at the beginning of resting heart rate, heart rate star, heart rate 1 minute up and down the bench YMCA, heart rate 2 minutes up and down the bench YMCA, heart rate 3 minutes up and down the bench YMCA, heart rate 1 minute after the break of up and down the bench YMCA, heart rate 2 minutes after the break of up and down the bench YMCA. ACE gene variations affect the variation of ACE levels that are implicated in heart rate differences between genotype II and non-genotype II so that the type of genotype II is more on increasing cardiovascular endurance. In addition, attention should also be given to the type of genotype status of I / D ACE gene for athletes in order to match the sports that they occupy. Therefore, an exercise program is in accordance with the internal factors of athletes that will deliver them to the level of achievement.

REFERENCES

1. Muchsin Doewes., Kiyatno., Suradi. 2011. Kontribusi system respirasi terhadap VO_2 Max. J Respir Indo. Vol:31. No:1
2. Foss, L.M. 1998. Physiological basis for exercise and sport. New york; Mc. Graw Hill Book company.
3. George, G., Bing, Yu., Bret, H., Alan, H. 1998. Elite endurance athletes and the ACE I allele the role of genes in athletic performance. Human genetic. Vol, 103. No, 1. Hal, 48-50.
4. Blair, S.N. 1995. Exercise Prescription for Health. Canada: Hill Companies, Inc.
5. Lucky Azisa et al. 2010. Hubungan Polymorfisme Gen Angiotensin-Converting Enzyme Insersi/Delesi dengan Hipertensi pada penduduk Mlati, sleman, Yogyakarta Indonesia. Majalah Kedokteran. Volume: 60. No: 4.
6. Rasyid H.,Bakri. S., Yusuf .I . 2012. Angiotensin Converting Enzyma gene polymorphime, blood pressure. Pulse pressure in subyek

7. Domingo, H., Alejandro, D.L., et al. 2014. The ACE/ DD genotype is associated with the axtent of exercise-induced left ventricular growth in endurance athletes. Jacc Journal Of the American College of Cardiologi. Vol:42. Issue:3 (diakses tanggal 1 maret 2014) https://onlinejacc.org/journals.aspx
8. Woods D, Hicman M, Jamshidi Y, Bruul D,Vassilliau V, Jones A,et al. Elite simmers and the D allele of the ACE I/D polymorphism. Hum Genet. 2001; 108:230-2.
9. Michael. H. S. 2000. Training principle: Evaluation of modes and method of resistance training. National Strengh and Conditioning Association. Vol:22. No: 3.
10. Syatira Arsdiani, 2006. "Pengaruh olahraga terprogram terhadap tekanan darah pada mahasiswa Fakultas Kedokteran Universitas Diponegoro yang mengikuti ekstrakulikuler basket". Artikel karya tulis ilmiah. Semarang. Diakses tanggal 6 januari 2015.
11. Yin, Z., Moore, J., Johnson, M.H., Barbeau, P., Cavnar, M., Thornburg, J. 2005. The Medical College of Georgia Fitkid project: the relations between program attendance and changes in outcomes in year 1. Int J Obes (Lond), 29 Suppl 2, 40-5.
12. Kusmiyati. 2009. Mengenal tekanan darah dan pengendaliannya. Vol. 10 No 1, Hal 40-41. Biologi PMIPA FKIP : Unram
13. Hagberg, JM., Ferrell, RE., McCole, SD., Willund, KR., Moore, GE. 1998. VO_2 Max is associated with ACE genotype in post menopausal women. Vol:5. No: 85(1842-6).
14. Adrian Umboh., Syakib Bakri., Syarifuddin Rauf. 2010. Pengaruh Polimorfisme I/D gen Angiotensin Converting Enzyme terhadap Tekanan Darah Anak Berat Lahir Rendah.
15. Sahin, S., Ceyhan, K., Benli, I., Ozyurt, H., Naseri, E., Tum. 2015. Traditional risk factors and angiotensin-converting enzyme uklu, M. M., Aydogan, L., Elalmis, A. O., Ozugurlu, A. F. & Onalan, O insertion/deletion gene polymorphism in coronary artery disease. *Genet Mol Res,* 14**,** 2063-8.
16. Shah, DM. 2005. Role of the renin angiotensin system in the pathogenesis of preeclampsia. Amj Renal Physiol;288:614-25
17. Dispasquale., Cannizaro,S., Patena, S. 2004. Angiotensin Converti Enzyme gene pholymorphysme affect blood pressure, finding after 6 years follow up in healthy subjects. Berj Heart, Fail. Vol:6., No: 11.