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SHORT COMMUNICATION

The effect of prolonged hanging test to grip strength, changes in muscle mass and imunoekspresi IGF-1r in bicep muscle of mice (Swiss Webster)

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ABSTRACT

Resistance training increases strength and stamina without enlarging muscle. Jaras ifg1 responsible for the proliferation and differentiation of muscle tissue in response to the exercise. Post-allocation of adaptation 36 research subjects were randomly allocated to the control group and the test. The purpose of this study to determine the effect of prolonged hanging test of grip strength, muscle mass changes and IGF-1r imunoekspresi the bicep muscles of mice. The uniqueness differences in physiological mechanisms increase the strength after resistance exercise through changes in the

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dynamics of unknown IGF1 receptors , so this time we did the study increased expression of IGF1 receptors (Igf1r) after resistance exercise, using new method is prolonged hanging test. Grip strength, muscle mass and score imunoekspresi igf1r in bicep muscles will be tested in the mice model (Swiss webster) using pre and posttest design. Examination of grip strength, muscle mass, muscle fiber cross-sectional diameter and imunoekspresi IGF-1r have done at day 28 in the Laboratory of Pathology in Dr. Hasan Sadikin Hospital, Bandung. Our results showed there were effect of prolonged hanging test to grip strength in the final test on mice and igf1r Imunoekspresi on mice. This research concluded that resistance exercise using hanging prolonged test increases grip strength and receptor expression igf1r without increasing muscle mass or muscle fiber cross-sectional diameter.

***Keywords*:** Grip strength, muscle mass, igf-1r

1. INTRODUCTION

The increasing of skeletal muscle fitness is often associated with improved health status. If the muscle strength does not maintained and fitness skeletal muscle decreases, it can significantly affect the physical health and well-being (1-3). Resistance training is recommended by several health organizations because it has potential benefits to health and fitness associated with the performance of the body.

Resistance training programs can be categorized as an aerobic exercise or endurance training can improve heart and lung capacity, in contrast to anaerobic exercise or power training, which tends to be done in order to build muscle (4, 5). Adaptation of the human body from prolonged resistance exercise due to a combination of several factors, namely, mechanical stress, neuromotor control, metabolic and endocrine activity system (6). Neural factors important for improving muscle strength, especially in the early phases of resistance training, whereas hypertrophy the trained muscles also contribute to the formation of muscle strength during prolonged endurance exercise (7).

Regular repetition of heavy resistance exercise will affect theincreasing of maximal muscle strength and neuromuscular function and morphological changes in muscle (8, 9). Hormones play an important role in the regeneration of muscle after resistance exercise and changes in hormone levels has the effect of hypertrophy. Muscle hypertrophy occurs due to increased acute exercise on anabolic androgenic hormones that can increase the amount of receptor interaction thus causing an intermediary three changes in muscle size and neuromuscular function. This occur because the process of adaptation to the production mechanism in the endocrine system (9).

Skeletal muscles can not only increase the mass as an adaptation to a given mechanical load but also regenerate after damage through the intrinsic regulation of gene transcription (9-12). Both of these cellular processes, regeneration and muscle hypertrophy mediated by the activation, proliferation and differentiation of cells satellite regulated by mitotic activity and myogenic locally produced, namely insulin-like growth factor-1 (IGF-1), which serves as a paracrine or autocrine (9-12). The function of the endocrine, autocrine and paracrine of IGF-1 are mediated through binding to IGF receptor type 1 (IGF1R), which is a ligand activation of the receptor tyrosine kinase (13). Insulin-like growth factor (IGF) is the main intermediary of the effects of growth hormone (growth hormone). The growth hormone is made in the anterior pituitary gland, is released into the bloodstream, then stimulates the liver to produce insulin-

like growth factor -1. Insulin-like growth factor -1 (IGF-1) and then stimulate the growth of the body's systems, and stimulate growth that affect almost every cell in the body, particularly skeletal muscle, cartilage, bone, liver, kidneys, nerves, skin, hematopoietic cells, and lung. Insulin-like growth factor -1 can regulate cell growth and development, especially in nerve cells, and cell synthesis of DNA (4, 13). Insulin-like growth factor system is a critical determinant of the growth of skeletal muscle. The main mechanism of action of Insulin-like growth factor 4 muscle hypertrophy is to stimulate the proliferation and differentiation of muscle precursor cells, known as myoblasts (4, 13).

Skeletal muscle hypertrophy is an increasing of the fibers size without an increasingof fibers numbers, regardless of any increasing in the number per fiber core. Receptor IGF-1r of transmembrane is the tyrosine kinase that contained in a variety of cell types, including skeletal muscle (12, 13). Binding of insulin and IGF (I and II) on IGF1R produce a variety of responses, such as cell proliferation, differentiation and inhibition of apoptosis, depending on the cell type and cross talk of the other signaling pathways (14, 15). in addition, IGF1R can replace insulin receptors in animals that lacked insulin receptor (16). Most studies show that the activation of IGF1R signaling pathways in skeletal muscle required for hypertrophy and maintenance of muscle mass (12, 15, 17).

Hanging Test is very easy to do and inexpensive, even though the animals must be supervised at all times, but the number of animals that can be simultaneously analyzed relatively small. Mice were willing to do the test for normal behavior indicates that they do not want to fall out of the handle, it is useful to connect the body mass and encouragement to hold, and to assess the potential effect of body mass on the ability to hold the handle. Four limbs hang test is a test that is very cheap because the equipment can be built alone or can use the top of the cage (18). In some journals hang test was carried out for less than 600 seconds and is usually used to examine the ability of the neuromuscular. The test measures the ability of the four legs of mice were hung to generate ongoing tension in the leg muscles (18, 19). The test can be done either by hanging five young or old mice and can be used in conjunction with other steps without affecting the flow of the natural course of the disease (18). However, research on the effects of prolonged hanging test of muscle mass, grip strength, muscle fiber cross-sectional diameter and analysis of *imunoekspresi* IGF-1r the bicep muscles of mice still need to be explored.

2. MATERIALS AND METHODS

The subject of this research selected randomly, are intended to avoid bias due to variations in age and weight. Randomization was done directly because the samples were taken from mice that have met the inclusion criteria so it is considered sufficiently homogeneous. Subject of this research are mice who met the inclusion criteria. A large number of research subjects or sample is determined based on the formula Frederer (20).

3. STATISTICAL ANALYSIS

The Analysis of experimental data is processed with SPSS version 15.0 for Windows with a significance level of $p \leq 0.05$, the steps that test with the Shapiro-Wilk normality ($p \geq$

0.05) to determine the average muscle mass sample is normal or not normal distribution. When the normal distribution of data, the unpaired t test was used or if the data is not distributed normally used Mann Whitney two-tail. Mann-Whitney two-tail or two test unpaired samples is one part of the non-parametric statistics.

Mann-Whitney two-tail become an alternative when the data did'nt normal. Mann-Whitney test is conducted to determine two differences samples were not related or pair up with each other. Unpaired t test is a comparative test or a different test to find out is there any difference in mean or mean significant between the two groups free scale interval data / ratios. Two free group in question here are two groups that are not paired, meaning that the source data comes from different subject.

4. RESULTS

4. 1. The Effect of Prolonged Hanging Test to Grip Strength of Mice (Swiss Webster)

The data research in the form of grip strength was done as much as 2 times that before and after treatment afterwards normality test data using 51 Shapiro-Wilk test ($p > 0.05$). The results showed normal distribution of data. To determine the effect of prolonged hanging grip strength tests on mice conducted unpaired t test as shown in Appendix 7. Results of the unpaired t test analysis showed no effect of prolonged hanging test significant grip strength mice initially measured grip strength $p = 0.113$ ($p > 0.05$), while the results of the analysis of unpaired t test at the end of the measurement of grip strength showed there hanging prolonged effect a significant test of the grip strength of mice $p = 0.0001$ ($p < 0.05$) as shown in Figure 1.

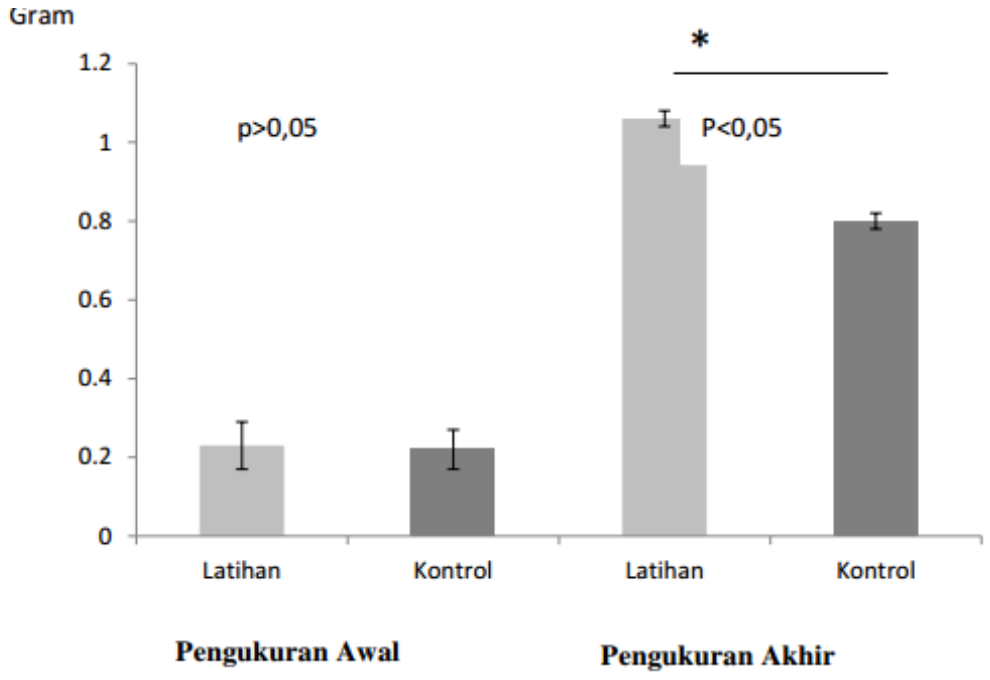

Figure 1. The effect of prolonged test chart hanging on the grip strength of mice (Swiss Webster)

4. 2. The Effect of Prolonged Hanging Test to Bicep Muscle Mass Of Mice (Swiss Webster)

Data research of bicep muscle mass in mice after the normality test data using the Shapiro-Wilk test ($p < 0.05$). The result indicates the data are not normally distributed. To determine the effect of prolonged hanging test of muscle mass in mice conducted two tail Mann Whitney test. The results of the analysis of two tail Mann Whitney test showed no effect of prolonged hanging a significant test of the bicep muscle mass in mice $p = 0.568$ ($p > 0.05$) as shown in Figure 2.

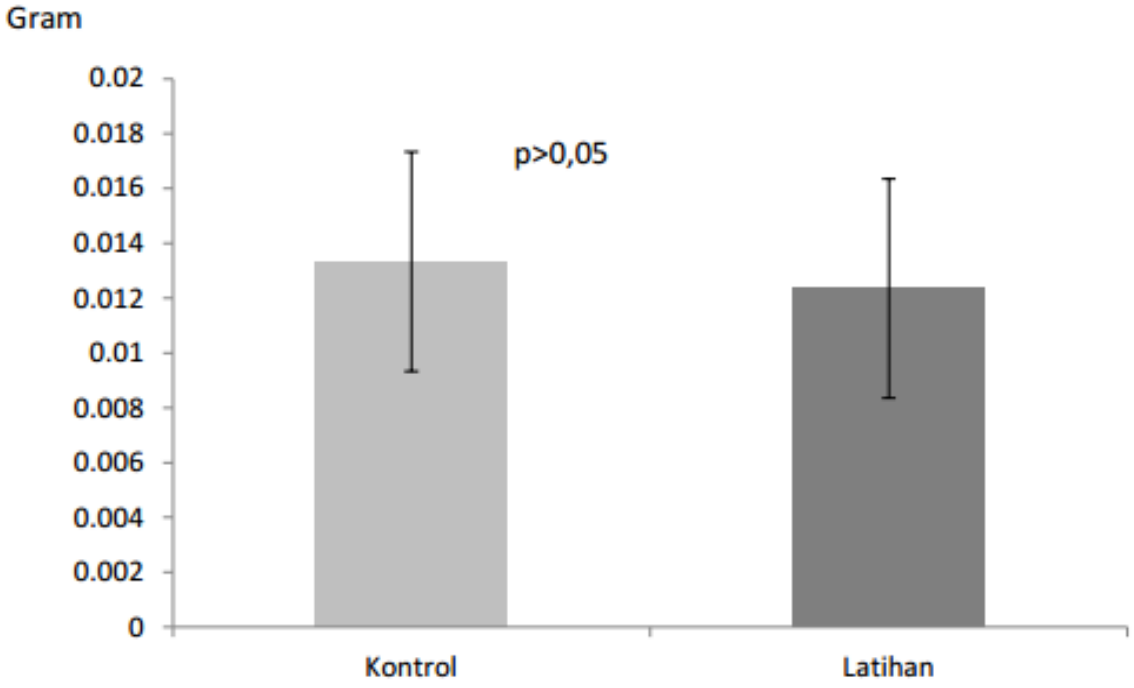

Figure 2. The effect of prolonged test chart hanging on the bicep muscle mass in mice (Swiss Webster)

4. 3. The Effect of Prolonged Hanging Test to The Diameter of Muscle Fibers Section of Mice's Bicep (Swiss Webster)

The Datas are divided into 2 types of muscle fiber cross-sectional diameter of the largest and smallest. The research data were obtained and test data normality using the Shapiro-Wilk test ($p < 0.05$). The results show both the data are not normally distributed. To determine the effect of prolonged hanging test the cross-sectional diameter of muscle fibers of mice conducted two tail Mann Whitney test. The results of the analysis of two tail Mann Whitney test showed no effect of prolonged hanging a significant test of the bicep muscle fiber cross-sectional diameter mice ie, $p = 0.811$ ($p > 0.05$) on the largest muscle fibers and $p = 0.131$ ($p > 0\ 05$) the smallest muscle fibers as shown in Figures 1 and 2.

4. 4. The Effect of Prolonged Hanging Test to *Imunoekspresi* IGF-1r of Bicep in Mice (Swiss Webster)

Research data of *imunoekspresi* IGF-1r in mice (Swiss Webster) used normality test with the Shapiro-Wilk test ($p < 0.05$). The results showed no normal distribution data. To determine the effect of prolonged hanging test against *imunokspresi* IGF-1r Mann Whitney test was done two tail. Mann Whitney test analysis results showed that there were two tail hanging prolonged effect significant test against *imunokspresi* IGF-1r $p = 0.008$ ($p < 0.05$) as shown in Figure 3.

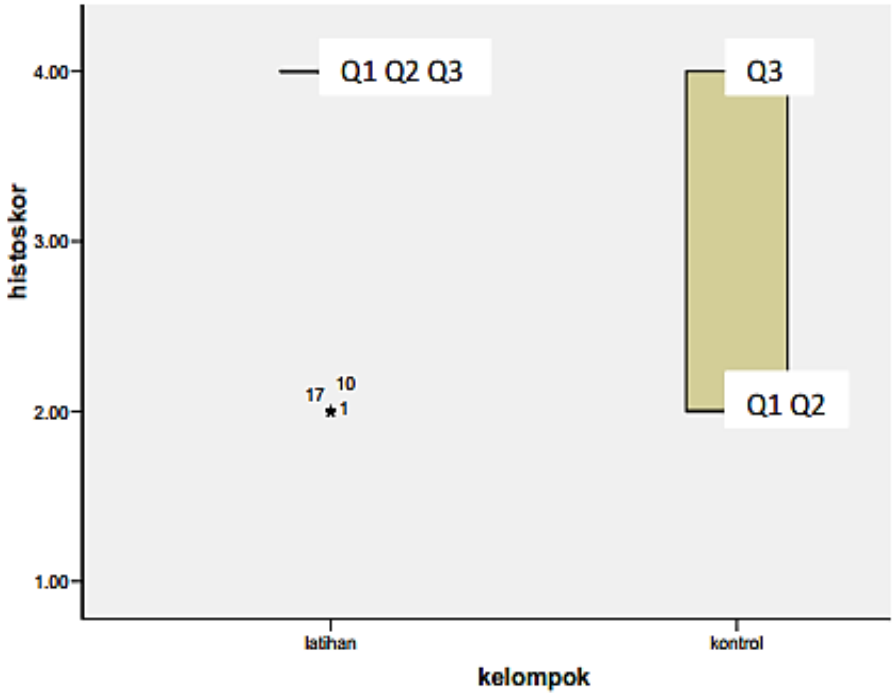

Figure 3. Box plots hanging prolonged effect test against IGF-1r imunoekspresi bicep muscle of mice (Swiss Webster)

5. DISCUSSION

5. 1. The Effect of Prolonged Hanging Test to Grip Strength of Mice (Swiss Webster)

Muscle endurance is the ability of muscles to perform contractions a row for a long time. According to the expert opinion states that muscle endurance, termed strength endurance is the ability of all body organism to overcome fatigue during the activity that demanding strength in a long time (21).

Physical activity is carried out continuously on a regular basis can increase muscle endurance because of the increasing capillary in muscle. In addition, associated with an increase myoglobin, oxidative enzymes in the muscle, as well as the size and number of mitochondria in muscle. Myoglobin contained in the muscles function as hemoglobin binds oxygen, with physical activity done regularly, it will cause an increase in the myoglobin of

13-14% so that the muscles' ability to bind oxygen will also increase, thus making it the size and number of mitochondria multiply as energy-producing machines (ATP) in the cells (21-24).

5. 2. The Effect of Prolonged Hanging Test to Bicep Muscle Mass Of Mice (Swiss Webster)

The results of the analysis of two tail Mann Whitney test showed that there was no effect of prolonged hanging a significant test of the bicep muscle mass in mice p = 0.568 (p> 0.05), some exercise programs can increase body mass due to participant's or animal obese or patients suffering from syndrome metabolic (25, 26). In general, long-term exercise program can not alter the medium or body mass significantly. The body mass changed complicated and based on the mechanism of energy balance, including changes in metabolic rate at rest, activity without exercise, smoking and intake of fat mass energi (27-29). In the present study used a normal diet without the addition of another in order to increase muscle mass, so that the results obtained did not significant increase in muscle mass.

5. 3. The Effect of Prolonged Hanging Test to The Diameter of Muscle Fibers Section of Mice's Bicep (Swiss Webster)

The results of the analysis of two tail Mann Whitney test shows there are significant prolonged hanging a significant test of the IGF-1r *imunoekspresi* bicep muscle mice. It also supports various types of exercise that induces an increase in IGF-1, IGF-1 and IGF-1 receptor-activated signaling pathways in specific rangka.13Lebih muscle, increased IGF-1r mRNA and protein levels have been found in response to both acute and aerobic exercise chronic endurance or resistance exercise, is associated with increased IGF-1r transcription or changes in IGF-1 receptor mRNA and / or stability protein.13 Increasing the capacity of binding of IGF-1r have also been reported after acute exercise ran on a treadmill or chronic activity, while differ between acute and chronic responses exercise seems posed in terms of affinity IGF-1r, because only chronic exercise causes increased binding of more besar (13). In research involving cell lines and culture muscle satellite cells, it has been found that activation of IGF-1r initiate intracellular signaling cascades involved in mitogenic response and myogenic. Depending on the time and conditions of intracellular, IGF-1 can stimulate both proliferation and cellular differentiation as shown in Figure 3.

From the description above shows that the test exercise is hanging the longest in experimental animals mice can increase the grip strength, the number of cell nuclei as well as increased levels of IGF-1r in skeletal muscle but not an increase in muscle mass and changes in the diameter of muscle an shown Figure 3.

6. CONCLUSION

Based on the result of the research that has been done, it can be concluded that prolonged hanging influences of grip strength test to the end of the mice and there is a prolonged effect of hanging test against *Imunoekspresi* igf1r mice. Further research is needed, because the increasing of grip strength can be caused by several factors such as cell

proliferation, then the exclusion or inclusion of other factors require some further investigation, including IGF-1, Glycogen, Mitochondria and Actin / Myosin fibers.

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