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THE COMPARISON BETWEEN PLYOMETRICS EXERCISE WITH AEROBIC EXERCISE TOWARDS DECISION-MAKING IN YOUNG ADULTS

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ABSTRACT

Background: Lack of physical activity in individual has a big impact towards brain as if in the cognitive parts of the brain, especially decision making and memory. The relation between physical activity and cognitive ability is related to angiogenesis and neurogenesis that is more optimal in individuals who do their physical activity routine. Plyometrics and Aerobic exercise are proven to have a positive effect on the body, but there has been no further research on the comparison of the two sports. **Aim:** to understand the comparison between plyometrics exercise with aerobic exercise towards decision-making in young adults. **Methods:** This study used quasi experimental design pretest and posttest. The subjects were 39 aged, all of whom are students of Fakultas Kedokteran Universitas Diponegoro. Subjects divided into 3 groups as control, Plyometrics exercise, and Aerobic exercise. Decision-making score measured by IOWA Gambling Task (IGT). Data's significance was analyzed with paired t-test. **Results:** There was significant difference in decision-making score before (pre-test) and after (post-test) Plyometrics and Aerobic exercise ($p < 0,05$). Nevertheless, higher score was found in experimental group 1 which is the Plyometrics exercise ($p = 0,000$). Furthermore, there was significant difference towards decision-making score in experimental and control group ($p < 0,05$). **Conclusion:** Plyometrics and Aerobic exercise increase decision-making score for young adults. A more significant increase was found in the Plyometrics group ($p = 0,000$).

Keywords: *Plyometrics exercise, Aerobic exercise, Young adults, Decision-making.*

INTRODUCTION

Physical activity especially exercise, not only made body physically healthy but also have positive effect towards cognitive function. This positive effect is an increase of capillary density through the angiogenesis process, namely the development of new capillaries from pre-existing capillaries in the brain, especially the *gyrus dentatus*.³ *Gyrus dentatus* is a part that plays an essential role in neurogenesis, especially in learning, memory and cognitive functions.⁴ One of the cognitive functions is decision making.

Decision-making is a process using scientific analysis based on logic, considering all available data and all possible alternatives.⁵ In this case, the brain, especially the prefrontal cortex, especially

the middle ventromedial (medial orbitofrontal cortex) plays an important role in regulating a person in making decisions. The orbitofrontal cortex is a structure of the prefrontal cortex that has a significant influence in decision making based on an assessment of the advantages and disadvantages that will be obtained according to the associated emotional experiences under normal circumstances.⁶ This process involves working memory associated with other structures such as the *gyrus dentatus*, amygdala and hippocampus.^{7,8}

Plyometrics and Aerobic exercises are types of sports that are easy to do and are well known to the public. Regular Plyometrics training for six weeks can increase the agility, strength and explosive



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power of the muscles.⁹ This increase is directly proportional to the increase in overall proprioceptive. Proprioceptive enhancement results in increased joint dynamic stability which is acted out by the neuromuscular control mechanism through the highest function of the central nervous system.¹⁰ This collaboration shows a relationship between movement control in motoric function and the cognitive processes that occur, especially the prefrontal cortex, which plays an important role in decision making.¹¹

Aerobic Exercise involves physical exercise that increases cardiopulmonary capacity (VO₂ max).¹² However, a growing number of studies are showing that Aerobic exercise can also have a positive effect on brain health and cognitive function in healthy subjects because aerobic exercise improves cognitive task performance, particularly in executive function and memory.¹³ This is related to the effect of Aerobic exercise on the neural plasticity mechanism.¹⁴ Apart from neural plasticity, Aerobic exercise also enhances neurogenesis hippocampal.¹⁵

In this study, one type of Aerobic exercise was carried out, namely the 20-m-shuttle-run. Aerobic exercise in the form of 20-m-shuttle-run is considered to be able to maximize oxygen uptake and make changes to the substansia alba through the corpus callosum and corona radiata, which affect the development of the cognitive function.¹⁶ There has been no further research regarding the comparison of the benefits of Plyometrics and Aerobic exercise on the brain, especially decision making, so it is necessary to expand the world of science.

MATERIALS AND METHODS

The type of research used was quasi-experimental with pre-test and post-test designs. The study was conducted on 39 males with an age range of 15-25 years who

were students of the Faculty of Medicine, Diponegoro University. The research subjects had approved the informed consent and were determined by purposive sampling method. Subjects who had met the criteria such as normal BMI, did not take sedative drugs and did not have comorbidities were then divided into 3 groups, namely the treatment group who was given Plyometrics exercise, the treatment group that was given Aerobic exercise, and the control group.

Both treatment groups underwent routine exercise twice a week for 6 weeks. Meanwhile, the control group was not allowed to exercise at all for 6 weeks. All groups did a pre-test at the beginning of the study and a post-test at the end of the study. The parameter test used to assess the score for decision making is the IOWA Gambling Task (IGT). The test is in the form of a computer program so that the subject is required to be able to operate a computer.

Data analysis in the form of descriptive analysis and hypothesis. The dependent variable (decision-making score) of each group was analyzed using the paired T-test if it was normally distributed, and the Wilcoxon test if it was not normally distributed. The results were significant if $p < 0.05$. Research ethics was obtained from *Komisi Etik Penelitian Kesehatan (KEPK) FK UNDIP* with Number 42/EC/KEPK/FK-UNDIP/IV/2020 on April 15, 2020.

RESULTS

This study involved 39 subjects who were students of the Faculty of Medicine, Diponegoro University. The three groups of research subjects, both the control group, the Plyometrics exercise treatment group and the Aerobic exercise treatment had met predetermined inclusion criteria. Each group consisted of 13 people in the control group, 13 people in the Aerobic treatment group and 13 people in the Plyometrics treatment group. The mean age of the research



subjects was $20,15 \pm 0,894$, with the youngest age being 18 years and the oldest being 22 years old. The mean body mass index (BMI) of the research subjects was $22,83 \pm 0,145$, with the lowest BMI of 18 and the highest BMI of 25. The score for decision making

was obtained through parameter testing in the form of IOWA gambling task (IGT).

The measurement of the decision-making score that has been obtained through the pre- and post-test shows the data as shown in the table below.

Table 1. Decision Making Score

Decision Making Score	Group		
	Control (Mean±SD)	Plyometrics (Mean±SD)	Aerobic (Mean±SD)
Pretest	3146.15±975.42	2534.62±923.39	2450.00±717.92
Posttest	2684.62±1064.46	3415.38±830.50	3050.00±1015.30
<i>p</i> [§]	0.001	0.000	0.025
Difference	-461.54±395.36	715.38±289.67	600.00±842.12

* Significant ($p < 0,05$); § Paired T-test

Paired T-test data showed a significant increase in the treatment group in the form of plyometrics and Aerobic exercises. In the Plyometrics group, there was a significant increase in decision-making scores with $p = 0.000$. Whereas in the Aerobic group, there was also an increase in the score of decision making with $p = 0.025$. In contrast to the control group which actually experienced a decrease with $p = 0.001$.

It can be seen that the difference between the pre-test score and the post-test decision making in the Aerobic treatment group is greater than the Plyometrics treatment group. Meanwhile, the control group had the lowest difference between the two treatment groups.

DISCUSSION

The purpose of this study was to understand the comparison of Plyometrics and Aerobic exercise to decision making scores in young adult students of the Faculty

of Medicine, Diponegoro University. Both exercises are performed routine exercise twice a week for 6 weeks. This 6-week exercise timing was based on a previous study conducted by the physiotherapy department at the Nigerian Federal Teaching Hospital. The study states that there is an increase in cardiovascular function as measured by blood pressure, pulse and VO_2 max as well as an increase in quality of life including cognitive function measured through the quality of life scale parameters in someone who routinely undergoes Aerobic exercise within 6 weeks.¹⁷

Another supporting study regarding regular exercise for 6 weeks has also been studied by Western Michigan University where someone who routinely did Plyometrics for 6 weeks experienced a significant improvement in the neuromuscular system in the form of agility.⁹ An increase in cardiovascular function, quality of life and neuromuscular



affect the cognitive function of the brain, one of which is decision making.¹⁵

In the research that the author has carried out, research subjects who did Plyometrics and Aerobic exercise routinely twice a week for 6 weeks experienced a significant increase in cognitive function in the form of an ability to make decisions measured through IGT compared to subjects who did not exercise ($p < 0.05$). However, the increase in decision-making ability tended to be higher in the subject group who underwent Plyometrics training ($p = 0.000$).

During routine exercise, there are developments in several parameters of cardiovascular function such as VO₂max, blood pressure and pulse. Cardiovascular function becomes more optimal in performing tissue perfusion of body organs, including the central nervous system.¹⁸ This has a positive impact on the central nervous system. The central nervous system can increase the production of neurotrophic growth factors which are useful for neurogenesis so that it can increase the volume of the cortex in the brain hemisphere and increase the volume of the hippocampus which causes an increase in one's cognitive function.¹⁹

A study conducted by Kirk I. Erickson et al. stated that exercise could increase neurocognitive processes due to increased cell proliferation in the hippocampus mediated by increased production and secretion of BDNF and its receptors.¹⁹ In Aerobic exercise, found an increase in the volume of the substantia nigra and alba in the prefrontal cortex. Meanwhile, in Plyometrics exercise, in addition to finding an increase in activity in the hippocampus, there is also an increase in neuromuscular coordination, especially in proprioceptive.²⁰

The more significant improvement in Plyometrics exercise on decision-making abilities can be explained by the

involvement of neuromuscular mechanisms, especially proprioceptive in the body. During Plyometrics exercise, there is an increase in proprioceptor activity in muscles due to an increase in neurological receptor stimulation, thereby accelerating the reactivity of the neuromuscular system. If the Plyometrics exercise is done routinely, the higher the increase in proprioceptor activity in the muscles, thus creating a stronger and bigger stimulation to the nerves. Plyometrics exercises lead to increased nerve stimulation, increasing overall neuronal activity. The neuromuscular control mechanisms in the preceding sentence involve the highest functions of the central nervous system such as the motor cortex, ganglia basalis and cerebellum.²¹ The collaboration between neuromuscular control on motoric function and cognitive processes is the cause of a significant increase in the decision-making score of the group that did Plyometrics for 6 weeks.

CONCLUSION

The results from our study shown that there was significant increase towards decision-making score measured through Iowa Gambling Test (IGT) after routine exercise of Plyometrics exercise and Aerobic exercise in young adults ($p < 0.05$). Furthermore, there was a difference in the increase of decision-making score that has more significant in Plyometrics training ($p = 0.000$) compared to Aerobic exercise ($p = 0.025$). The training programs presented in our study can be implemented as routine exercise to help people improve their cognitive function.

Future research is needed to expand the world of science such as comparing data between collecting data in the morning and afternoon.



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