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THE COMPARISON BETWEEN PLYOMETRICS AND AEROBIC EXERCISES TOWARD MEDICAL STUDENTS OF DIPONEGORO UNIVERSITY

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ABSTRACT

Introduction: Sedentary life style had become one of factors causing health problem for someone in general. To avoid that condition we could apply some exercises regularly. Exercise can improve concentration, memory, and intellectuals. The sports enjoyed today are plyometrics and aerobics. Both sports proved beneficial in improving cognitive function, including concentration. **Aim:** to observe the comparison between plyometric and aerobic towards concentration level. **Methods:** This research applied quasi-experimental study with pre and post-test design. The subjects were divided into three groups, the control group, plyometrics group and aerobics group. Medical students of Diponegoro University were taken as subjects of the research which consist 39 males. The subjects underwent the intervention for 6 weeks. Each week consists of two meetings. The indicator of this research focused on concentration level measured by using Digit Symbol Substitution Test (DSST) that has been done before and after 6 weeks exercise. Statistical analysis of this study using Paired *t*-test. **Results:** There was a significant difference in concentration measurement results between treatment and control groups (p=0.00). Treatment group concentration scores improved better than control group. The DSST score on plyometrics exercises was 60.00 ± 5.08 and after intervention to 78.00 ± 2.30. The DSST score on aerobic exercises was 58.76 ± 4.88 and after intervention to 63.07 ± 5.88. Plyometrics exercises are shown to have better effects in increased concentration compared to aerobic exercises. **Conclusion:** Plyometric and aerobic exercise were able to enhance concentration level with the highest result achieved by plyometric group.
Keywords*: Plyometrics exercise, Aerobic exercise, DSST, Concentration*

INTRODUCTION

Nowadays, the outgrowth of technology has stepped forward, making things very accessible and also transforming traditional lifestyle into sedentary.[1] Sedentary lifestyle shows the lack of someone doing physical activities where little energy is produced. Such condition reduces body's function such as muscle strength and cardiovascular stability.[2]

To keep away from sedentary lifestyle we can do exercises regularly.[3] Doing exercises is believed being capable of strengthening essential functions such as memory, intellectual, and our concentration.[4] On the other hand, exercise causes blood flow and oxygen to the brain to be smoother to stimulate neurogenesis and synaptogenesis. Oxygen carried by blood to the brain can help the growth of new cells in the brain and prevent damage or death of these cells. Neurons consist of cell bodies, axons and dendrites, the more dendrites the more likely they are to connect with other neurons which accommodate more information and improve cognitive functions such as memory, attention and concentration.[5]

Concentration is an ability to centralize our mind towards study activities.[6] One of the parts of the limbic system is Amygdala. Amygdala has a role in attention regulation system in the brain. It processes selective functions during activities that require a lot of attention. Processing of selective functions of attention-causing concentration.[7,8] Concentration can be measured using Digit Symbol Substitution Test (DSST) during 90 to 120 seconds.[9]

A form of exercise quite enjoyable for now is plyometrics. Plyometrics exercises are time-consuming, simple, and easy to do. Types of plyometrics movements with Agility Ladder, namely Side shuffle, Straddle hops, Lateral jump lunge, and Bunny hops.[10] This exercise can train brain function because it requires good coordination and balance when doing plyometrics exercises. Previous research on plyometrics exercise has shown that regular 6 weeks of exercise showed a significant effect on concentration.[11]

Another example of a recent popular sport is aerobics. Aerobics is a form of physical exercise that consists of rhythmic, repetitive and continuous movements of large muscle groups. An example of aerobic exercise is the 20 meters shuttle run.[12] There have been many studies that showed aerobics can stimulate the production of neurotransmitters which improve mood and grow the BDNF factor, so that the

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volume of the hippocampus increases and add a new brain cells, increasing visual acuity and improve cerebrovascular function.[13]

This study was conducted to determine the comparison of plyometrics exercise with aerobics on the concentration scores of Diponegoro University Medical Faculty students.

METHODS

This research applied quasi-experimental study with pre-test and post-test as the design. The subjects were divided into three groups plyometrics, aerobic, and control group. Medical students of Diponegoro University were taken as subjects of the research which consists of 39 males. Plyometrics and aerobic exercises were put in an application in the experimental groups during six weeks. Each week consisted of two meeting with the treatments. The indicator of this research focused on concentration level measured by using Digit Symbol Substitution Test (DSST). The research was conducted using purposive sampling based on specified criteria.

Data analysis covers descriptive analysis and hypothesis test. Data on a continuous scale such as concentration value in descriptive analysis would be stated as average and standard intersection if distributed data were normal. Otherwise, if it were not normal then it was considered as median, minimum and maximum range. Normality of data distribution was rated using Shapiro-Wilk test. This test was chosen because sample size was less than 50. The distributed data was considered normal if the value $p \geq 0.05$. If the data were categorical in scale then it was stated as frequency distribution and percentage. Concentration score difference of hypothesis test before and after treatment within research groups would be analyzed by paired t test if it were normally distributed. Otherwise, it was analyzed by Wilcoxon if it were not normally distributed. The difference was considered significant if $p < 0,05$. Computer program would be used in analyzing data. Data retrieval had been approved by Health Research Ethics Committee (KEPK) from faculty of medicine of Diponegoro University with number of letter 41/EC/KEPK/FK-UNDIP/IV/2020.

RESULTS

This research was conducted using quasi-experimental study on medical students of Diponegoro University, focusing on concentration using Digit Symbol Substitution Test (DSST) which showed significance on a group given plyometrics and aerobic during six weeks compared to the group without any treatment.

The research was held in July until September 2020 with medical students of Diponegoro University year of 2017, 2018, and 2019 as subjects of the research that had met inclusion criteria without exclusion criteria, and were up to be on the research.

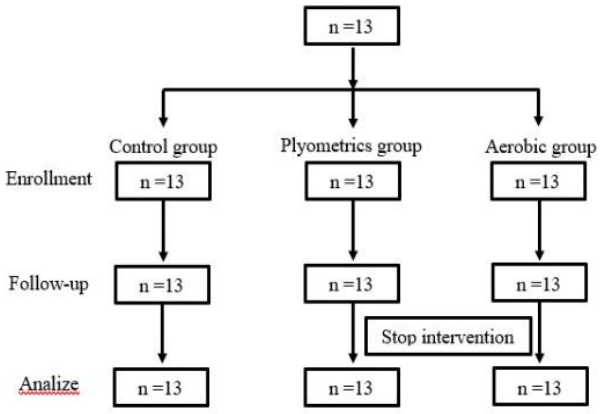

Figure 1. Research Subject Consort Diagram

Based on the picture above, groups were divided into control group (n=13), plyometrics group (n=13), and aerobic group (n=13). The activities were followed up regularly during those six weeks where each week had two meetings to implement plyometrics and aerobic. Post-test with DSST was also given at the end of the research on 39 subjects.

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Table 1. Characteristics of Research Subjects

Parameter	N	F	%	Average ± Standard Deviation
Age (year)	39	-	-	20.22 ± 0.95
Body Mass Index (kg/m^2)	39	-	-	22.00 ± 1.942
Suffering Leg Injury	39			
-Yes		0	0	
-No		39	100	
Having History of Leg Injury	39			
-Yes		0	0	
-No		39	100	
Having Posture Abnormalities	39			
-Yes		0	0	
-No		39	100	

The average of research subject age was 20.22 ± 0.89 with the youngest was 18 years old, and the oldest was 22 years old. Subjects had height average of 171.19 cm and 63.98 of weight. Their body mass index was 22 kg/m^2. All subjects did not have any history of injury and posture abnormalities. Concentration was measured off using Digit Symbol Substitution Test (DSST) twice. First action was done before treatment was given on experimental group on July 9, 2020. The second one was on post-test after six weeks of exercises on September 4, 2020. Concentration scores were obtained by duplicating symbol into space under number sequence. The number of correct pairs indicated the level of concentration and memory got higher. The following table serves result of measurement obtained by Digit Symbol Substitution Test (DSST).

Table 2. Concentration Score of DSST

DSST Score	Group		
	Control (n=13) Mean ± SD	Plyometrics (n=13) Mean ± SD	Aerobik (n=13) Mean ±S D
Pretest	58.76 ± 4.88	60.00 ± 5.08	59.92 ± 3.47
Post-test	63.07 ± 5.88	78.00 ± 2.30	69.30 ± 4.26
P$^{£}$	0.00	0.00	0.00
Difference	4.30 ± 2.75	18.00 ± 4.37	9.38 ± 3.77

*Significant (p < 0,005); $^{£}$ Paired T-test

Based on DSST, the result of pretest on plyometrics group was 60.00 ± 5.08. It is higher than aerobic group with score of 59.92 ± 3.47, and 58.76 ± 4.88 on control group. Based on statistic test the difference had significance of (p=0.00; paired t-test). Also, DSST score on post-test of plyometrics group was 78.00 ± 2.30 higher than control group with 63.07 ± 5.88 and aerobic group with 69.30 ± 4.26. This statistic test indicated significant difference (p=0.00, paired t-test). We can see from the picture that score difference of pretest and post-test from DSST showed plyometrics treatment gained higher result with 18.00 ± 4.37 compared to aerobic and control group where each of them gained 9.38 ± 3.77 and 4.30 ± 2.75.

DISCUSSION

The purpose of this study was to determine the difference in concentration scores shifting using the Digit Symbol Substitution Test (DSST) between the groups that were given intervention in the form plyometrics and aerobics and the control group or

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those who were not given training to students of the Faculty of Medicine, Diponegoro University.

There was no drop out subjects in this study. Subjects did plyometrics and aerobic exercises for 6 weeks with a frequency of twice a week. Every two weeks the exercise set will be increased by 1 set. Then the subjects were asked to measure their pulse rates following the recommendations of the "American Heart Association" (220 - (Age of study subjects)). The average pulse rate obtained in the subject after the intervention was 150x/minute, these results were in accordance with the target pulse and did not reach the target limit of "HR Zone" so that it did not cause excessive exercise and could avoid injury.

Exercises that are carried out regularly for 6 weeks can cause vasodilation of blood vessels, and an increase in pulse which causes blood and oxygen flow to the brain to become smoother so that it can improve cognitive function.[14]

The subjects who participated in the study had an average age of 20-21 years with an average Body Mass Index (BMI) of 22 kg/m^2. The BMI used in this study was normal. A normal BMI will affect the quality of the subject when conducting interventions, both when doing plyometrics and aerobics, besides it will also reduce the risk of injury to the sampel.[15]

The intervention given for 6 weeks can increase the concentration as indicated by statistical results (p=0.00), both in the plyometrics and aerobic treatment. This is supported by the theory that people who often exercises has a better metabolic function than someone who rarely does sports.[16]

In addition, Erickson et al. said that exercise can improve cerebrovascular function, such as increase blood flow to the brain accompanied by sufficient oxygen intake and increase the volume of the hippocampus. The volume of the hippocampus is also associated with increased levels of BDNF which affect the attention function.[17] Attention function requires the ability to concentrate to maintain this function over a long period.[18]

In this study, aerobic exercise for 6 weeks caused a significant increase (p=0.00) with the difference in pretest and posttest (9.38 ± 3.77). This is in line with previous study, aerobic exercise will increase the circulation of neurons so that a person gets more oxygen and nutrients in the brain, stimulates the production of neurotransmitters which can improve mood and grow the BDNF factor so that the volume of the hippocampus increases, creating cell-cell processes. new brain, and improve visual acuity.[13]

In this study, the sampel who underwent plyometrics exercise got more significant results (p=0.00) with a higher pretest and posttest differences (18.00 ± 4.37) compared to subjects given aerobic exercise (9.38 ± 3.77). When doing plyometrics exercises, coordination and balance are needed to achieve maximum strength in the shortest possible time so that speed, concentration and strength are needed.[19]

This is supported by previous research conducted by Netz that when doing plyometrics exercises with repetitive movements, and using coordination movements will result in greater muscle strength and concentration so that it can affect metabolic processes in the brain which will increase brain neuroplasticity in certain areas such as prefrontal cortex and increase cognitive functions such as concentration. On the other hand, aerobic exercise only has one movement that is the same from start to finish. So that when doing aerobic exercise does not directly affect cognitive function, but by improving cardiovascular function, then to the cerebral circulation and improve cognitive.[20]

CONCLUSION

Plyometrics and aerobic exercise were able to enhance concentration level. Plyometrics exercise is proven to increase consentration level better than aerobic exercise.

The DSST score after plyometrics training (78.00 ± 2.30) is higher than before the plyometrics exercise (60.00 ± 5.08). The DSST score after aerobic training (63.07 ± 5.88) is higher than before aerobic training (58.76 ± 4.88). The DSST score after conducting plyometrics exercises (78.00 ± 2.30) is higher than after aerobic exercise (63.07 ± 5.88).

REFERENCES

1. Kim SY. Sedentary lifestyle and cardiovascular health. Korean J Fam Med. 2018;39(1):1.
2. Riskesdas K. Hasil Utama Riset Kesehatan Dasar (RISKESDAS). 2018;44(8):1–200.
3. Kemenkes. Buku Pedoman Manajemen Penyakit Tidak Menular. 2019;2.
4. Giriwijoyo, H.Y.S santosa, lilis komariyah neng tineh kartinah. Sport Medicine Kesehatan, Pendidikan Jasmani Dan Pembelajaran Olahraga

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Di Sekolah. Jakarta: EGC; 2012.
5. Kovacevic A, Fenesi B, Paolucci E, Heisz JJ. 1 Running head: Exercise Intensity and Cognition In Aging The effects of aerobic exercise intensity on memory in older adults Ana Kovacevic. 2019;1–38
6. Nuryana A PS. Efektivitas Brain Gym dalam Meningkatkan Konsentrasi Belajar pada Anak. Indig J Ilm Berk Psikol. 2010.
7. Elaine NM, Katja H. Human Anatomy & Physicology. 7th,ed. USA: Person Education,Inc; 2017.
8. Frederick HM. Fundamentals of Anatomy & Physicology. 9th,ed. US: Pearson Education: 2012.
9. Sheridan LK, Fitzgerald HE, Adams KM, Nigg JT, Martel MM, Puttler LI, et al. Normative Symbol Digit Modalities Test performance in a community-based sample. Arch Clin Neuropsychol. 2019;21(1):23–8.
10. Oden W & Development of agility utilising a multidimensional modality of plyometric. J Fit Res. 2014;3(3):8-22.
11. Davies G, Riemann BL, Manske R. Current Concepts of Plyometric Exercise. Int J Sports Phys Ther. 2015;10(6):760-86.
12. Patel H, Alkhawan H, Madanieh R, Shah N, Kosmas CE, Vittorio TJ. Aerobic vs anaerobic exercise training effects on the cardiovascular system. World J Cardiol. 2017;9(2):134.
13. Blanton E, Honerlaw K, Kilian R SJ. The Effects of acute aerobic exercise on cognitive function in young adults. J Adv Students Sci. 2013:1-20.
14. Bossers Willem J.R., Scherder,Erik J. A. Boersma, Froukje., Hortobagyi, Tibor., Woude, Lucas H. V danHeuvelen,Marieke J. G. 2014. Feasibility of a Combined Aerobic and Strength Training Program and Its Effects on Cognitive and Physical Function in Institutionalized Dementia Patients. A Pilot Study. Volume 9, Issue 5.
15. Radcliffe, James C, Farentinos RC. High-Powered Plyometrics. Barnard M, editor. Vol. 34. United States of America: Human Kinetics; 1999. 297 p.
16. Guyton, Arthur C. 2012. Buku Ajar Fisiologi Kedokteran edisi 11. Jakarta: EGC.
17. Erickson KI, Voss MW, Prakash RS, Basak C, Szabo A, Chaddock L, et al. Exercise training increases size of hippocampus and improves memory. Proc Natl Acad Sci U S A. 2011;108(7):3017-22.
18. Green, Shawn C BD. Action Video Game Modifies Visual Selective Attention. Nature. 2003:423, 534-537.
19. Trecroci A, Cavaggioni L, Caccia R, Alberti G. Jump rope training: Balance and motor coordination in preadolescent soccer players. J Sport Sci Med. 2015;14(4):792-798.
20. Netz Y. Is There a Preferred Mode of Exercise for Cognition Enhancement in Older Age?-A Narrative Review. Front Med. 2019;6(March):1