DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 10, Number 2, March 2021

THE COMPARATION BETWEEN PLYOMETRICS AND AEROBIC EXERCISE ON MEDICAL STUDENT'S MOOD IN DIPONEGORO UNIVERSITY

Karoni Karoni[1], Muflihatul Muniroh[2], Marijo Marijo[3], Endang Kumaidah[2*]
[1]Undergraduate Program, Faculty of Medicine, Diponegoro University, Semarang, Indonesia
[2] Department of Physiology, Faculty of Medicine, Diponegoro University, Semarang, Indonesia
[3] Department of Anatomy, Faculty of Medicine, Diponegoro University, Semarang, Indonesia
* Corresponding author: Email: endangkumaidah@gmail.com

ABSTRACT

Background: Physical activity is important to do because a sedentary lifestyle is one of the causes of various health problems in the world. One of the importance of physical activity is to improve mental health, quality of life and well-being. Physical activity significantly has a positive impact on a person's mood. Plyometrics and aerobic exercises are popular physical activities, but comparing the effects of both in improving cognitive function, especially in the mood domain, has never been done. **Objective:** To analyze mood differences between the group with plyometrics exercise and the group with aerobic exercise in students of the Faculty of Medicine, Diponegoro University. **Methods:** This study is an experimental study with parallel 3 groups pre and post-test design. The research subjects were 45 UNDIP medical students who were selected by purposive sampling and grouped into 3 groups randomly. The untreated control group (n = 15), the plyometrics treatment group (n =15), and the aerobic treatment group (n = 15). The treatment group did physical activity for 6 weeks. Mood levels were measured before and after the intervention using the Profile Of Mood States (POMS). The better a person's mood, the lower the Total Mood Disorder (TMD) score is obtained. **Results:** TMD scores (pre-test to post-test) in the plyometrics ($p < 0.001$) and aerobic ($p = 0.001$) groups both experienced a significant decrease. However, there was no significant difference between the TMD post-test scores in the plyometrics treatment group and the aerobic treatment group. **Conclusion:** Plyometrics and aerobic exercise has a similar effect on improving mood score.

Keywords: *Aerobic, Mood, Plyometrics*

INTRODUCTION

Physical activity is very important to do because a sedentary lifestyle is one of the causes of various health problems in the world. In addition to preventing heart disease, stroke, diabetes, hypertension, obesity, physical activity has been shown to improve mental health, quality of life and well-being.[1] Research conducted by WFZ Werneck, CA Navaro shows that there is a relationship between scores Physical Activity Level (PAL) with Total Mood Disosder (TMD) level.[2]

The increase or decrease in mood is influenced by hormone systems such as serotonin, dopamine, and norepinephrine. Norepinephrine and serotonin normally generate a boost in the limbic system to increase one's sense of comfort, create feelings of happiness, satisfaction, good appetite, appropriate sexual drive, and psychomotor balance.[3] Other studies have shown that physical exercise affects levels serotonin, dopamine, and noradrenaline (norepinephrine) in the brain prove that exercise supports changes in the synthesis and metabolism of the monoamine neurotransmitter.[4]

Plante TG at al stated that regular physical activity has been shown to significantly have a positive impact on a person's mood. Mood is one of the cognitive components related to a person's intelligence.[5] The drive to learn is related to mood where a positive mood will make a person's brain more creative in thinking.[2] Positive mood can be improved through regular physical exercise so as to improve student academic achievement.[6]

Plyometrics training is a popular form of exercise recently because of its effect on increasing muscle tone, producing fast and strong movements and improving nervous system function.[7,8] Recent research by Marisna et al in 2019 that plyometrics significantly improved mood in medical students.[9] This plyometrics exercise is dominated by jumping movements with explosive force.[10] As is the case with aerobic exercise in the 20 meter multistage shuttle run test (20mMST) exercise design, this sport is simply done by running back and forth at a distance of 20 meters.[11]

Research conducted by Olutende et al in 2017 states that aerobic exercise with a cycling exercise design and rhythmic gymnastics were effective in improving mood in students.[12] No previous research has discussed the effect of 20mMST exercise design on cognitive function,

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 10, Number 2, March 2021

especially in the mood domain. (mood). This study was conducted to determine whether there is a difference in effect on physical exercise performed in different forms of exercise where in this study using plyometrics and aerobic training in the 20mMST exercise design.

METHOD

Research Design and Variables

This research is an experimental study with a parallel 3 groups pre and post-test design carried out in January-October 2020. This research was conducted in the Firing Range of Diponegoro Regional Military Command, Tembalang sub-districts, Semarang city. The control variable in this study was not given any physical activity. The independent variable in this study is the provision of interventions in the form of plyometrics and aerobic exercises. While the dependent variable is the mood.

Research Subject

Participants in this study were medical faculty students who were registered as active students from the Faculty of Medicine, Diponegoro University, Semarang in the academic year 2017, 2018, 2019 aged 18-25 years who met the inclusion and exclusion criteria. Participants were selected by purposive sampling. Exclusion criteria included a history of head trauma, brain tumors and / or epilepsy, central nervous system infection, leg or lower leg injuries, history of psychiatric drug use and refusal to be included in the study. Subjects in the treatment group who did not intervene were included in the drop out. Based on the calculation of the minimum sample size, the number of samples for each group is 15 people. This study used a total sample of 45 people because there were 3 groups.

Tools and Materials

The tools and materials used in this study were agility ladder drills, profile of mood states (POMS) questionnaire, letter of approval after explanation (PSP), sphygmomanometer, weight scale, stature meter, sports cone, mat, stopwatch, demographic questionnaire.

Procedure

Subjects who had been given an explanation about the study and had signed the consent form were then randomly allocated into three groups. The control group was not administered any treatment; The intervention group 1 was administered plyometrics exercises; The intervention group 2 was administered aerobic exercise for 6 weeks.

Mood levels were measured using a profile of mood states (POMS) questionnaire consisting of 65 question items used to assess 7 dimensions of mood, including depression, anxiety, fatigue, vigor, irritability, tension, and confusion. Subjects were asked to fill out a POMS questionnaire which had 5 points of assessment on a Likert scale, consisted of not at all, a little, moderate, quite a bit and extremely. Measurements were carried out on all research subjects 2 times, consisted of before being given the intervention and after being given the intervention for 6 weeks together with the control group.

The research subjects who were included in the control group were not allowed to exercise and were asked to do activities as usual, while the two treatment groups would first have their blood pressure and heart rate measured before exercise. One set of plyometrics treatment consists of 4 variations of movement, namely Side Shuffle, Straddle Hops, Lateral Jump Lunge, Bunny Hops. While one aerobic treatment carried out in the 20 meter multistage shuttle run test (20mMST) exercise design consisted of jogging back and forth 4 times. Both treatment groups were performed in 2 sets at week 1 and 2, 3 sets at week 3 and 4, and 4 sets at week 5 and 6.

Data analysis

Data were analyzed using the Shapiro-Wilk normality test. The hypothesis about the difference in mood levels before and after being given plyometrics and aerobic treatment was tested using the Paired Sample T-test because the data were normally distributed.

Furthermore, the hypothesis about differences in pre-test scores differences in mood levels between the control group, the plyometrics treatment group, and the aerobic treatment group were tested using the ONE-Way ANOVA test because the data were normally distributed. Meanwhile, the difference in post-test scores in mood level between the control group, the plyometrics treatment group, and the aerobic treatment group was tested using the Kruskal Wallis test because the data were not normally distributed.

RESULTS

Sample Characteristics

Table 1 shows that the total study sample (n = 45) was divided equally by each group; control group (n = 15); plymetrics treatment group (n = 15)

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 10, Number 2, March 2021

and aerobic treatment (n = 15). The mean age in the aerobic treatment group was younger than in the control group and the plyometrics treatment group, but the difference was not significant (p = 0.398; Kruskal Wallis test). All study subjects, both the control group, plyometrics treatment, and aerobic treatment were male, did not have a history of head trauma, a history of epilepsy / brain tumors, a history of central nervous system infection, a history of lower leg injuries, and a history of psychiatric disorders.

Table 1. Sample Characteristics

Element	Groups			*p*
	Kontrol (n=15)	Plyometrics (n=15)	Aerobik (n=15)	
Age	19,87 ±0,743	19,87 ±0,990	19,53 ±0,834	0,398**
Height	171,33 ±4,530	167,13 ±7,328	172,40 ±5,275	0,042*
Weight	65,40 ±3,719	59,60 ±7,029	66,20 ±4,648	0,003*
BMI	22,27 ±0,826	21,29 ±1,507	22,27 ±1,073	0,048**

Measurement Results Comparison of TMD Scores in the plyometrics, aerobic and control groups

Table 2. Comparison of TMD scores in the plyometrics, aerobic and control groups

TMD	Groups			*p*
	Control (n=15)	Plyometrics (n=15)	Aerobic (n=15)	
Pretest	79,40 ±37,196	80,00 ±36,079	83,27 ±34,56	0,951§
Posttest	75,80 ±30,931	56,40 ±31,133	64,47 ±31,177	0,242€
p	0,125¶	<0,001¶*	0,001¶*	

Table 2 shows that the TMD control group's pre-test score results were 79.40 ± 37.196 lower than the plyometrics treatment group 80.00 ± 36.079 and the aerobic treatment group was 83.27 ± 34.56. However, there was no significant difference (p = 0.951; One-Way ANOVA). The result of the TMD post-test score from the plyometrics treatment group was 56.40 ± 31.133 lower than the aerobic treatment group of 64.47 ± 31.177 and the control group 75.80 ± 30.931. Based on the test using the Kruskal Wallis test, there was an insignificant difference in the post-test scores (p = 0.242).

Based on table 2, it can be seen that there was a decrease in TMD scores (pre-test to post-test) in both the plyometrics and aerobic treatment groups. The plyometrics treatment group experienced a significant decrease in TMD scores (p <0.001; Paired Samples T test). The aerobic treatment group also experienced a significant reduction in TMD scores (p = 0.001; Paired samples T test). Nevertheless, the decrease in TMD score in the plyometrics treatment group was not much different from the decrease in TMD score in the aerobic treatment group.

On the other hand, based on the Paired samples T test there was no significant decrease in TMD scores in the control group (p = 0.125; Paired Samples T test).

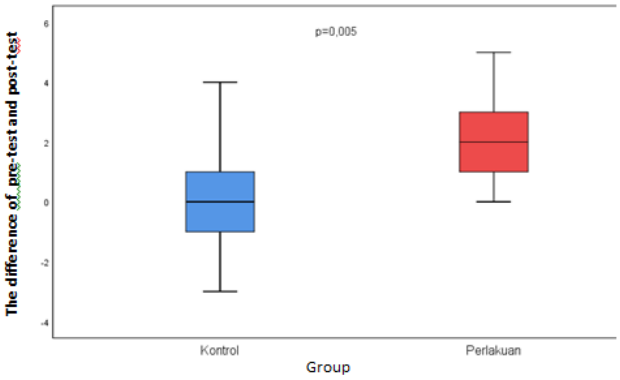

Figure 1. Difference in TMD scores at pre-test and post-test

After the data normality test was carried out, the difference between the TMD pre-test and post-test scores between groups was analyzed using the Mann-Whitney test because the data were not normally distributed. The difference between the TMD pre-test and post-test scores in the control group was 3.60± 8.542; 2.00(-9-25). The difference between the TMD pre-test and post-test scores in the aerobic group was 18.80±17.997; 12.00(7-78). The difference between the TMD pre-test and post-test scores in the plyometrics group was 23.60±19.478; 14.00(-8-51). Based on the analysis, there was a close difference between the pre-test and post-test TMD scores between the aerobic treatment group and the control group (p = 0.001). Then it was also found that there was a difference in the difference between the TMD pre-test and post-test scores between the plyometrics treatment group and the control group (p = 0.002). In addition, there was also a different difference between the TMD pre-test and post-test scores which was not related to the

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 10, Number 2, March 2021

plyometrics treatment group and the aerobic treatment group (p = 0.589).

DISCUSSION

Significant results were obtained in both treatment groups, both given plyometrics and aerobic interventions for 6 weeks. In the plyometrics treatment group there was a significant decrease in TMD scores from pre-test to post-test scores. In the aerobic treatment group also experienced a significant decrease in TMD scores from pre-test to post-test, while in the control group there was no significant change in TMD scores from pre-test to post-test scores. The post-test results in the plyometrics treatment group showed a higher mood score when compared to the aerobic treatment group, but the difference in scores did not show any significant value between the two groups.

The significant results in both plyometrics and aerobic treatment groups were supported by previous research by Marco Aurelio Monteiro Peluso, et al which stated that there was an increase in mood (mood) in subjects who were given physical activity compared to subjects who were not given physical exercise (control).[13] The results in the plyometrics treatment group are in line with previous research by Adinda Marisna in 2019 which states that 6 weeks of plyometrics exercise has been shown to significantly improve mood.[9] The results in the aerobic group are also in line with previous research by Oloo Micky Olutende in 1999 - 2017 which states that 6 weeks of aerobic exercise is shown to be able to significantly improve mood.[12]

Plyometrics and aerobic exercise are physical activities that can affect the neurotransmitter and neurochemical systems that play a role in mood regulation such as dopamine, serotonin, norepinephrine, and endorphins.[1,14] Research conducted by Ruhe HG, et al. Shows that the production of the neurotransmitter dopamine, serotonin , and norepinephrine can produce positive moods (comfort, happiness, satisfaction, etc.) in individuals.[15] Another study conducted by Lin TW and Kuo YM explained that four weeks of exercise can prevent a decrease in dopamine, whereas with six weeks of exercise can provoke neural adaptation in response to uncontrolled stress.[4]

Research conducted in 2019 by Lawrence Robinson and Jeanne Segal showed that physical activity can promote all kinds of changes in the brain, including nerve growth, reduced inflammation, and can lead to feelings of calm and well-being.[16] Physical activity can also increase neuronal adaptation and neurogenesis. induced by an increase in serotonin, B-endorphins, and Brain Derived Neurotrophic Factor (BDNF) which will improve mood and a feeling of overall health.[17] Not only that, physical exercise also causes structural changes such as an increase in the volume of gray matter in the frontal area and the hippocampus as well as reducing damage to gray matter that plays a role in mood regulation.[17,18]

The post-test results in the plyometrics treatment group showed a higher mood score when compared to the aerobic treatment group, but the difference in scores did not show a significant value between the two groups. This could happen because the two groups intervened for almost the same duration. Exercise sessions in the plyometrics and aerobic treatment groups took between 10-30 minutes to complete 2 sets of exercises at week 1 and 2, 3 sets at week 3 and 4, and 4 sets at week 5 and 6th.

Previous research conducted by Elizabeth A, et al in 2017 stated that exercise has a beneficial effect on various mood profiles, whatever exercise is carried out in a duration between 10-60 minutes. et al in 2019 which stated that the duration of effective exercise to improve mood is 10-30 minutes.[6]

The Journal of Psychology in 2019 states that the effects of exercise are not linearly related to the duration of exercise. Exercising with a duration of less than 10 minutes has a limited effect on the nervous system for mood improvement. 6 While exercising with a duration of more than 30 minutes provides little additional benefit to mood and if the duration continues to increase it will cause fatigue. and losing performance which will lead to a negative mood.[6,19]

The results showed that the plyometrics exercise had a higher mood score compared to aerobic exercise, although it did not show a significant difference in value. This is because aerobic exercise has more potential to cause boredom compared to plyometrics training because of the monotonous form of aerobic exercise in the form of a shuttle run. This is supported by research conducted by van Hooff et al in 2016 which states that boredom is positively related to decreased mood.[20]

Previous research conducted by Yael Netz in 2019 showed that exercises that involve a lot of

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 10, Number 2, March 2021

learning and memorization, new skills and patterns, and maintaining attention, can help to improve overall executive functioning abilities, one of which is the mood domain. Compared to exercises that have one movement or movement pattern the same from start to finish.[21]

The limitations of this study are the researcher's inability to control the subject's personality, the events experienced by the subject before participating in the study, and the amount of effort of the research subject in completing the treatment. Researchers were also unable to ensure that subjects felt comfortable, especially when filling out the POMS questionnaire. One of the causes of this inconvenience is due to patients who have to wear masks during training and fill out the POMS questionnaire during the COVID-19 pandemic.

CONCLUSION

Six weeks of plyometrics and aerobic exercise have been shown to be "effective" in improving mood levels in medical students. On the other hand, the difference in effect between these two forms of exercise does not show any significant value. Thus, plyometrics and aerobic exercise have a similar effect in increasing mood scores. Further comparative research is needed on giving plyometrics or aerobic exercise interventions, especially shuttle runs using a certain duration or intensity.

Ethical Approval

This research has received ethical permission from the KEPK (Commission on Ethics for Medical and Health Research) Faculty of Medicine UNDIP with No. 97 / EC / KEPK / FK-UNDIP / VI / 2020.

Conflicts of Interest

The authors declare no conflict of interest.

Funding

No specific funding was provided for this article.

Author Contributions

Writing-original draft preparation, Karoni; writing-review and editing, Dra. Endang Kumaidah, M.Kes, dr. Muflihatul Muniroh, M.Si.Med, Ph.D, Marijo, S.Pd., M.Pd.

Acknowledgments

This work was supported by Department of Physiology, Faculty of Medicine, Diponegoro University.

REFERENCES

[1] Cooper RN. Living with global imbalances: A contrarian view. Vol. 28, Journal of Policy Modeling. 2006. 615–627 p.

[2] Legey S, Aquino F, Lamego MK, Paes F, Nardi AE, Neto GM, et al. Relationship Among Physical Activity Level, Mood and Anxiety States and Quality of Life in Physical Education Students. Clin Pract Epidemiol Ment Heal. 2017;13(1):82–91.

[3] Ruhé HG, Mason NS, Schene AH. Mood is indirectly related to serotonin, norepinephrine and dopamine levels in humans: A meta-analysis of monoamine depletion studies. Mol Psychiatry. 2007;12(4):331–59.

[4] Lin TW, Kuo YM. Exercise benefits brain function: The monoamine connection. Brain Sci. 2013;3(1):39–53.

[5] Plante TG, Oppezzo MA, Diaz LA, Pistoresi S, Santos M, Fahey JE, et al. The Influence of Exercise Environment and Gender on Mood and Exertion. Int J Exerc Sci. 2014;7(3):220–7.

[6] Chan JSY, Liu G, Liang D, Deng K, Wu J, Yan JH. Special Issue–Therapeutic Benefits of Physical Activity for Mood: A Systematic Review on the Effects of Exercise Intensity, Duration, and Modality. J Psychol Interdiscip Appl. 2019;153(1):102–25.

[7] Davies G, Riemann BL, Manske R. Current Concepts of Plyometric Exercise. Int J Sports Phys Ther. 2015;10(6):760–86.

[8] Exercises P. Plyometric exercises. Dict Rheumatol. 2009;2(April):173–173.

[9] Marisna A. Pengaruh Latihan Plyometrics terhadap Mood Mahasiswa Fakultas Kedokteran Universitas Diponegoro. Diponegoro Medical Journal. 2019; 1(October):1-15.

[10] Radcliffe J, Farentinos R. High-Powered Plyometrics. 2nd ed. Champaign, United States: Human Kinetics Publishers. 2015;8(2):124-58

[11] Paradisis GP, Zacharogiannis E, Mandila D, Smirtiotou A, Argeitaki P, Cooke CB. Multi-stage 20-m shuttle run fitness test, maximal oxygen uptake and velocity at maximal oxygen uptake. J Hum Kinet. 2014;41(1):81–7.

[12] Olutende M. Effects Of Aerobic Exercise

DIPONEGORO MEDICAL JOURNAL
(Jurnal Kedokteran Diponegoro)
Online : http://ejournal3.undip.ac.id/index.php/medico
E-ISSN : 2540-8844
Volume 10, Number 2, March 2021

On Mood State Of University Students : A Quasi-Experimental Approach. International Journal of Current Research. 2017;9(November):108-12.

[13] Peluso MAM, Guerra de Andrade LHS. Physical activity and mental health: the association between exercise and mood. Clinics (Sao Paulo). 2005;60(1):61–70.

[14] Yektayar M, Saham M, Ahmadi S, Khodamoradpoor M. Effect of Rhythmic Aerobic Training on Mood Status Profile and Salivary Alpha Amylase in Non-athlete Students. Sch Res Libr Arch Appl Sci Res. 2012;4(5):2184–90.

[15] Tomkinson GR, Lang JJ, Blanchard J, Léger LA, Tremblay MS. The 20-m shuttle run: Assessment and interpretation of data in relation to youth aerobic fitness and health. Pediatr Exerc Sci. 2019;31(2):152–63.

[16] Luebbers PE, Hulver MW, Thyfault JP, Carper MJ, Lockwood RH, Potteiger JA. Effects of Plyometric Training and Recovery on Vertical Jump Performance and Anaerobic Power. Med Sci Sport Exerc. 2003;35(September):253-87.

[17] Mandolesi L, Polverino A, Montuori S, Foti F, Ferraioli G, Sorrentino P, et al. Effects of physical exercise on cognitive functioning and wellbeing: Biological and psychological benefits. Front Psychol. 2018;9(APR):1–11.

[18] Ruben Martin and Stephen L. Buchwald. Jiyin de Gaibian. NIH Public Access. Bone [Internet]. 2008;23(1):1–7.

[19] Stults-Kolehmainen MA, Sinha R. The effects of stress on physical activity and exercise. Vol. 44, Sports Medicine. 2014. 81–121 p.

[20] van Hooff MLM, van Hooft EAJ. Work-related boredom and depressed mood from a daily perspective: the moderating roles of work centrality and need satisfaction. Work Stress. 2016;30(3):209–27.

[21] Netz Y. Is There a Preferred Mode of Exercise for Cognition Enhancement in Older Age?—A Narrative Review. Front Med. 2019;6(March):1–10.