The Effect of Aerobic Dance and Peripheral Heart Action Training (PHAT) on Aerobic Capacity, Body Mass Index, and Heart Rate

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Abstract: The purpose of this study was to investigate the effects of combination aerobic dance and Peripheral heart action training (PHAT) on aerobic capacity (VO2max), body mass index (BMI), and heart rate of physically-active students. Observational study with one group pre-post test design. Eleven healthy active college sudent participants were assesed by several tests. They are multistage fitness test (Bleep test) for aerobic capacity, body weight and height for calculating body mass index, and heart rate palpation prior to and following six week exercise intervention. Both aerobic dance and PHAT consisted of functional movement as running or marching in place, turning, jumping, isometric and isokinetic muscle contraction, and other movement that could activate most system in the body. The exercise lasts approximately 50 to 60 minutes a day, three times a week (aerobic dance once a week, and PHAT twice a week), for total 6 weeks. This study shows there was 2.32% improvement in VO2max and 1.35% decrease in body composition Meanwhile, the heart rate increased by fasting condition (normal heart rate: 10.14%, warm-up actrivities 8.68%, training: 15.23%, 10 minute recovery 9.00%). These findings suggest that combination of both aerobic dance and PHAT facilitate improvement of aerobic capacity, and better body composition. In contrast, heart rate is significantly increased by fasting in post-test assessment where the student participants were assumed experiencing bad hydration.

1 INTRODUCTION

Many studies have shown that regular exercise does not only improve and enhance biophysical capacity such as strength, endurance, agility, coordination, balance, and other biomotor components, but also improves psychological capacity, including self-perception, motivation, mood level, and self-confidence. The improved psychological condition will indirectly have a positive impact on the social concept of a community, as college students.

Aerobic dance is one of the physical activities that may not be as popular as other sport activities such as soccer or badminton, but the percentage of community involvement in this sport increases significantly year by year. Nowadays it is not too difficult to find male instructors or dance aerobic male athletes, which in the past may still be considered taboo or unusual. It is due to aerobic dance or gymnastics are inherently identical to women alone. Aerobic dance is a kind of sport activities which dominantly utilizes the glicolisis oxydative energy system and its functions. This system is included in aerobic exercises which aim to improve several physical components, namely strength and cardiorespiratory endurance, muscle strength and endurance, and agility, balance, coordination, speed and power.

Many studies have shown that aerobic dance can provide positive effects on increasing physical components, especially those related to one's aerobic capacity. Conversely, some studies underline that exercise which is carried out with weights and pauses (there is a recovery phase in it/interval) correlated with an increase in muscle mass, or anaerobic increase in physical capacity. This study seeks to address the effect of the intervention in the combination of aerobic dance with a modified weight training fitness program.

In this study, fitness program refers to special weight training (internal and external loads) known as Peripheral Heart Action Training (PHAT). It is carried out in a measured, orderly manner, and has a dominant training goal in the components of muscle strength and endurance. Aerobic dance and PHAT are two training models that have different goals, but

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they are expected to have an effect on increasing optimal physical and psychological capacity. Peripheral heart action training is a form of circuit training that was brought to the masses in the 1960's by Mr. America and Mr. Universe Bob Gajda. Developed by Dr. Arthur Steinhaus, the process behind PHA training was aimed at keeping blood circulating throughout the body during the entire duration of the workout. By training opposing muscle groups, local lactic acid build up was avoided while it still allows for continuous training to occur. High intensity and minimal rest times were absolute when it came to PHA training. This allows for maximized body fat loss with minimal muscle mass loss (Alex Roberts, 2018). This study aims to investigate the effects of combination aerobic dance and PHAT on aerobic capacity (VO_2max), body mass index (BMI), and heart rate in physically active students.

2 METHODS

This research is a quasi experimental with one group pre-post test design. It employsobservation, tests and measurement as data collection procedures. Tests and measurement were carried out before and after the intervention to the research participants in order to find out the relationship between the research variables. The variable of this study consists of aerobic dance and fitness program (PHAT) as the independent variables and VO_2max, BMI, and heart rate served as dependent variables. The results of the study are presented quantitatively.

The subjects of the study were eleven college students from the Sports Science study program who were enrolled in the sixth semester (third year of college). Several inclusion criteria to determine the research subject were determined Theyare (1) willing to participate in all stages of the study, (2) having fit condition and (3) not being injured, and (4) performing active sports activities (minimum 2x / week for the last 2 months).

2.1 Assesment of Body Mass Index (BMI)

Body mass index (BMI) is a measure of body fat based on people's height and weight that applies to adult men and women. Calculating Body Mass Index is a simple calculation using a formula BMI = kg/m^2 , where kg is weight in kilograms and m^2 is height in metres squared.

Table 1: Body mass index chart.

BODY MASS INDEX (BMI)	
CLASSIFICATION	BMI SCORE (kg/m2)
Underweight	< 18.5
Normal	18.5 - 24.9
Overweight	25.0 - 29.0
Obese	30.0 - 40.0
Extreme Obese	> 40.0

2.2 Aerobic Capacity Measurement (VO_2max)

The subject's aerobic capacity can be determined by measuring the prediction of VO_2max, for which the multi-stage fitness test (MFT) is used to measure it.

The multi-stage fitness tests, also known as PACER (Progressive Aerobic Cardiovascular Endurance Run) or the PACERtest , the 20 m Shuttle Run Test (20 m SRT), or the beep test, are running tests used to estimate an athlete's aerobic capacity (VO_2max).

In the test, subjects must run from one line to another before the timer beeps. Subjects must continue running back and forth, reaching the line before the next beep. Once one can no longer run, the test finishes and the number of laps is recorded. As the test continues, the period between beeps gets shorter. VO_2max prediction was obtained from MFT shuttling level and then was converted using normative data table which values were presented in ml/kg/min (Heywood, 2006).

2.3 Heart Rate Measurement

Measuring heart rate is an easy way to identify one's health condition, as it provides a real-time snapshot of heart muscle function. For most adults, a normal resting heart rate—the number of heartbeats per minute while at rest—ranges from 60 to 100 beats per minute. A normal heart rate can vary from person to person. However, a high or low resting heart rate can be a sign of trouble (Julie Corlis, 2016). A normal heart rate for adults is typically 60 to 100 beats per minute. A heart rate that is slower than 60 beats per minute is considered bradycardia ("slow heart") and a rate that is faster than 100 beats per minutes is termed tachycardia ("fast heart").

There are some experts who believe that an ideal resting heart rate is closer to 50 to 70 beats per minute. To check the pulse, one can use their fingers to feel the pulse, either at the wrist or the side of the neck. To check the pulse at the wrist (radial pulse), people should lightly press the index and middle

fingers of one hand on the opposite wrist, just below the base of the thumb. Meanwhile, to check the pulse at the neck (carotid pulse), they should lightly press the side of the neck, just below the jawbone. They can count the number of beats in one minute.

2.4 Exercise Protocol

After agreeing to the informed consent, the research subjects were measured in terms of prediction of VO_2max (MFT), heart rate assesment, weight and height (BMI). These data were used as pre-intervention data. Then, they followed a specific exercise program consisting of once a week aerobic dance, and twice a week PHAT for total 18 training session. After 6 weeks of intervention, they were again measured on the same variables.

2.5 Statistical Analysis

The data were analyzed for normality and homogenity (Kolmogorov Smirnov and Levene test), to analyze the behaviour of each variable. The statistical significance level was set at $p<0,05$ for all variables. Pre- and post-training values for all variables were analyzed using a two-tailed student's T-test. All values are presented as mean ± *SE*.

3 RESULTS

The research subjects, consisting of 8 male students (72.23%) and 3 female students (27.27%). Male respondents had an average age of 20,625, while female respondents had an average age of 20.67. The youngest male and female students were both 20 years old. The oldest male respondent was 22 years old, while the oldest female respondent was 21 years old. After conducting the pre-test, it shows that the research population is normally distributed and the variance of research subject is homogeneous. The data were analysed to answer the research question using a paired t-test. The results of processing research data are described as follows.

3.1 Body Mass Index (BMI)

Based on the results of participants' weight and height for BMI meassurement, it can be described in the table 2.

BMI status of the subjects at pre and post-intervention was classified as the normal category with mean 21.71 and 21.41.

Table 2: BMI statistic description.

Statistic	Pre-test	Post-test
Mean	21,7062955	21,4161236
Std. Deviation	1,29811476	1,37059303
Minimum	20,06822	19,35404
Maximum	24,01242	23,81424

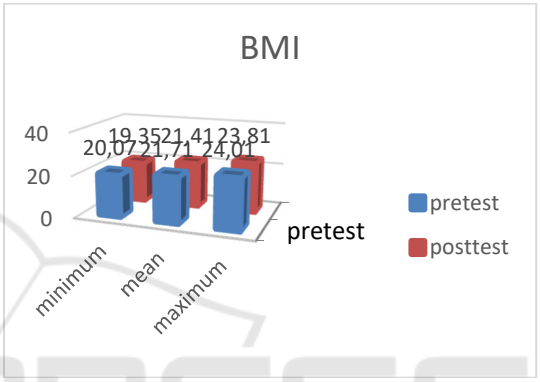

Figure 1: Pre-post BMI comparison.

Table 3: T-test for BMI.

Variable	T-test for equality of Means			
	T-value	T-table	Sig. (2tailed)	Mean Difference
BMI	4,320	2,228	0,002	0,29

From the t-test, it can be seen that t count is 4.320> 2.282 (t-table) and the value of the probability significance is 0.002<0.05, meaning that there is a significant influence on the training given to BMI. The Difference mean was 0.29, indicating that the training given decreased 1.35% of BMI index.

3.2 Aerobic Capacity (VO_2max)

From the results of MFT data analysis, it can be described in the table as follows:

Table 4: VO_2max statistical description.

Statistics	*Pretest*	*Posttest*
Mean	40,4455	41,4091
Standard Deviation	4,55749	4,76790
Minimum	33,60	33,60
Maximum	48,00	50,20

The test result can be presented in the following categorization:

Table 5: VO_2 max pre-test categorization.

No	Interval	Frequency	Percentage
1	Excellent	0	0,00
2	Good	2	18,18
3	Fair	3	27,27
4	Poor	6	54,55
5	Very poor	0	0,00
	Total	11	100

From the table above, it is clear that the participants' level of VO_2max in the pre-test was poor, considering the highest frequency 54.55%.

The following table, in addition, demonstrates the participants' level of VO_2max in the post-test. It shows poor results, considering that the highest frequency is in still the poor category at 45.45%.

Table 6: VO_2max Post-test categorization.

No	Interval	Frequency	Persentage
1	Excelent	0	0,00
2	Good	2	18,18
3	Fair	4	36,36
4	Poor	5	45,45
5	Very poor	0	0,00
	Total	11	100

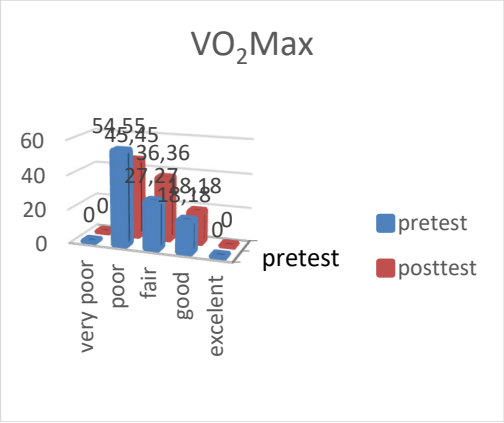

Figure 2: Pre-post VO_2Max comparison.

Table 7: T-test for VO_2max.

Variable	t-test for equality of Means			
	T-value	T-table	Sig. (2-tailed)	Mean Difference
VO_2max	0,937	2,228	0,371	0,96

From the results of the t-test, it can be seen that t-count is 0.937<2.282 (t-table) and the value of the probability significance is 0.371>0.05. It is implied that there is no significant effect of the exercise given on VO_2max. Viewed from the Mean Difference number of 0.96, it indicates that the given training is able to improve VO_2max achievement as much as 2.32%.

3.3 Normal Heart Rate

Table 8: T-test for Normal heart rate.

Variable	T-test for equality of Means			
	T-value	T-table	Sig. (2-tailed)	Mean Difference
Normal heart rate	3,710	2,228	0,004	9,18

The table shows t-count is 3.710> 2.282 (t-table) and the value of probability significance is 0.004 <0.05. It implies that there is a significant effect of the intervention given on increasing the normal heart rate. The Difference mean was 9.18, indicating that the exercise given increased the normal heart rate by 10.14%.

3.4 Training Heart Rate (MFT Heart Rate)

Training heart rate was measured immediately after the subjects could not followed the rhytm, and thus cannot continue the MFT.

Table 9: T-test for training heart rate.

Variable	T-test for equality of Means			
	T-value	T-table	Sig. (2-tailed)	Mean Difference
Training heart rate	9,552	2,228	0,000	26,27

The table shows t-count 9.552> 2.282 (t-table) and the value of probability significance 0.000 <0.05, meaning that there is a significant influence on the exercise given to the MFT pulse. Based on

the Mean Difference 26.27, it shows that the exercise increases the MFT heart rate by 15.23%.

3.5 5 Minute Recovery Heart Rate

Table 10: T-test for 5 Minute recovery heart rate.

Variable	T-test for equality of Means			
	T-value	T-table	Sig. (2tailed)	Mean Difference
Heart rate 5'Rc	3,214	2,228	0,009	19,09

From the table, it can be seen that t count is 3.214> 2.228 (t-table) and the value of probability significance is 0.009 <0.05. It implies that there is a significant effect of exercise given to the 5 minutes after recovery heart rate. Based on the Mean Difference 19.09, it shows that the exercise given increases the 5-minute pulse by 13.49%.

3.6 10 Minute Recovery Heart Rate

Table 11: 10 Minute recovery heart rate.

Variable	T-test for equality of Means			
	T-value	T-table	Sig. (2-tailed)	Mean Difference
Heart rate 10Rc	2,289	2,228	0,045	11

Based on the results of the t-test, it can be seen that t-count is 2.289>2.228 (t-table) and the value of probability significance is 0.045<0.05. It implies that there is a significant effect of exercise given on the 10-minute after recovery heart rate. Based on the Mean Difference 11, it shows that the given exercise with 10-minute recovery time increasesthe heart rate by 9.00%. The results of an increased pulse in this exercise process can be clarified through the following picture:

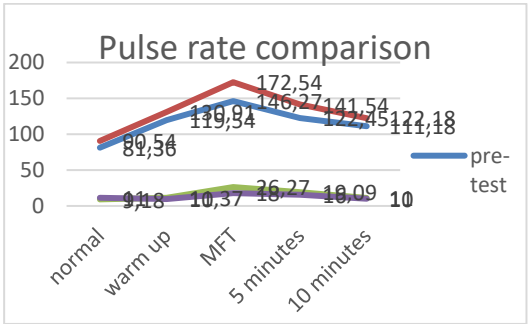

Figure 3: Pre-post heart rate comparison.

Observing the pattern of changes from normal to recovery heart rate, the hear ratehave the same pattern. The state of the pre-test and post-test pulse from normal to MFT training will increase and decrease from MFT to a 10-minute recovery time. It also shows that the highest difference occurs in MFT exercises which has a difference in the heart rate of 26.27. This demontrates that people will experience an increase at the peak point when they perform the main activity or the most severe physical activity, undergoing a decrease at rest. The pattern of heart rate increase in the pre-test was greater than that in the post-test and the heart rate decrease in the post-test was greater or faster in that in the pre-test. This shows that someone who has been trained will be faster to reach the peak or training zone and will be easier to control the pulse after doing high activity or entering a break.

4 DISCUSSION

It is a necessary for sport college students to have good nutritional status in order to support their physical performance. Anthropometric parameters are the basis for evaluating nutritional status. One simple anthropometric index that is often used to monitor a person's nutritional status is the Body Mass Index (BMI) which is calculated based on body weight (kg) divided by the square of the height (m). Ideally sport college students have a proportional body composition between muscle mass and body fat. Therefore, aerobic exercise is usually more recommended. During aerobic exercise, the body is working at a level that demands oxygen and fuel and these were provided by the body's intake. The only waste products are carbon dioxide and water which are removed by sweating and breathing. Aerobic endurance training or aerobic dance can be sub-divided as follows:

a. Short aerobic - 2 up to 8 minutes (lactic / aerobic)
b. Medium aerobic - 8 up to 30 minutes (mainly aerobic)
c. Long aerobic - 30 minutes or more (aerobic)

The data show that before and after the intervention, the entire research subject seemed to show ideal body proportion as seen from the BMI value showingthe normal zone. It shows that input selection process for students is physically good, and as knowledge increases, it is positively correlated with students' awareness to enjoy an active lifestyle so that they can maintain body condition.

The physical capacity of a person who is often judged based on VO_2max has a very important role to support a person's performance and productivity, especially for the sports science faculty students who will naturally always be associated with physical activity. The research data showed an increase in MFT achievement, which was suspected due to a better heart pulmonary system and anincreased muscle endurance. This means that the combination of aerobic and PHAT exercise can provide a positive influence on the achievement of VO_2max. In line with Alessandropiras' research, et al (2015) which states that the effects of resistance training throughout the PHA body can increase muscle strength and oxygen consumption.

PHAT was a resistance exercise to promote cardiovascular adaptations, with a decrease in the power spectral component of vascular sympathetic activity and an increase in the vagal modulation. Low-frequency oscillation estimated from systolic blood pressure variability seems to be a suitable index of the sympathetic modulation of vasomotor activity. The beneficial effects of this particular training is inversely associated with mortality causes and the prevalence of metabolic syndrome, independent from cardiorespiratory fitness levels (Piras, A., et al, 2015).

Resistance exercises using the PHA approach can be considered as a low-risk treatment for people with high blood pressure in order to improve blood pressure, increase muscular strength, and enhance overall fitness. (Nabilpour, M., & Mayhew, J., 2018). Gajda stated the benefits of PHA training: “first, the PHA system of training allows for a greater work load. Second, it gives one recuperative buffer in case of an injury, due to the implementation of the secondary heart action. Third, it builds stamina due to the continuous blood circulation. Fourth, it alleviates boredom by proving itself good for weightlifting and the total physical fitness.

Participation in 6 weeks of aerobic dance and PHAT training programe can also reduce body image dissatisfaction (Attractiveness, Feeling Fat, Salience and Strength and Fitness) and enhanced physical self-perceptions (Body Attractiveness and Physical Self-Worth) (Burgess, G., Grogan, S., & Burwitz, L., 2006). Combination of aerobic exercise and the PHAT exercise program influence the research participants’ BMI. This is because the two combinations of exercises can have a holistic impact, which does not only focus on the aerobic capacity, but also on weight training that promotes increased anaerobic capacity such as power, muscle strength, and muscle mass.

Endurance training decreases resting and submaximal heart rate, while maximum heart rate may decrease slightly or remain unchanged after training. The effect of endurance training on heart rate variability remains inconclusive. This may be due to the use of inconsistent analysis methodologies and different training programes that make it difficult to compare the results of various studies and thus reach a consensus on the specific training effects on heart rate variability.

Heart rate recovery after exercise involves a coordinated interaction of parasympathetic re-activation and sympathetic withdrawal. It has been shown that a delayed heart rate recovery is a strong predictor of mortality. Conversely, endurance-trained athletes have an accelerated heart rate recovery after exercise. Since the autonomic nervous system is interlinked with many other physiological systems, the responsiveness of the autonomic nervous system in maintaining homeostasis may provide useful information about the functional adaptations of the body. This review investigates the potential of using heart rate recovery as a measure of training-induced disturbances in autonomic control, which may provide useful information for training prescription (Borresen, J., & Lambert, M. I., 2008).

In contrast to the positive influence on BMI and increased aerobic capacity, the combination of aerobic and PHAT exercises actually bear the opposite effect on the subject's pulse. Data showed a massive increase in the pre-and post-test heart rates, which comprise the normal pulse, warm-up pulse, exercise pulse, and recovery pulse (5 and 10 minutes). Age and fitness level have a big impact on resting heart rate. A reduction in heart rate for a given intensity is usually due to an improvement in fitness but a number of other factors might explain why heart rates can vary for a given intensity:

a. Dehydration can increase the heart rate by up to 7.5%
b. Heat and humidity can increase the heart rate by 10 beats/minute
c. Altitude can increase the heart rate by 10 to 20%, even when acclimatized
d. Biological variation can mean the heart rate varies from day to day by 2 to 4 beats/minute
e. body position, such as lying, sitting, or standing
f. Emotional state and certain medications.

Changes in body proportion (BMI) and aerobic capacity (VO_2max) are two things that are adaptative. It means that they don't change instantly. Unlike the pulse of a person who is more sensitive

and easily intervened so that the fluctuations also respond more quickly, adjusting one's internal and external conditions.

5 CONCLUSIONS

Aerobic endurance develops using continuous and interval trainingwhich is aimed at improving maximum oxygen uptake (VO_2max) andthe heart as a muscular pump. Therefore, the combination between two training models could improve one's physical capacity. Meanwhile, an increased heart rate (normal, training, 5' and 10' recovery) among participants is caused by dehydration.

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