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Reseacrh

The Effects of Skipping Rope Exercise, Brisk Walking Exercise, and Weight Training on Cardiorespiratory Endurance in Physiotherapy Students

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ABSTRACT

Background: There is a mutually influencing relationship between physical activity and fitness level, especially the cardiorespiratory endurance component. Types of exercise that can increase cardiovascular endurance are skipping rope, fast walking, and weight lifting. Thoses exercises are simple and easy to do. This study aimed to determine whether or not there was a difference in influence and which one was the most influential between skipping rope, fast walking, and weight training on the cardiorespiratory endurance of physiotherapy students.
Subjects and Method: This was a randomized control trial study, conducted at the Department of Physiotherapy, School of Health Polytechnics, Ministry of Health, Surakarta, from July to August 2020. A total of 36 students was selected by random sampling, and allocated into 4 groups consisted of 9 students: (1) Skipping rope exercise group; (2) Fast walking group; (3) Weight training group; and (4) Control group. The dependent variable was cardiorespiratory endurance. The independent variable was skipping rope, fast walking, and weight training. Cardiorespiratory endurance was measured by the Cooper method to measure VO2 max. Data were analyzed using paired t test, Wilcoxon, and One Way ANOVA.
Results: After intervention, cardiorespiratory endurance was increased in all intervention groups. There was no statistically significant different effects on cardiorespiratory endurance between skipping rope group (Mean= 1.48; SD= 0.42), fast walking group (Mean= 1.42; SD= 0.30), weight training group (Mean= 1.38; SD= 0.22), and control group (Mean= 1.17; SD= 0.28) with p value of 0.218.
Conclusion: Skipping rope and weight training significantly increase cardiorespiratory endurance. There is no difference in the effect of skipping rope, fast walking, and weight training on cardiorespiratory endurance.

Keywords: skipping rope, fast walking, weight training, cardiorespiratory endurance, cooper test, VO2max

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BACKGROUND

Maintaining health can be done by doing physical activity. WHO recommends doing physical activity or exercise in 1 week to accumulate at least 150 minutes (ACSM, 2018). If calculated per day, the minimum physical activity carried out is only about 20 minutes, but this relatively short time is

not enough to encourage someone to do exercise regularly. This can be caused by a shift in habits due to the use of gadgets that offer many conveniences through technology so that it makes someone lazy to exercise. In fact, physical activity is correlated with fitness. The more often a person does physical activity, the better the fitness will be (Power and Howley, 2015).

Decrease in physical activity occurs in all circles of society, including adolescents. Based on data from the Ministry of Health, the level of physical activity at the age of adolescents is in the less category, which is 49.6% at the age of 15-19 years and by 33.2% at the age of 20-24 years (Ministry of Health of the Republic of Indonesia, 2018). This shows that the level of physical activity in adolescents, including students, needs to be increased.

Research that has been conducted to identify the fitness of physiotherapy students at the Health Polytechnic of Surakarta shows that the fitness of physiotherapy students is in the sufficient category, with a fitness index of 3.125 (Handari and Kusumaningtyas, 2021), so efforts are needed to improve the fitness of physiotherapy students at the Health Polytechnic of Surakarta.

Fitness to support health has several components, namely cardiorespiratory endurance, muscle strength, muscle endurance, flexibility and body composition (ACSM, 2018). Cardiorespiratory endurance can be used as a reference to measure a person's level of fitness, therefore it is important to do exercises that can increase cardiorespiratory endurance.

Some exercises that can be done to increase cardiorespiratory endurance include skipping rope, brisk walking and weight lifting. These exercises are often encountered everyday and are classified as exercises that are quite simple, easy to implement and do not require a long time especially for students to do. Skipping rope exercises, brisk walking and lifting weights will stimulate overall muscle work, so that it will stimulate an increase in the work of organs and organ systems, one of which is the heart to supply the oxygen and nutrients needed to muscles and other organs, so that cardiorespiratory endurance will increase (Power and Howley, 2015).

Based on the above background, the objectives of this study were: (1) to determine the effect of the skipping exercise on the cardiorespiratory endurance of physiotherapy students, (2) to determine the effect of brisk walking exercise on the cardiorespiratory endurance of physiotherapy students, (3) to determine the effect of weight training on the cardiorespiratory endurance of physiotherapy students, (4) to determine whether or not there is an effect between skipping rope, brisk walking, and weight training on the cardiorespiratory endurance of physiotherapy students, and (5) to find out which skipping rope exercise is more influential, brisk walking, and weight training on cardiorespiratory endurance of physiotherapy students

SUBJECTS AND METHOD

1. Study Design

The design of this study was a randomized control trial, the sample was divided into 4 groups by means of each subject taking a lottery paper. If the subject gets the words "1" means entering group I with the treatment of giving skipping rope exercises, the subject getting the words "2" means entering group II with the treatment of giving fast walking exercises, and the subject getting the words "3" means entering group III with the treatment of giving weight training, and the subject getting the words "4" means entering group IV to be the control group. This research was

conducted in July – August 2020 at the Department of Physiotherapy, Health Polytechnic of the Ministry of Health, Surakarta, Central Java.

2. Sample

The sampling technique used was simple random sampling on students of the Surakarta Health Polytechnic Department of Physiotherapy. The subjects of this study were 36 people who met the inclusion and exclusion criteria that had been set. Inclusion criteria included: (1) students of the Physiotherapy Department of the Health Polytechnic of the Ministry of Health Surakarta semester I - VI, (2) had no history of serious illness or disease that could recur due to fatigue/stress, (3) willing to participate in the research program. Exclusion criteria: (1) the student suffered an injury so that he stopped the research program, (2) the research subject could not participate in the research program due to illness.

3. Study Variables

The dependent variable in this study was cardiorespiratory endurance, while the independent variables in this study were skipping rope, brisk walking, and weight training.

4. Operational Definition of Variables

Cardiorespiratory endurance is the ability of the heart and lungs to work optimally during physical activity without being accompanied by fatigue as measured by the Cooper method (12 minutes running). Skipping rope exercise is a jumping exercise using a rope that is held in both hands and the rope is swung up to the top of the head with a training dose of 3 minutes, 2 sets, 1 minute rest. Brisk walking is a walking exercise with a slight leaning technique, swinging your arms and stepping your feet at a faster speed than normal walking but not running, continuous contact between your feet and the ground with an exercise dose of 4 minutes, 3 sets, 1 minute rest. Weight training is lifting weights on the biceps, hamstrings, quadriceps gastroc and abdominal muscles with a dose of 2x a week, 50-70% of 1 RM, 10 repetitions, 3 sets.

5. Study Instruments

The measuring instrument used to measure endurance in this study is the Cooper method for measuring VO2 max. Cooper's method is done by running the subject for 12 minutes. The level of validity of the Cooper method is 0.962 and the reliability is 0.9886, meaning that the Cooper test has good validity and reliability to measure VO2 max. The instruments used are a flat running track, stopwatch, whistle, writing instrument and a list of run results conversion tables.

6. Data analysis

Data were analyzed using SPSS version 22 program. Characteristics of research subjects were analyzed based on age and gender. Statistical tests used: (1) Normality test using Shapiro Wilk test (sample <50), (2) Data homogeneity test using Levene test, (3) Hypothesis testing in the skipping rope group, weight training and control group using paired t test , while in the fast walking group using Wilcoxon, (4) The test to determine the difference in the effect between the skipping rope group and weight training using one way ANOVA.

7. Research Ethics

This research has obtained an ethical approval from the Health Research Ethics Committee of Dr. Hospital. Moewardi Surakarta number: 727/VI/HREC/2020.

RESULTS

1. Univariate Analysis

The description of the univariate analysis described the general characteristics of the sample data for each variable including

data on age and gender. Univariate analysis can be seen in Tables 1 and 2.

Table 1. Sample characteristics of categorical data

Characteristics	Category	Group I		Group II		Group III		Group IV	
		N	%	N	%	N	%	N	%
Gender	Male	1	11.1	1	11.1	1	11.1	1	11.1
	Female	8	89.9	8	89.9	8	89.9	8	89.9

Table 2. Sample characteristics of categorical data

	N	Mean	SD	Min.	Max.
Group I	9	18.89	0.33	18.00	19.00
Group II	9	19.00	0.00	19.00	19.00
Group III	9	19.22	0.44	19.00	20.00
Group IV	9	19.11	0.33	19.00	20.00

The normality test of the data was carried out using Shapiro Wilk. The data is declared normal if the p value >0.05, then the data that is normally distributed is carried out by parametric analysis, while the data that is not normally distributed is carried out by non-parametric analysis.

Table 3. Data Normality

	Group I		Group II		Group III		Group IV	
Pre intervention	0.974	Normal	0.227	Normal	0.112	Normal	0.238	Normal
Post intervention	0.825	Normal	0.019	Not normal	0.095	Normal	0.481	Normal

Homogeneity test using Levene test to determine the homogeneity of the data before treatment. The results of the homogeneity test in this study showed a p value >0.05, so the data distribution was homogeneous, meaning that all data departed from the same conditions.

Table 4. The Effect of Skipping Rope Exercise, Fast Walking and Weight Training on Cardiorespiratory Endurance

Intervention	Mean	SD	p
Group I			
Pre intervention	1.32	0.41	0.008
Post intervention	1.48	0.42	
Group II			
Pre intervention	1.37	0.41	0.858
Post intervention	1.42	0.30	
Group III			
Pre intervention	1.26	0.20	0.043
Post intervention	1.38	0.22	
Group IV			
Pre intervention	1.23	0.26	0.462
Post intervention	1.17	0.28	

2. Bivariate Analysis

Bivariate analysis was used to analyze the mean pre test – post test values for each group and the post test – post test scores between groups. The results of the bivariate analysis were as follows: (1) in group I, the value of p=0.008 (p<0.05), which means that skipping rope exercise had an effect on increasing cardiorespiratory endurance, (2) in group II, the value of p=0.858, which means that brisk walking does not increase cardiorespiratory endurance, (3) In group III, the value of p= 0.043 means that weight training increases cardiorespiratory endurance, and (4) in group IV it is obtained p= 0.462, which means that there is no significant difference in cardiorespiratory endurance in the control group in the pre-test and post-test. Bivariate analysis is shown in Table 4 and Table 5.

Of the four groups, only groups I and III experienced an increase in cardiorespiratory endurance. The results of the statistical test of post-test scores for groups I and III showed p value = 0.489 (p>0.05), which means that there is no difference in the effect of skipping rope exercise with exercise on cardiorespiratory endurance.

Table 6. Differences in the Effects of Skipping Rope, Fast Walking and Weight Training on Cardiorespiratory Endurance

Group	Mean	SD	p
Group I	1.48	0.42	0.218
Group II	1.42	0.30	
Group III	1.38	0.22	
Group IV	1.17	0.28	

DISCUSSION

Based on the results of this study, it was found that skipping rope and lifting weights increased cardiorespiratory endurance. Skipping rope exercise for 6 days with a dose of 2 minutes, 5 sets and 1 minute rest between sets. The skipping rope movement consists of skipping and landing phases on two feet, accompanied by the movement of the hands turning the rope when going to jump, causing contraction of almost all body muscles, increasing the supply of oxygen demand for the contracting muscles (Lee, 2018). The respiratory system will increase work to take in more oxygen, which is followed by an increase in the work of the cardiovascular system, the heart works hard to pump blood and circulate oxygen to the contracting muscles, so that oxygen needs are fulfilled. The increase in oxygen supply causes cardiorespiratory endurance to increase (Plowman and Smith, 2011). Other similar studies also show skipping rope can improve physical fitness and cardiovascular endurance. Skipping rope is a plyometric exercise that can increase power, speed of movement and strength and stimulates the stretching reflex of the muscle spindle (Veena Kirthika et al., 2019)

In this study, the subjects used were physiotherapy students from the Health Polytechnic of Surakarta who did not carry out routine exercise activities, so that when they first started skipping rope with a predetermined dose, adaptation had not occurred in the body. This causes the muscles, respiratory and cardiovascular systems to get pressure or stressors. The longer it takes, the muscles, respiratory and cardiovascular systems will adapt, so that at the end of the exercise there will be an increase in cardiorespiratory endurance.

The brisk walking exercise performed 6 times with a dose of 4 minutes, 3 sets and 1 minute rest per set did not increase cardiorespiratory endurance. The brisk walking movement is basically the same as normal walking, except that there is an increase in walking speed, but not running. Although the walking speed increases compared to normal walking, the work of the muscles does not increase significantly, so that the oxygen demand to the muscles is not maximal and so does the work of the cardio respiration and heart systems (Plowman and Smith, 2011). The increase in oxygen demand tends to be constant between the beginning of the exercise until the end of the exercise, meaning that there is no significant adaptation from the first exercise to the end of the exercise. This shows that when the exercise was carried out for 6 times, brisk walking exercise showed no difference between before and after exercise.

In another study comparing jogging with brisk walking, it was shown that both exercises can improve fitness, but jogging is better at increasing cardiorespiratory endurance (Mahalingam and Rajkumar, 2014).

Weightlifting exercises are performed on 3 muscles, namely the biceps, hamstrings and abdominal muscles. In the bicep and hamstring muscles, different doses were used for each subject according to the measurement results of 1 RM, but the load used was 70% of 1 RM. The results of the 1 RM measurement ranged from 3kg, 4kg and 5kg loads. The dose of weight lifting differs in the number of sets, but each set is equally repeated 10 times. For a 3 kg load consisting of 1 set, a 4 kg load consisting of 2 sets and a 5 kg load consisting of 3 sets. In the abdominal muscles, sit ups are performed with a dose of 1 set of 10 repetitions (ACSM, 2010). Weight training performed on these 3 muscle groups can increase oxygen demand significantly from the beginning of the exercise to the end of the exercise, so that the cardiorespiratory system and heart work harder to circulate oxygen to the muscles in need (Plowman and Smith, 2011).

Based on the three interventions given, it shows that skipping rope and lifting weights have an effect on cardiorespiratory endurance. After doing a different test between the 3 interventions, it was found that there was no difference, this means that there is no difference between skipping rope, brisk walking, and lifting weights in increasing cardiorespiratory endurance.

Skipping rope exercises and lifting weights both cause an increase in muscle contraction, so that the work of the respiratory system to increase oxygen intake and the cardiovascular system to circulate oxygen to the muscles will increase. In addition, both of them cause an adaptive response from the beginning of the exercise to the end of the exercise, so that an increase in cardiovascular endurance is obtained (Plowman and Smith, 2011).

Brisk walking exercises also cause contractions in the whole body, but if the speed is too low, it will not produce an increase in cardiorespiratory endurance, because the muscle work is not optimal. The speed that must be generated on a brisk walk is the boundary between being faster than normal walking but not running. The results of this study are not in line with previous research on the effect of brisk walking and jogging on middle age man fitness which showed that jogging was better than brisk walking. (Mahalingam and Rajkumar, 2014).

AUTHOR CONSTRIBUTIONS

Mei Kusumaningtyas and Herdianty Kusuma Handari formulated study methods, collected data, analyzed data, and wrote the manuscript.

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CONFLICT OF INTEREST

There are no conflicts of interest.

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