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Efforts to Increase Physical and Social Immunity in Adolescents: A Study of Cardiorespiratory Endurance in Adolescents through Jumping Rope and Deep Walking Activities

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Abstract

Adolescents today experience a decline in fitness, even though fitness is related to health. To improve fitness, there are many choices of sports or simple exercises that can be done, including jumping rope and brisk walking. These two exercises will be compared to find out which exercise is better in increasing cardiorespiratory endurance in adolescents. This study was an experimental study with a randomized control trial design on a total of 51 subjects divided into three groups, namely the jumping rope group (15 subjects), the brisk walking group (17 subjects) and the control group (19 subjects). The jump rope exercise was performed for 15 minutes, twice a day, while the brisk walking exercise was performed for 30 minutes. Both were carried out for 12 times, while the control group was not given any treatment. The results of the statistical analysis of the pre-test and post-test using Wilcoxon showed a value of p=0.050 in the jumping rope group, p=0.001 in the brisk walking group, and p=0.080 in the control group, while the post-test using Mann Whitney between the jumping rope and brisk walking shows the value of p=0.766. Jump rope and brisk walking can both increase cardiorespiratory endurance, but neither is better.

Keywords
jumping rope; brisk walking; fitness; adolescent

I. Introduction

Fitness is needed to support health. A person is said to be healthy if he has good fitness. Fitness can be defined as how well a person performs physical activities so that health is obtained and avoids disease (Plowman & Smith, 2011). Health-related fitness is supported by components of cardiovascular endurance, abdominal muscle strength and endurance, body composition, and lower back and hamstring flexibility (Victor L; Katch et al., 2011). On the other hand, fitness is also defined as a person's ability to carry out physical activities without being accompanied by severe fatigue (Kementerian Kesehatan, 2015). Thus someone who is fit means being able to do physical activity so that health is maintained.

A person is said to be doing enough activity if in 1 week he accumulates moderate-intensity aerobic activity for at least 150 minutes, or heavy intensity for 75 minutes (ACSM, 2018). If it is calculated per day, then the activity carried out is only about 20 minutes at a moderate intensity, but the relatively short time is not enough to encourage someone to do regular exercise. This is partly due to a shift in habits to a sedentary lifestyle, namely the habit of sitting or sleeping lazily which results in minimal energy expenditure (ACSM, 2018). In a long time this lifestyle will have an impact on a person's fitness level, especially adolescent.

Data shows that 31.1% of adults are physically inactive worldwide (Hallal et al., 2012). Data in Indonesai showed that the proportion of physical activity at the age of 15-19 years of 50.4% is in the sufficient category and 49.6% is in the less category, while the proportion of physical activity at the age of 20-24 years is 66.8% in the sufficient category and 33.2% fall into the less category. This proportion of physical activity has decreased compared to 2013 (Kementerian Kesehatan RI, 2018). Many factors influence this, including external factors in the form of food consumption and activities.

To encourage adults to regularly do sports or exercise, one of the efforts that can be done is to choose simple exercises, the implementation is easy and can be done by many people, but can have an impact on fitness. These simple exercises include jump rope and brisk walking. Jump rope exercises and brisk walking 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 lungs to supply oxygen and the heart to circulate the oxygen and nutrients needed to the muscles and other organs. Rope jump is an exercise using a rope in which both ends of the rope are held in both hands and then swing over the head with a movement of both legs jump together as high as 0.5-1 inch (Lee, 2018), while brisk walking is an exercise with principles as normal walking, but increased walking speed but not running. The brisk walking technique is to lean forward accompanied by arm swings which aims to balance body movements, so that walking speed is obtained (Hoga-Miura et al., 2016).

The results of research on fitness in physiotherapy students at Poltekkes Kemenkes Surakarta show that the fitness level of these adolescents is in the sufficient category (Handari & Kusumaningtyas, 2021). However, the COVID-19 pandemic brings significant disruption to daily routines which causes changes in activity, such as online lectures which tend to be too long in front of a laptop, and significant longer sleep duration (Zheng et al., 2020). These changes will certainly have an impact on fitness. Thus, efforts are needed to improve fitness in adolescents so that fitness can become better and health status increases, so this study aims to determine the difference in the effect of jumping rope exercise with brisk walking on fitness in adolescents.

II. Research Method

This study is a randomized control trial with three groups. Randomization of research subjects was carried out by taking lottery paper containing numbers 1, 2, and 3. Subjects who received number 1 in the lottery entered the jumping rope group, subjects who received number 2 in the lottery group entered the brisk walking group, and subjects who received number draw 3 entered into the control group

This research was conducted in October 2021 around the Physiotherapy department, Tohudan, Colomadu, Karanganyar with a student population majoring in physiotherapy at the Poltekkes Kemenkes Surakarta. The sampling technique was purposive sampling, which was determined at the beginning using physiotherapy semester 1 students as many as 75 students who met the inclusion and exclusion criteria. The inclusion criteria included did not have a disease that could recur due to fatigue or stress and was willing to participate in the research program, the exclusion criteria included regularly doing sports and, drop out criteria included did not complete the exercise program, could not continue the research because of illness

The variables of this study were jump rope and brisk walking as independent variables and cardiorespiratory endurance as the dependent variable. The measuring instrument used in this study was the Cooper test (r=0.93), namely running for 12 minutes to measure cardiorespiratory endurance (VO2 max) (Bandyopadhyay, 2014). After running

for 12 minutes, the distance traveled by the subject is calculated and then converted to find out the value of VO2 max.

Before the exercise, each subject did the Cooper test, then each group did a jump rope exercise for 4 weeks with a dose of exercise 3x/week, frequency 2x/day, each for 15 minutes. Brisk walking exercise is done with a dose of 3x/week, the frequency is 1x/day for 30 minutes. The control group was not given any treatment, only pre and post tests were measured.

III. Result and Discussion

After conducting research for 12 treatments on 64 subjects, namely 22 subjects in the jumping rope group, 22 subjects in the brisk walking group and 21 subjects in the control group, the subjects who dropped out were 7 subjects in the rope jump group, 4 subjects in the brisk walking group and 2 subjects in the control group, so the number of subjects who completed the study was 51 with details of 15 subjects in the jumping rope group, 17 subjects in the brisk walking group, and 19 subjects in the control group.

Characteristics of research subjects based on gender, age, body mass index, pre and post VO2max in the three groups obtained the following data.

Table 1. Characteristics subject based on type gender, age, BMI, VO2 $_{max}$ pre and post in all three group

Characteristics subject		Rope jump group	Brisk walk group	Control group
Gender	Male	6	2	3
	Female	15	15	16
Age	Mean ± SD	18.20±0.414	18.18 ± 0.393	18.37 ± 0.761
BMI	Mean ± SD	20.73 ± 3.081	21.12±3.638	21.32 ±3.163
VO2 $_{max}$ pre		22.52±11,558	17,864 ± 13,334	17,663±12,164
VO2 $_{max}$ post		25,713±13,029	27. 711 ± 16.207	21.605 ± 12.534

Based on these data, it shows that on average there are more female in each group than male, the same average age and normal body mass index in all groups, higher VO2 max pre in the jump rope group and VO2 max. higher max post in the brisk walk group.

Furthermore, the data that has been obtained is carried out statistical analysis by performing normality tests, homogeneity tests and hypothesis testing. The normality test used Shapiro Wilk because the number of subjects was less than 50 and there were abnormal data ($p < 0.05$), so that each group carried out non-parametric analysis to test the hypothesis, while the homogeneity test by looking at the Levene test value obtained data distribution homogeneous ($p > 0.05$) (table 2).

Table 2. Test for normality and homogeneity

Pre-Test condition	Group	Pre/post test	p	Information	Hypothesis testing
Normality test	Jump rope	Pre test	0.046	Abnormal	Non parametric
		Post test	0.329*	Normal	
	Brisk	Pre test	0.001	Abnormal	Non parametric
		Post test	0.119*	Normal	

	Control	Pre test	0.003	Abnormal	Non parametric
		Post test	0.013	Abnormal	
Homogeneity test	Jump rope-walk quick-control	Pre-pre-pre	0.997	Homogeneous	-

The results of statistical tests (table 3) using Wilcoxon in each group showed that there was a different effect in the treatment group, both jumping rope and brisk walking ($p<0.05$), while in the control group there was no difference ($p>0.05$). Statistical test using Mann Whitney between groups showed no difference ($p>0.05$).

Table 3. Non- parametric statistical test results

Test	Group	p	Information
Pre-post test (Wilcoxon)	Jump rope	0.050	There's a difference
	Brisk	0.001	There's a difference
	Control	0.080	No difference
Test posts (Mann Whitney)	Jump rope-Fast walk	0.766	No difference

3.1 Discussion

This study aims to determine the difference between jump rope exercise and brisk walking in increasing cardiorespiratory endurance in adolescents by measuring VO_2 max, which is the amount of oxygen the body needs when doing maximum activity (Plowman, 2011).

Based on the results of this study, it was found that jump rope exercise had an effect on increasing VO_2 max in adolescents. This is because the movement of the body when jump rope occurs in the upper extremity to rotate the rope through and the lower extremity to jump. Each jump of muscle group coordination to produce precise and rhythmic movements. This coordination can develop the neuromuscular system, muscle strength, and cardiovascular endurance (Chen and Lin, 2011). Contractions that occur simultaneously in the upper and lower extremities require a greater intake of energy and oxygen, so that it will stimulate the lungs to supply more oxygen to flow to the muscles of the upper and lower extremities. Regular exercise causes changes in the body, including the cardiorespiratory system (Jafarnezhadgero et al., 2021) .

The results of this study are in line with research which states that jumping rope exercises can increase cardiovascular endurance in male students (Veena Kirthika et al., 2019). Another study that examined the effects of jumping rope exercises said that jumping rope can improve balance in children with mental disorders (Chao-Chen and Yi-Chun, 2012), jumping rope can increase strength and agility in adolescent girls (Singh & Rajan, 2015). Another research showed that jump rope exercise improve pulmonary function and reduce oxidative stress among medical students (Adhyaksa et al., 2020).

Brisk walking exercises also have an effect on increasing VO2 max. When doing brisk walking exercises there is an increase in speed compared to normal walking, the increase in speed is accompanied by the work of the dominant leg muscles, so that it has an impact on increasing the oxygen demand for the leg muscles. Basically brisk walking is an aerobic exercise, so the resulting physiological effect is an increase in cardiorespiratory

endurance through increased blood circulation, oxygen uptake and pulse rate (Jafarnezhadgero et al., 2021).

This study is in line with research on the effect of brisk walking and jogging on physical fitness in middle-aged men with the results that there is an increase in fitness after brisk walking and jogging after 12 workouts (Mahalingam & Rajkumar, 2014). In addition, brisk walking can also improve the fitness component, namely agility and flexibility in female students (Durai & Mary, 2019). Other studies have also shown that brisk walking not only improves cardiorespiratory endurance but also muscle strength and body composition in the elderly (Bai et al., 2022).

Although both jumping rope and brisk walking can increase VO2 max, they do not show a significant difference.

IV. Conclusion

The purpose of this study was to determine the difference in the effect of jumping rope exercise with brisk walking on adolescent cardiorespiratory endurance. The results of this study found that jumping rope and brisk walking can both improve adolescent cardiorespiratory endurance. Thus, adolescent can perform alternative simple exercises, both jumping rope and brisk walking to improve cardiorespiratory endurance.

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