



THE EFFECT OF CLIMBING UP AND DOWN STAIRS EXERCISE ON VO₂ MAX IN YOUNG ADULTS (AGE 18-22 YEARS)

Anafatun Ihtammaliya^{1*}, Yosef Purwoko², Buwono Puruhito², Yuswo Supatmo²

¹Undergraduate of Medical Student, Faculty of Medicine, Diponegoro University

²The Lecturer Science of Physiology, Faculty of Medicine, Diponegoro University
Jl. Prof. H. Soedarto, SH, Tembalang-Semarang 50275, Tel. (024) 76928010

*Corresponding author: Email : ihtammaliya@gmail.com

ABSTRACT

Background : One of the example of aerobic exercise that is easy and safe is climbing up and down stairs. But with time, people prefer using escalators or elevators to stairs. Whereas, climbing up and down stairs exercise can improve physical fitness which can be assessed from the VO₂ max. **Aim :** To find out the effect of climbing up and down stairs exercise on VO₂ max in young adults. **Method :** This research used Quasi Experimental with pre-test and post-test non-equivalent group method. The sample was medical students of Faculty of Medicine, Diponegoro University (n=36) age 18-22 years that meet the inclusion criteria. The sample was divided into 2 groups, control and treatment groups each consisting of 18 people. The VO₂ max was assessed using Multistage Fitness Test (Bleep Test). Statistical analysis with Saphiro-Wilk test, paired T test, Wilcoxon test, unpaired T test, and Mann Whitney test. **Result :** There was a significant difference of VO₂ max before and after climbing up and down stairs exercise in experimental group (p=0.001) and not significant in control group (p=0.181). There was a significant difference of the difference in VO₂ max pre-posttest in experimental group and control group (p = 0.001). **Conclusion :** Six weeks of climbing up and down stairs exercise increases VO₂ max in young adults.

Keywords : VO₂ Max, Climbing Up and Down stairs Exercise, Multistage Fitness Test (Bleep Test)

BACKGROUND

Physical activity is defined as any form of body movement that is produced by skeletal muscles and produces meaningful energy expenditure.¹ Physical activity can be increased through exercise. One of the goals of exercising is to improve physical fitness. Physical fitness is the ability of a person to do daily activities without experiencing significant fatigue, and still has spare energy remaining to do other activities.²

Exercise can be grouped into 2, anaerobic and aerobic exercise. Aerobic exercise is an exercise that involves large muscle groups and is carried out for a long period of time with low enough intensity so that fuel sources can be converted to ATP by using the citric acid cycle and oxidative phosphorylation as the main metabolic pathway.³

One example of aerobic exercise that is easy and safe to do is climbing up and down stairs.⁴ But with time, many



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people prefer using escalators or elevators rather than climbing stairs. Whereas, climbing up and down stairs as an aerobic exercise can improve physical fitness. A person's physical fitness can be assessed from the value of VO_2 max. VO_2 max is the maximum amount of oxygen in millilitres, which can be used in one minute per kilogram of body weight.⁵

Previous research reports that climbing up and down the Harvard bench for eight weeks can increase VO_2 max in soccer athletes.⁶ However, the study did not examine the effect of climbing up and down stairs exercise on the value of VO_2 max in young adults. Other study reports that aerobic exercise can increase VO_2 max in active smokers.⁷ However, this study was conducted on active smokers and did not examine the effect of climbing up and down stairs exercise on the value of VO_2 max. Thus, this study aims to find out the effect of climbing up and down stairs exercise on the value of VO_2 max in young adults (ages 18-22 years).

METHODS

This study used a Quasi Experimental design with pre-test and post-test unequal group method. The study was conducted on 34 male students

of the Faculty of Medicine, Diponegoro University which were divided into two groups: control and treatment with 17 people each per group. Subjects were selected based on inclusion and exclusion criteria.

The treatment group received climbing up and down stairs exercise for 6 weeks with 3 sessions each week. The control group was not given any exercise. VO_2 max assessment used the Multistage Fitness Test (Bleep Test).

Data analysis includes descriptive analysis and hypothesis testing. Data normality was analyzed with Saphiro-Wilk test for samples <50 subjects. The dependent variable (VO_2 max) of each group was analyzed using the paired T test for normal distribution, and the Wilcoxon test for abnormal distribution. Inter group dependent variables data were analyzed using the unpaired T test if the distribution is normal and the Mann Whitney test if the distribution is not normal. Significant value in this study is $p < 0.05$.

RESULT

This study used 36 subjects which were students of the Faculty of Medicine at Diponegoro University. Research subjects who met the inclusion criteria were



grouped using the Matched Subject Ordinal Pairing (MSOP) technique into 2 groups, namely experimental group that

performed climbing up and down stairs exercise and control group that did not exercise.

Table 1. Research Subjects Characteristics

Parameter	N	Minimum	Maximum	Mean \pm Standard Deviation
Age (year)	36	18	21	19,72 + 1,00
Height (cm)	36	147	178	168,29 + 5,63
Weight (kg)	36	49	77,50	62,69 + 7,42
Body Mass Index (kg/m ²)	36	18,69	24,80	22,10 + 1,98

The mean age of the research subjects was 19.72 years with the youngest age was 18 years and the oldest age was 21 years. Subjects had a mean height of 168.29 cm and a mean weight of 62.69 kg with a mean body mass index (BMI) of 22.10 kg / m².

The VO₂ max was measured twice, before the experimental group was given an intervention (pre-test), and after 6 weeks of climbing up and down stairs was given (post-test).

Table 2. Results of VO₂ Max Pre-test, Post-test, and Difference

VO ₂ Max	Group		p
	Control (Mean \pm SD)	Experimental (Mean \pm SD)	
Pre	29,17 \pm 4,12	29,41 \pm 4,35	0,867*
Post	30,01 \pm 3,57	32,84 \pm 4,34	0,062 [‡]
p	0,181 [¶]	0,001 ^w	-
Difference	0,99 \pm 2,67	3,44 \pm 2,75	0,011*

Description: p = significance value; [‡] = Mann whitney;

^w = Wilcoxon; [¶] = paired t-test; * = independent samples t-test

The results in the table above show a significant increase in the VO₂ max pre-post of the experimental group, while the VO₂ max pre-post of the control group is not significant. The p-value in the pre-post treatment group was 0.001 using Wilcoxon

and the pre-post control group was 0.181 using the paired t-test. In the inter-group test to compare the post-test of the control group with the experimental group, it was found that the results were not significant with a p-value of 0.062 using Mann



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Whitney. In testing the difference between the VO_2 max of the experimental group and the control group obtained significant results with a p-value of 0.001.

DISCUSSION

This study provides results that indicate the effect of climbing up and down stairs for 6 weeks on VO_2 max in young adults. Based on statistical tests in the experimental group showed a significant difference as well as an increase in VO_2 max while the control group showed a difference in VO_2 max that was not significant. The inter-group test showed that there was a significant difference between the increase in VO_2 max of the experimental group and the control group. This is because the increase in VO_2 max of the experimental group is greater than the control group. The results of this study are in line with previous studies which state that routine stepping up and down Harvard bench increases the VO_2 max.⁶ Previous research also states that mild and moderate-intensity aerobic exercise can increase the VO_2 max.⁷ This is because physical exercise is one of the factors affecting VO_2 max.⁸

Climbing up and down stairs is a type of aerobic exercise. A routine exercise

with the right intensity, duration, and frequency can provide good benefits for the body because of the adaptation of the cardiovascular, respiration, and musculoskeletal systems.⁵

In the cardiovascular system, the heart becomes bigger, so that the capacity increases and the pulse (stroke volume) becomes stronger. This is caused by an increase in oxygen demand in active muscles, an increase in the nutrients used, and an acceleration of metabolic processes. Other responses include increased myocardial contractility and cardiac output which will cause an increase in blood pressure and heart rate. But after regular exercise, an increase in work efficiency of each heart rate (stroke volume), resulting in a decrease in heart rate frequency which is marked by a decrease in pulse at rest.⁵

In the respiratory system, there is an increase in lung elasticity, so that the ability of the lungs to expand and deflate increases. The number of active alveoli also increases.⁵ In the musculoskeletal system, muscles become hypertrophy accompanied by an increase in the number and size of mitochondria. This will also increase the supply of oxygen to the muscles.⁹ Changes that occur in the cardiovascular, respiration, and



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musculoskeletal systems together cause an increase in the value of VO_2 max.¹⁰

In this study, the control group experienced an increase in VO_2 max even though it was not significant. This is because the pre-test was done after the subject conducts learning activities at campus until afternoon so that the subject's body condition was less fit when the VO_2 max was measured. This can cause the subject's VO_2 max to be lower. While the post-test was done when the subject's body was in a fit condition because there was not much activity and did not experience fatigue before measuring VO_2 max.

CONCLUSION AND SUGGESTION

Conclusion

Climbing up and down stairs exercise affect the VO_2 max in the treatment group. There is a significant difference between the mean VO_2 max before and after doing the climbing up and down stairs exercise. Also, the difference/increase in VO_2 max value in the treatment group was higher than in the control group.

Suggestion

Further research needs to be done on the effect of climbing up and down stairs exercise on the VO_2 max using the gold

standard of VO_2 max measurement so the results can be more accurate. Further research should also be done on the effect of climbing up and down stairs exercise on the VO_2 max with a longer duration of exercise (more than 6 weeks) to find out whether there is a difference in the change in VO_2 max values after climbing up and down stairs exercise with a longer duration. Also, it is necessary to monitor the food consumption of research subjects because food consumption can affect the VO_2 max. Finally, it is necessary to do further research on stairs of different sizes to find out if there are different changes in the VO_2 max after climbing up and down stairs with different stair sizes.

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