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DIFFERENCES IN INCREASING VO2 MAX BETWEEN BRISK WALKING AND HIGH INTENSITY INTERVAL TRAINING (HIIT) IN YOUNG ADULTS

Cindy Calista Chandra[1], Yosef Purwoko[2], Sumardi Widodo[3], Tanjung Ayu Sumekar[2]
[1] Undergraduate of Medical Student, Faculty of Medicine, Diponegoro University
[2] The Lecturer Science of Physiology, Faculty of Medicine, Diponegoro University
[3] The Lecturer Science of Anatomy, Faculty of Medicine, Diponegoro University
Jl. Prof. H. Soedarto, SH., Tembalang-Semarang, Jawa Tengah, Indonesia 50275, Telp. 02476928010

ABSTRACT

Background: Sedentary lifestyle is widely adopted by the society. Sedentary lifestyle is associated with limited physical activity, thereby increasing the risk of diseases, as well as reducing fitness. Fitness is assessed with VO_2Max. However, people with sedentary lifestyle are reluctant to exercise, thus the authors want to see whether briskwalking, an easy exercise and HIIT, a short-time exercise can increase VO_2Max. **Research Method:** Quasi-experimental research with a pre-test and post-test comparison group design. 60 young adult women were divided into three groups, namely brisk walking, HIIT, and control by using purposive sampling. The brisk walking group did brisk walking and HIIT did HIIT aerobics for six weeks, three times in every week. The control group was not treated. All subjects performed VO_2Max pretest and posttest with Cooper test. **Result:** The VO_2Max value for brisk walking and HIIT increased by averages of 9.83±3.93 and 8.84±4.76, while the control decreased by -3.97±4.02 The result from paired t-test and Wilcoxon shows significancy thus indicating a significant difference of VO2 max value before and after the treatments towards the brisk walking, HIIT, and control groups. After the Mann Whitney test is performed, no significant difference is found between brisk walking and HIIT, whereas there is a significant difference between brisk walking and control, and also between HIIT and control. **Conclusion:** Brisk walking and HIIT can increase VO_2Max. However, there was no difference in the increase between brisk walking and HIIT.
Key Words: VO_2Max, brisk walking, HIIT

BACKGROUND

In this modern era, sedentary lifestyles are increasingly prevalent in the society. Sedentary lifestyle itself is associated with limited physical activity, long period of sitting at work, cars, schools, and homes so as to limit one's muscle activity and movement.[1] When a person adopts sedentary lifestyle, the burning of food intake decreases, thereby increasing calories that are not used and accumulating fat in the body. The high amount of free fat in the blood will be a risk factor for obesity, hyperlipidemia, ischemic heart disease, cerebral vascular disease.[1] Due to the rampant adoption of sedentary lifestyles, there is a shift in the biggest cause of death from infectious diseases to diseases related with the lack of physical activity and lifestyle.[2] Based on WHO data, the two biggest causes of death globally are ischemic heart disease and stroke, it can be seen from the data seen that there was an initial increase in the year

2000 from 7 million to 9.5 million in the year 2016 for ischemic heart disease. While stroke increased from 5 million in the year 2000 to 6 million in the year 2016.[3] Therefore, it is necessary to find solutions regarding to the physical activities that are suitable for people with sedentary lifestyles, especially young adults who have not suffered from any diseases so that various risks for diseases can be prevented and the person's fitness can be enhanced.

One of the best predictors for assessing one's fitness is the VO_2 max rating, which is the maximum volume of O_2 that a person can use per minute to oxidize nutrient molecules to produce energy. VO_2 max depends on three systems, namely the respiratory, circulation, and muscular systems. Exercise can improve VO_2 max by making the heart and respiratory system more efficient in channeling O_2 to the muscles and so the muscles are more ready to receive O_2.[4]

There are several ways to improve one's VO_2 max, namely by aerobic exercises such as brisk walking, jogging, interval training, soccer, swimming, cycling.[5] Problems for people with sedentary lifestyle are the reluctance to exercise because exercising causes exhaustion or takes a considerably long period of time. Therefore, the authors want to see whether the brisk walking exercise that is easy to perform and high intensity interval training that only requires a short amount of time can increase VO_2 max.

METHOD

Quasi-experimental research with a pre-test and post-test comparison group design. Research subjects are 60 young adult women (ages 18-22 years old) in Diponegoro University Medicine Faculty with a sedentary lifestyle and a normal BMI (28.5-24.99 kg/ m^2), no extremities and cardiovascular diseases, not smoking. Subjects are divided into three groups, namely brisk walking, HIIT, and control by purposive sampling. Each treatment groups consists of 20 subjects.

Before the research, the measurement of VO_2 Max (pretest) was done using Cooper's test on all subjects. The brisk walking group did brisk walking at a distance of 1.2 km in week I and II, a distance of 1.6 km in week III and IV, and a distance of 2 km in week V and VI, while the HIIT group did HIIT aerobic consisting of 30 seconds of running and 30 seconds of jogging in 1 cycle, in week I and II the HIIT group did 4 cycles without rest, week III and IV did 5 cycles without rest, and

week V and VI did 6 cycles without rest. The treatment of the brisk walking group and HIIT is done for six weeks, three times in every week. The control group was not treated during those 6 weeks of treatment. Upon the completion of all treatments, VO_2 Max value measurement posttest is done towards all subjects using Cooper test.

The data is processed, coded, tabulated and inputted into a computer for descriptive analysis and hypothesis testing. The normality of data distribution is analyzed by the Kolmogorov Smirnov test to compare control, brisk walking, and High Intensity Interval Training data.

Changes in VO_2 Max values of the control group and the treatment group were compared using the Kruskal-Wallis test and continued with the Mann-Whitney test. VO_2 Max values before and after brisk walking and HIIT from each group were analyzed using a paired t test, while the control group using the Wilcoxon tests.

RESEARCH RESULT

VO_2 Max Value Measurement

VO_2 Max measurements were carried out twice, which are before (pretest) and after (posttest) the treatments. Table 1 contains the measurement result of VO_2 Max pretest, posttest, and the difference between the before and after treatment of the brisk walking, HIIT, and control groups.

Table 1. VO_2 Max *pretest*, *posttest*, and difference Measurement Result

VO_2 Max	**Group**		
	Brisk Walking	**HIIT**	**Control**
	Mean±SB Median (Min-Max)	**Mean±SB Median (Min-Max)**	**Mean±SB Median (Min-Max)**
Pretest	11.43±3.91 11.11 (4.78-18.33)	17.14±5.54 17.56 (5.67-25.44)	10.81±4.66 9.89 (4.78-23.22)
Posttest	21.27±2.90 21.56 (15.44-25.56)	25.99±3.31 25.67 (22.11-33.22)	6.84±4.54 6.33 (2.11-21.00)
Difference	9.83±3.93 9.56 (4.44-17.56)	8.84±4.76 7.00 (3.33-17.78)	-3.97±4.02 -2.89 (-18.67-(-22.00))

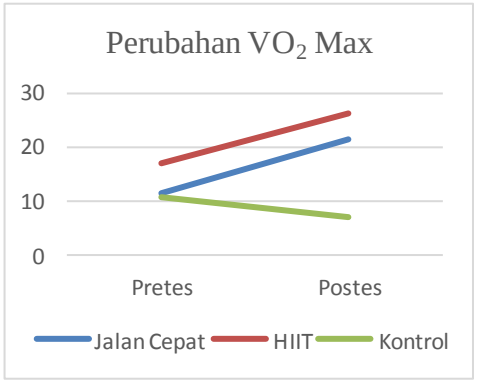

Figure 1. Graph of VO_2 Max Change

From table 1 it can be seen that the mean VO_2 Max pretest value of the HIIT group is greater than the brisk walking and control group. This indicates that the initial condition of the HIIT group subjects was fitter compared to the other two groups. The mean VO_2 Max posttest value of the HIIT group was also greater than the brisk walking and control group. From these data, it can be inferred that the mean increase in the subjects' VO_2 Max after brisk walking treatment was 9.83 ± 3.93 mlO2 / kg / min, while the mean increase in the subjects' VO_2 Max after HIIT treatment was 8.84 ± 4.76 mlO2 / kg / min. However, in the control group there was a decrease in VO_2 Max, with a mean of 3.97 ± 4.02 mlO2 / kg / min. From the change of VO_2 Max value, it can be seen that the increase in VO2 Max in brisk walking is greater than HIIT. From Figure 1, it can be seen that there is a parallel increase of VO_2 Max in brisk walking and HIIT, and that there is a decrease in the control group.

From the Kolmogorov-Smirnov test results showed that the VO_2 Max values of the brisk walking and HIIT groups were normally distributed. However, in the control group the distribution was not normal. So, the test was continued with the Kruskal-Wallis method and if significant continued with the Mann-Whitney method. To see whether or not there was a difference between the VO_2 Max pretest and posttest value for each treatment group, i.e. the brisk walking and HIIT groups, paired t-tests is done. Meanwhile, the difference test between the pretest and posttest VO_2 Max results of the control group was done using the Wilcoxon test.

Difference test of VO_2 Max before and after brisk walking, HIIT, and control

Table 2. Paired t-test Result of VO_2 Max pretest and posttest in brisk walking and HIIT groups

Variable	VO_2 Max	
	Mean ± SB	**P**
Pretest-Posttest Brisk Walking	-9.83 ± 3.93	0.000
Pretest-Posttest HIIT	-8.84 ± 4,76	0.000

The paired t-test results of VO2 Max values between the pretest and posttest brisk walking group and HIIT were significant, with p <0.05, which means that there were significant differences both in the brisk walking group and HIIT before and after treatments. A negative result on the pretest-posttest mean indicates an increase in VO2 Max after being treated because the posttest results are greater than the pretest.

Table 3. Wilcoxon Test Result of VO_2 Max pretest and posttest in control group

Variable	VO_2 Max							
	Negative Ranks			*Positive Ranks*			*Ties*	P
	N	*Mean Rank*	*Sum of Ranks*	N	*Mean Rank*	*Sum of Ranks*	N	
Pretest-Posttest Control	0[a]	0.00	0.00	20[b]	10.50	210.00	0[c]	0.000

a. *Pretest < posttest*
b. *Pretest > posttest*
c. *Pretest = posttest*

The Wilcoxon test results of VO2 Max values between the pretest and posttest of the control group were significant, with p <0.05, which means that there were significant differences in the control group before and after despite not being given any treatment. However, Positive Ranks can be seen in the VO2 Max values between the pretest and posttest in 20 control subjects. That positive difference indicates a decrease in the VO2 Max value because the pretest is greater than the posttest.

Difference test of VO_2 Max changes in the treatment and control groups

Table 4. Kruskal-Wallis Test Result of VO_2 Max changes in the brisk walking, HIIT, and control group

Group	N	*Mean Ranks*	P
Brisk Walking	20	42.13	
HIIT	20	38.88	0.000
Control	20	10.50	

Table 4 shows that there were significant differences between the three treatments towards the changes of VO_2 Max value shown by the value of p<0,05. This significant result needs to be continued with Mann-Whitney test.

Table 5. Mann-Whitney Test Result of VO_2 Max changes in brisk walking and HIIT groups

Group	N	*Mean Ranks*	P
Brisk Walking	20	22.13	0.379
HIIT	20	18.88	

Table 5 shows that there is no significant difference between brisk walking and HIIT in regards to VO_2 Max value changes since p>0,05. It happened because VO_2 Max *posttest* value of both brisk walking and HIIT groups increased compared to the pretest.

Table 6. Mann-Whitney Test Result of VO_2 Max changes in brisk walking and control groups

Group	N	*Mean Ranks*	P
Brisk Walking	20	30.50	0.000
Control	20	10.50	

Table 6 shows that there is a significant difference between brisk walking and control in regards to the VO_2 Max value changes since the value of p <0.05.

Table 7. Mann-Whitney Test Result of VO_2 Max changes in HIIT and control groups

Group	N	*Mean Ranks*	P
HIIT	20	30.50	0.000
Control	20	10.50	

Table 7 shows that there is a significant difference between HIIT and control in regards to the VO_2 Max value changes since the value of p <0.05.

DISCUSSION

The results showed that there was a statistically significant increase in VO_2 Max values after being treated with both brisk walking and high intensity interval training. This is because physical exercise is one of the factors that influence the value of VO_2 Max. [4]

The increase in VO_2 Max in the brisk walking group was caused by the increase of cardiorespiratory endurance due to the increased aerobic metabolism. [6] While the increase in VO_2 Max in the high intensity interval training group was caused by the thickening of the heart muscle in the left ventricle thereby increasing cardiac contractility and there was also an increase in the functionality of the blood vessel associated with endothelial cells which release nitric oxide and have a strong vasodilation effect thus the blood flow is efficient. [7,9,11] In addition to improved cardiovascular health, there is also an increase in metabolism, aerobic performance, and increased mitochondrial work of skeletal muscle cells. [8-12]

The mean increase in VO_2 Max in the brisk walking group was greater than the high intensity interval training group. This is due to the limitations of the study, where the sample was selected using the purposive sampling method which allows the sample to freely determine their own choice of treatments to perform, thus causing fitter samples to be concentrated in the high intensity interval training group whereas the less fit samples being concentrated in the brisk walking group.

This can be seen from the VO_2 Max pretest value of the brisk walking group and the high intensity interval training where the average VO_2 Max of the high intensity training interval group is greater than the brisk walking group. In the short duration high intensity interval training, VO_2 Max increases due to the influence of two things, namely baseline VO_2 Max and fatigue index, with higher fatigue index indicating greater increase in VO_2 Max. The fatigue index itself depends on muscle fibers, whereas women who show an increase in type IIb fiber size when given repeated Wingate tests have a higher fatigue index because type II fibers contain less mitochondria, thus the increase in VO_2 Max will be greater than individuals with more type I fibers to short duration high intensity training intervals.[13]

The results showed that there were significant differences in the VO_2 Max values changes that were significant ($p < 0.05$) statistically between the brisk walking group, high intensity interval training, and control. After that, the Mann-Whitney test was performed to see the significant differences between groups and it shows that there were no significant difference ($p > 0.05$) between the brisk walking group with high intensity interval training. Meanwhile, the results of the differentiation test between the brisk walking and control groups, and also the high intensity interval training group were showing significant differences ($p < 0.05$). That was because the VO_2 Max of the brisk walking group and high intensity interval training increased, while the control group decreased.

The results of the questionnaire after the study shows some changes felt by the subjects after participating in the study, namely the subjects of high intensity interval training and brisk walking feel like they're don't get tired quickly, experience weight loss (1-4 kg), an increase in muscle mass, increased appetite, regular hours of sleep, increased concentration, feeling refreshed to resume activities, feet feel light during exercise, regular breathing not wheezing, fitter, and decreased belly and arm fat. However, all changes felt by the subject are subjective and not yet measurable.

One of the limitations of this study is that the method used to measure VO_2 Max is Cooper test, which is not as accurate as the measurement of VO_2 Max using a bicycle ergometer. In addition, part of the study period was conducted during Ramadan fasting which caused a drop in VO_2 Max control subjects because most of them in the control group were Muslim,

and because of the limitations of the subject and pretest was done before fasting, and posttest during fasting. Fasting in a sedentary person can cause a decrease in VO_2 Max during the first week and will return to the initial in the last week of fasting.[14] In addition, a small proportion of the treated subjects of both brisk walking and high intensity interval training were also Muslim who could cause bias in the results of the study because some of the treatments and posttests were done during fasting. However, aerobic training during fasting can increase the oxidative capacity of muscles and the degradation of intramyocellular lipids, as well as prevent the development of decreased blood glucose concentrations compared to people who are fasting but not exercising. According to Noorbhai, exercise during fasting is recommended to be done 90 minutes before breaking the fast because breaking the fast can increase energy reserves and glycogen which is lost during exercise.[16] In addition, the sampling method which is purposive sampling makes the subject distributed unevenly and can also affect the results of this research.

CONCLUSION AND SUGGESTIONS

Conclusion

There is a significant difference in the value of maximal aerobic capacity (VO_2 Max) before and after brisk walking and high intensity interval training in young adults with sedentary lifestyles. In addition, there were significant differences in the changes of VO_2 Max values after treatments in the three groups, namely brisk walking, high intensity interval training, and control. Meanwhile, there was no significant difference in the changes in VO_2 Max values between the brisk walking group and high intensity interval training. That is because the two groups experienced an increase in the value of VO_2 Max.

Suggestions

Future studies are expected to examine changes that the subjects of brisk walking and high intensity interval training feels regarding other benefits, such as weight loss, increased muscle mass, not easily tired, increased concentration, regular sleep hours, objective and measurable increase of appetite to prove the assumption of the subjects. For further research, it is advisable to avoid differences in subject conditions, such as not undergoing fasting to reduce bias. It is recommended for future research to use the

random sampling method in selecting subjects, so that the subjects are evenly spread. Future studies are expected to use other tests that are more sensitive than Cooper's test in assessing maximal aerobic capacity (VO_2 Max).

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