



THE EFFECT OF HIGH INTENSITY INTERVAL TRAINING (HIIT) ON REACTION TIME

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ABSTRACT

Background: Reaction time is a cognitive-motoric connection that is important in making quick decisions. Due to the lack of time, medical student has low physical activity. High Intensity Interval Training (HIIT) is a strong and intense exercise interspersed with low intensity exercise that does not require much time. It has been known that can improve cognitive function. **Objective:** To determine the effect of HIIT on an individual's reaction time. **Methods:** Quasi-experimental research with pre-test and post-test groups design. The research subjects were 29 medical students of Diponegoro University, woman, normal IMT, 18-22 ages, has no neurologic deficit. The control group instructed not to do any physical exercises (n=15) and the experimental group was given an intervention of HIIT exercises that consists of warm-up, core, and cool-down movements for 6 weeks (n=14). Reaction time scores before and after were measured using the Attention Network Test (ANT). The significance of the data was analyzed using the paired sample t-test the independent sample t-test. **Results:** A significant decrease in reaction time scores (p=0,007) in both the experimental and control groups. A significant difference in reaction time scores (p=0.007) between the experimental group before and after the intervention was 592,07±74,82 to 517,21±56,77 milisecond. A significant difference in reaction time scores (p=0.024) between the control group before and after the intervention was 611,73±78,93 to 574,06±47,06 milisecond. **Conclusion:** HIIT for 6 weeks has been proved to reduce reaction time scores.

Keywords: High Intensity Interval Training, Physical Exercise, Reaction Time, Attention Network Test.

INTRODUCTION

Physical activity is every movement of the body that produced by skeletal muscle and needs energy.¹ Based on the data of Riset Kesehatan Dasar Kementrian Kesehatan Republik Indonesia (RISKESDAS), it was stated that there was an increase in the percentage of low physical activity among the population over 10 years of age, where in 2013 it was 26.1% increased to 33.5% in 2018.² A person with inadequate physical activity had a 20% to 30% greater risk of causing death, compared to someone who did the physical activity for at least 150 minutes per week.³

Exercise is a sub-classification of physical activity that is carried out in a planned, structured, sustainable, and beneficial manner for cognitive function through the mechanism of changes in brain neurotrophic factors and changes in plasma catecholamines.^{1,4} The positive effect of exercise on brain function due to the induced dopamine release.⁵ There are psychological components include cognitive function including attention, perception, thinking, knowledge, and memory.⁶

Reaction time is a variable part of cognitive function.⁷ Reaction time is the time lag between receiving a stimulus and a motoric response. Objectively, reaction time describes a person's level of alertness, an indicator of a person's fitness and fatigue.⁸ Many factors can influence the difference in reaction time for each individual, such as age, gender, level of fatigue, and the environment.⁹ If it is assumed that everyone's workload is the same, then the internal factors that can affect reaction time are age and gender.¹⁰

High Intensity Interval Training (HIIT) is an exercise that uses strong and intense energy. It is carried out in a short time, where each session is interspersed with low-intensity exercise as a recovery for the body to rest. Some examples of sports that are classified as HIIT such as running on a treadmill and cycling with an ergometer.¹¹ The duration of HIIT varies from 15 seconds to 4 minutes to reach 80-95% MHR.¹² HIIT is an exercise that can produce increased inhibition control and increased neuroelectricity related to one's attention which is effective in improving cognitive function.¹³ HIIT is also an excellent



strategy for enhancing physical exercise in individuals with a sedentary lifestyle.¹⁴

The purpose of this study is to determine the effects of HIIT on the reaction time of medical students in Universitas Diponegoro. The measurement of reaction time is measured by the Attention Network Test (ANT) by measuring the emphasis of the keyboard key in the direction of the arrow that appears on the monitor screen in milliseconds, so the reaction time score obtained is getting smaller.¹⁵

METHOD

This study used a quasi-experimental study with pre-test and post-test groups design. This study was conducted in the area of the Faculty of Medicine, Universitas Diponegoro before the Covid-19 pandemic and was carried out in the house of each subjects during the Covid-19 pandemic. This study was conducted from March to May for 6 weeks.

The samples were taken by purposive sampling method based on specified criteria and divided into two groups, experimental and control group. The inclusion criteria were students of the Faculty of Medicine, Universitas Diponegoro who were physically and mentally healthy, able to operate computer, women aged 18-22 years, normal Body Mass Index (BMI) (18.5-25 kg/m²), no anatomical abnormalities in the lower limbs, normal blood pressure, ready not to do another exercise for 6 weeks, and have no sleep deprivation. The exclusion criteria were having uncorrected eye refractive errors, history of brain tumors and epilepsy, head trauma causing neurological symptoms, central nervous system infection, taking sedative drugs, suffering from psychiatric disorders, taking brain supplements, and consuming alcohol.

The subjects for the control group was 15 people and for the experimental group was 14 people. The control group was instructed not to do any type of exercises for 6 weeks. The experimental group was instructed to do HIIT exercise. The mechanism of implementing HIIT starts with a warm-up for 8 minutes, followed by a core movement consisting of 15-meter sprints and 15-meter jogging as many cycles as determined (3 cycles in the first week with the pulse rate 140 x/minute, 4 cycles in the second week with the pulse rate 145 x/minute, 5 cycles in the third week with

the pulse rate 150 x/minute, 6 cycles in the fourth week with the pulse rate 155 x/minute, and 7 cycles in the fifth and sixth week with the pulse rate 160 x/minute), and cool-down for 1 minute. Every before and after HIIT, the experimental subjects' pulse rate were measured first. Before this pandemic, HIIT interventions were carried out in person, however, during this pandemic, it was carried out online via video calls.

The data collection process was carried out starting from all subjects following the pre-test measurement of reaction time scores using the ANT software that was installed on the laptop. After 6 weeks of the intervention, all study subjects were measured again using ANT software. The data normality was tested using the Saphiro-Wilk test. The difference in reaction time before and after High-Intensity Interval Training (HIIT) exercise was analyzed using a paired t-test. The difference in reaction time between the control group and the experimental group were analyzed using an unpaired t-test.

RESULTS

A total of 30 female students of the Faculty of Medicine UNDIP have fulfilled the inclusion and exclusion criteria for this study. For six weeks, the experimental group of 15 people did High-Intensity Interval Training (HIIT) exercise and the control group of 15 people did not do any exercises. In the middle of the intervention, one of the subjects in the experimental group could not be followed up (dropped out). Post-test with ANT has been conducted by 29 subjects.

Tabel 1. Characteristic of subjects

Variable	Group		p
	Control (n=15) Average±SD Min-Max	Experimental (n=14) Average±SD Min-Max	
Age	20.007 ± 0.884 (19-21)	20.00 ± 0.784 (19-2)	0,832*
BMI	22.485 ± 1.591 (19.70-24.76)	21.828 ± 2.042 (18.94 – 24.91)	0,340*

* Not Significant (p > 0,05)



Tabel 2. Reaction Time Score

Reaction Time	Group		p
	Control (n=15) Average±SD	Experimental (n=14) Average±SD	
Pre-test	611,73±78,93	592,07±74,82	0,498 [§]
Post-test	574,06±47,06	517,21±56,77	0,007 ^{§*}
p	0,024 ^{¶*}	0,007 ^{¶*}	

* Significant (p < 0,05); [§] Independent Sampel T-Test; [¶] Paired T Test

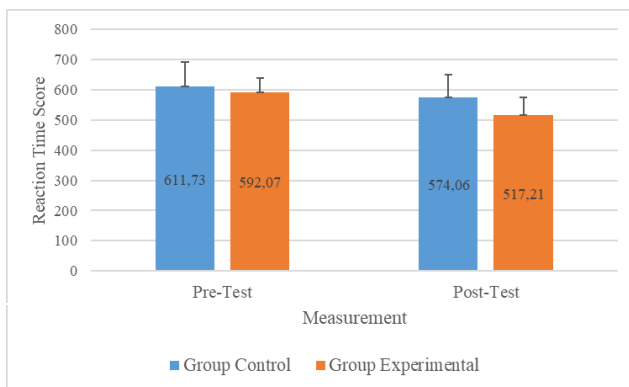


Figure 1. The difference of *pre-test* and *post-test*

Table 1 showed that a total of 29 subjects with an average age from the control group is 20.007 years old and the experimental group is 20.00 years old. There were no significant difference between the age of the control group and the experimental after doing independent t test because the p value was 0,832 (p > 0,05). The average BMI of the control group is 22.485 and the experimental group is 21.828. The p value after doing independent t test between the BMI of the control and the experimental group was 0,340 (p > 0,05) showed that the difference was no significant. All of the subjects either the control group or the experimental group did not exercise regularly, had uncorrected eye refractive errors, head trauma, history of psychiatric disorders, history of brain tumors, history of epilepsy, history of central nervous system infection, history of infection or systemic disease, consumption of sedatives or alcohol, taking brain supplements, experiencing stress, anxiety or depression, and musculoskeletal disorders of the limbs. The subjects are also able to operate computers and dominant using their right hand.

Tabel 2 and Figure1 showed that the pre-test reaction time score before the implementation of the control group intervention was 611.73 ± 78.93 and the experimental group was 592.07 ± 74.82. The pre-test reaction time score after the implementation of the control group intervention was 574.06 ± 47.06 and the experimental group was 517.21 ± 56.77. After doing the parametric independent sampel t-test, the reaction time score in the control group and experimental group showed that the difference was not significant 0.498 (p > 0.05). On the other hand, the post-test reaction time score in the experimental group and the control group showed that the difference was significant 0.007 (p < 0.05). The results of the paired sampel test showed that the assessment of the ANT reaction time score in the experimental group showed a significant decrease (p < 0.05) of 0.007 with an R value of 0.143. In the control group, it also showed a significant decrease (p < 0.05) of 0.024 with an R value of 0,690.

DISCUSSION

The study results after the HIIT intervention for 6 weeks on the reaction time scores either the control group or the experimental group, there were significant differences seen from the average of pre-test reaction time scores and the post-test reaction time scores. This results are consistent with the previous research stated that moderate intensity physical activity on reaction time had a significant decrease in reaction time scores.¹⁶

For 6 weeks, the research subjects have intervened the High-Intensity Interval Training (HIIT), physical exercise or aerobic exercise, which consists of short periods of high-intensity training interspersed with passive movements or moderate intensity exercises.¹² According to the research that has been done by Heisz et al., it is easier and more comfortable to do the type of HIIT exercise than the type of MICT exercise in the young adult age group with a sedentary lifestyle.¹⁴ Reaction time can be affected by someone who is doing physical exercise. Reaction time was found to be faster in someone who has done physical exercise than someone who has not done physical exercise.¹⁷ The intense and short physical exercise for 5 minutes with a duration of 3-7 times exercise per week using an ergometer bike with the reach of 2 times the basic heart rate, it was able to significantly reduce reaction time.¹⁸ The more blood flow reaches the brain, the better a



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person's cognitive function is, so that the brain can respond more quickly to stimuli anything around them.¹⁹

CONCLUSION

The results of this study showed that after the HIIT intervention was carried out for 6 weeks, there was a difference in the reaction time score of the experimental group that was given HIIT intervention compared to the control group, which was a significantly decrease more fast in the experimental group.

Ethical Approval

All research procedures received ethical clearance from the Health Research Ethics Commission of the Faculty of Medicine, UNDIP Semarang before conducting the research. The Ethical Clearance number is 86/EC/KEPK/FK-UNDIP/VI/2020.

Conflicts of Interest

The authors declare no conflict of interest.

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Author Contributions

Writing-original draft preparation, Chikita Dian Rahma Saphira; writing-review and editing, dr. Tanjung Ayu Sumekar M.Si.Med, Sp. KJ.

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