

The Impact of Tabata Protocol to Increase the Anaerobic and Aerobic Capacity

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Abstract. Tabata protocol is one of High Intensity Interval Training (HIIT) models whose time is relatively short yet intensity is high, which is followed by a recovery that is relatively short compared to the time execution. There is an appearing problem on how large the impact of the model to the dynamic aerobic and anaerobic capacity. Thus, this study tried to investigate the model's impact to both capacity. To do so, this study employed experimental method using one group pre-test post-test design. In implementing the research, this study conducted a pre-test followed by training treated by Tabata protocol and finally has a post-test. This study used correlation and determination test to analyse the data on how large the impact. Having analysed the data, the study proves that there is a positive correlation between the pre-test and post-test results which means that there is significant influence on the improvement of the capabilities using the model proposed. In the meantime, other factors influencing the improvement of both capabilities are assumed low. The results of the study imply that in physical training, the method chosen needs to adjust the physical components and physiological law of the training so that maximum achievement.

1. Introduction

High Intensity Interval Training (HIIT) became more popular in recent years. "Tabata Protocol" is a term which is frequently used synonymously as HIIT, first explained by a Japanese scientist, Izumi Tabata in 1996. A research comparing moderate intensity training at 70% of maximum oxygen consumption (VO₂max) for 60 minutes, with HIIT done at 170% of maximum oxygen consumption (VO₂max). Tabata method is a method which utilizes ratio between exercise and exercise break (interval with high intensity). In the implementation, this exercise method lasts for 4 minutes with the timing details of exercise activity within 20 seconds and 10 seconds for the break time, and it is repeated until those 4 minutes time had expired. This research found out HIIT can improve aerobic capacity for the same level as the sustainable moderate intensity training, this also resulted 28% of anaerobic capacity improvement. The other findings cause the development on various HIIT programs. Although there are many different ways to conduct HIIT, all the programs are marked by high intensity combined with break or short intensity recovery. Tabata training has evolved to include various forms of exercise conducted with 20:10 classic pattern (which is, 20 seconds of exercise followed by 10 seconds of break time) [1]. While the exercise with relative intensity and physiological responses of steady state exercises are well documented. Therefore, the goal of this study is to reveal



the effect of the use of Tabata protocol training method towards the dynamic capability improvement of anaerobic and aerobic capacity.

Several studies had been conducted with Tabata protocol training method using some activities with the intensity 170% of max by cycle exercise and treadmill activities during 3.5 minutes [2], and these activities require special equipment to reach maximum result. In fact, there are some activities in the field which cannot be conducted due to the limitations of the equipment so the exercise cannot be imposed with the intensity 170% of max. Therefore, there are some improvements of Tabata protocol with other activities, thus carrying out Tabata training method with intensity below 170% of max, as was conducted with exercise intensity 95% of max by exercise activity squat jumps during 4 minutes [3] and there was also an exercise done with intensity 74% of max by body weight circuit exercise activity during 16 minutes [4]. In these two studies, there are several differences result in the improvement, both the cardiovascular fitness and body composition, thus the weight training activities with external exercises was conducted in this study. This study revealed that Tabata protocol and HIIT exercise can be used for reducing body fat [5], reducing six skin folds [6], and also reducing body weight [7].

Aerobic capacity is an ability to maintain a high work output in the long term, meanwhile anaerobic is an ability to perform a high workload repeatedly. This is necessary because giving exercise to those who master aerobic, they are more resilient to fatigue and have rapid recovery process [8] [9]. Aerobic capacity, commonly recognized as $VO_2\text{max}$ [10][11], as an aerobic capacity indicator so it was done through $VO_2\text{max}$ measurement. This study focuses on the effect of Tabata protocol training method towards the improvement of aerobic dynamic ability which consists of physical ability which is included in the anaerobic work system; that is velocity, both in form of *Speed*, *Agility*, and *Quickness*.

There are many sport branches which need those components either individually that needs *Speed* only, or *Agility* only. However, there are many sport branches which need the combination of those abilities. Beside the velocity, other skill whose work system based on *anaerobe* energy sources is fast power ability or *power* [12], *power* which is maintained in long duration or in many repetitions, it also recognized as *Power Endurance*, or *Speed* ability which is maintained in relatively long duration or *speed endurance* [12].

2. Methods

Students who joined in *Futsal Puteri Universitas*' club which consists of 18 students. After receiving detailed explanation about the purposes, potential benefits, and risks related to this study, each student signed the written agreement.

In the implementation, the researcher carried out the pre test and measurement then gave exercise treatment with Tabata protocol training method, after the training was done, the post test and measurement conducted. These are the steps to collect the data, including prepared the instrument, conducted the test, and measured according to the procedure done by several tester personnel (4 people who are experts in data retrieval). The collected data is *quantitative* data. The schedule of data collection consists of 2 steps; the first step is pretest to reveal the initial subject's condition, the second step is posttest to observe the improvement of exercise treatment result.

The method used was experiment one group pretest-posttest design [13]. *Research Instrument* used to conduct the process and collect the data of Tabata protocol training program in form of weight training exercise and several test items to find out the *Anaerobe* and *Aerobe* ability, these include:

- 1) Aerob skill measured through Bleep Test (Tes Multi Tahap)[14]
- 2) Anaerob skill consists of some tests as follows :
 - Velocity in the form of Speed : test 20 m dash sprint[15]
 - Velocity in the form of Agility : shuttle run 4m x 5 rep
 - Foot Power : test 3 Hop[16]

- Power Endurance : test 10 Hop
- Speed Endurance : sprint test 150 m[17]

3. Statistical Analysis and Results

Statistical analysis in this study used SPSS application program, analysis technique used was correlation test followed by determination test to find out how much the influence given by Tabata protocol training method towards the dynamic ability improvement of anaerobic and aerobic.

To see the effect of aerobic improvement ability with Tabata protocol training method, so the first step was conducted a test through normality test by using One-Sample Kolmogorov-Smirnov Test, due to the normal subject distribution, so it was continued by descriptive data test using Paired Samples Statistics, after that the correlation test conducted using Paired Samples Correlation.

Table 1. Paired Samples Correlations

	N	Correlation	Sig.
Pair 1 vo2max1 & vo2max2	18	.893	.000

Table 2. Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 vo2max1 - vo2max2	2.64444	1.90239	.44840	-3.59048	-1.69841	5.898	17	.000

The correlation result between the two variables is 0.893, $p = 0.000 < 0.05$, it indicates that there was a significant correlation between aerobic pretest and posttest. Then it was continued by Paired Sample Test. Since $t = -5.898$, $p = 0.000 < 0.05$, so there was a significant difference between aerobic pretest and posttest. Therefore, it would require further research by using determination test.

Table 3. Determination Test

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.893 ^a	.797	.784	1.61855

a. Predictors: (Constant), vo2max2

Since the value $R = 0.893$, Determination Coefficient R^2 (R Square) = 0.797, It means the improvement from aerobic pretest and posttest influenced by Tabata is 79.7% while 20.3% was influenced by other factors.

On anaerobic skill, it was done with Tabata protocol training method, so the first step was conducting a test through normality test by using One-Sample Kolmogorov-Smirnov Test, due to

normal subject distribution, so it was continued by descriptive data test using Paired Samples Statistics, then it was carried out correlation test using Paired Samples Correlations.

Table 4. Paired Samples Correlations

	N	Correlation	Sig.
Pair 1 anaerobik1 & anaerobik2	18	.932	.000

The correlation result of these two variables is 0.932, $p = 0.000 < 0.05$, so there was a significant correlation between anaerobic pretest and posttest. Then it was continued by Paired Sample Test.

Table 5. Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 anaerobik1 - anaerobik2	80.389	73.516	17.328	-116.948	-43.830	4.639	17	.000

Table 6. Determination Test

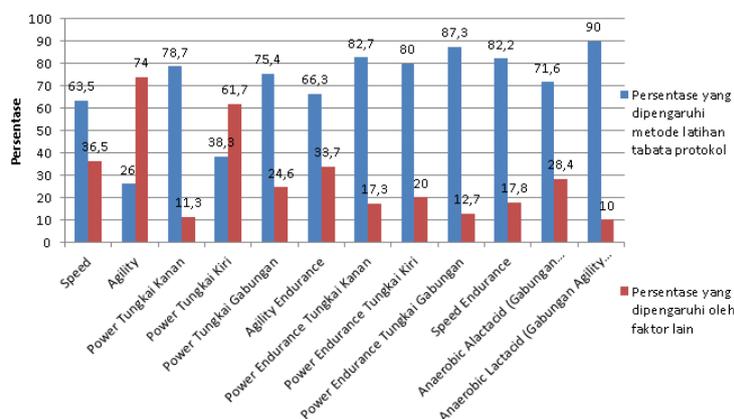
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.932 ^a	.869	.861	3.17929

a. Predictors: (Constant), anaerobik2
 b. Dependent Variable: anaerobik1

Since $t = -0.143$, $p = 0.000 > 0.05$, so there was a significant difference between anaerobic pretest and posttest. Therefore it would require further test by using determination test. Since the value $R = 0.932$, Determination Coefficient R^2 (R Square) = 0.869, it indicates that the improvement from the anaerobic skill pretest and posttest which influenced by Tabata is 86.9 % while 13.1 % was influenced by other factors.

4. Discussion

This section explains the findings which then can be further discussed after finding out several physical components influenced by Tabata protocol training method in the form of weight training exercise, including:



- Percentage Result Influenced by Tabata Protocol Training Method
- Percentage Result Influenced by Other Factors

Figure 1. Improving Percentage from Anaerobic Pre Test and Post Test Influenced by Tabata Protocol Training Method and Other Factors

As seen in Figure 1. It can be revealed speed physical component influenced by Tabata protocol training method is 63.5% with 36.5% influenced by other factors, while agility only influenced at 26% by Tabata protocol method and foot power influenced at 82.7% by Tabata protocol training method with 12.7% influenced by other factors, from the two feet, the right foot influenced at 78.7% while the left foot at 38.3% by Tabata protocol training method, it indicates that volume and intensity of those two feet need special treatment. Those three physical components are included in Alactacid Anaerobic category, which if combined they will have 71.6% influenced by Tabata protocol training method, while at 28.4% influenced by other factors.

In Lactacid Anaerobic category, at 90% influenced by Tabata protocol training method, while 10% influenced by other factors. Physical component agility endurance influenced at 66.3% by Tabata protocol training method, while power endurance influenced at 87.3% and speed endurance at 82.2% influenced by Tabata protocol training method.

This research indicates that there was an excellent relation between the result of pretest and posttest on anaerobic dynamic ability, so there was a significant difference with high improvement influenced by Tabata protocol training method, In the meantime, other factors influencing the improvement of both capabilities were assumed low, and also it indicates that there was a strong relation between the result of pretest and posttest on aerobic dynamic ability, so there was a significant difference with high improvement influenced by Tabata protocol training method, in the meantime, other factors influencing the improvement of both capabilities were assumed low.

5. Conclusion

The implication of the research result indicates that in physical training, exercise method needs to adjust with physical component which will be trained according to training principals in physiological law in order to get maximum training result.

Due to the implementation of Tabata protocol training method gave an impact towards the improvement average *anaerobic* and *aerobic* ability, so it is suggested that every coach is capable to design program by using Tabata protocol training method in the form of various exercises because it is important to reach a secure and focus exercise. The implementation of adequate exercise with regard to the method, pattern, principal, and norms appropriately is the important key to reach overcompensation (exercise effect).

It is suggested for further researchers to develop the knowledge on effective and efficient coaching, so this kind of research can be further improved in terms of other exercise or implementation on sports branch which is more specific on physical ability, such as sports branch which is dominant on speed (*sport speed*), power endurance (*sport power*), or durability (*sport endurance*).

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