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The Effect of Interval Training on Increasing VO2Max and Hemoglobin Levels in Central Java PPLOP Athletes

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Abstract

Background: In adolescence, the level of anemia is very high so it is feared that it can affect athlete performance, while athletes must have high hemoglobin levels to support their performance in training and competing. This study also aims to determine methods for increasing hemoglobin levels besides using iron-rich foods. **Method**: This study uses an experimental method with independent variables interval training and dependent variables VO2Max and hemoglobin levels. The population in this study were PPLOP Central Java karate athletes, the sampling technique used was total sampling. The test instrument used to measure VO2Max was the Balked test and the test instrument to measure hemoglobin was the HemoCue blood photometer. **Result**: the results in this study interval training can increase VO2Max with an average increase of 1.73% and interval training can increase hemoglobin levels by an average of 5.98 gr/dl. **Conclusion**: interval training can be used as a reference for increasing VO2Max and hemoglobin levels, for optimal increases can be accompanied by consumption of foods high in iron.

Keywords: hemoglobin levels, interval training, VO2Max

INTRODUCTION

Endurance is one of the main physical condition components that must be possessed by athlete [1]. Endurance by definition is the body's ability to work for a long period of time without experiencing fatigue [2]. The level of endurance can be measured by an endurance test to measure the Maximum Oxygen Volume (VO2Max), VO2Max is the amount of oxygen consumption when doing an activity [3]. Athletes who win are athletes with good VO2Max because with good VO2Max athletes will be able to carry out strategies well without fatigue [1]. By having a good level of endurance, athletes will be able to display their techniques optimally without any fatigue constraints. Poor endurance will reduce the quality of skills possessed and will have difficulty in implementing the strategies given by the coach.

There are several forms of endurance training methods such as continuous training, fartlek and interval training [4]. Circuit training can also increase endurance and strength [5]. Based on previous research, it can be concluded that endurance improvement methods can be done using continuous training, fartlek, interval training and circuit training methods. Interval training has a more significant effect than continuous training [6]. Interval training is divided into 2, namely short-distance intervals and long-distance intervals, long-distance intervals have been shown to increase endurance more significantly [7]. Interval training can reduce the percentage of fat in women [8]. In addition to being able to increase endurance, interval training can also reduce the percentage of

body fat and weight loss so that it can be used by martial artists who are in the process of losing weight who use body weight in their competition system.

Physiologically, the process of forming endurance in the body is by increasing the levels of hemoglobin that produce red blood cells, these red blood cells will bind oxygen in the body [9]. Hemoglobin levels will determine the amount of oxygen carried by the blood, hemoglobin can be obtained from iron, folic acid, zinc, vitamin C [10] Endurance and hemoglobin are related because with normal hemoglobin, red blood cells that carry oxygen will also be normal, thus increasing endurance. Hemoglobin plays an important role in endurance because hemoglobin is a protein that contains iron as a carrier of oxygen to all parts of the body [11].

The method of increasing endurance in practice is by doing exercises to increase oxygen capacity, namely interval training, continuous training, fartlek. While physiologically the process of forming endurance is by increasing red blood cells which can naturally be done by training in the highlands and through nutrition with foods high in iron. In previous studies, the effect of endurance training on increasing endurance was examined by increasing VO2Max. As a new science in this study, researchers want to know whether endurance training is not only able to increase endurance but also able to increase hemoglobin levels.

METHOD

This type of research is experimental, the design of this study uses one group pre test post design, namely research by conducting an initial test, then giving treatment not ending with a final test, so that the effect before and after treatment can be known. This method is used based on the consideration that the nature of experimental research is to try something to find out the effect or consequences of a treatment. The independent variable in this study is Interval Training, while the dependent variable in this study is an increase in VO2Max, leg muscle strength, hemoglobin levels, and a decrease in fat percentage. Researchers want to know the effect of independent variables on the observed dependent variables. The treatment given in this study is Interval Training to see its effect on increasing VO2Max, hemoglobin levels.

The population in this study were BPPLOP Central Java karate athletes, the sampling technique used was total sampling by taking all the population of BPPLOP Central Java karate athletes as many as 12 athletes. This research was conducted at the Jatidiri complex, Semarang City, the time of this research was from September to October 2024. The procedure in this study began with an initial test using a Balke test instrument to measure VO2Max, a HemoCue blood photometer to measure hemoglobin levels, then the Interval Training treatment stage for 16 exercises, then ended with a final test to determine the effect before and after treatment. The data analysis technique used the t-test, a mean difference test by displaying the percentage comparison of the pre-test and post-test.

Table 1. Balke test instrument for women

Sex	Poor	Fair	Good	Excellent	Superior	Normal Hb levels
Women	< 30	31 – 34	35 – 38	39 – 41	> 41	12 – 16
Men	< 37	38 – 44	45 – 50	51 – 55	> 55	14 – 18

RESULTS AND DISCUSSION

Interval training increased VO2Max of PPLOP Central Java karate athletes with the lowest increase of 0.28 or 0.60%, the highest increase of 1.69 or 3.40%, with an average increase of 0.82 or 1.73% (Table 2). The hemoglobin levels of PPLOP Central Java karate athletes increase after interval training. The lowest and highest increase are 0.10 or 0.68%, and 2.70 or 15.25% sequentially. The average increase is 1.11 or 5.98% (Table 3).

Table 2. Increased VO2Max after interval training

Subject	VO2Max		VO2Max Increase	Percentage of VO2Max Increase
	Pre-test	Post-test		
1	42,78	43,7	0,92	2,11%
2	52,16	53,81	1,65	3,07%
3	50,84	51,26	0,42	0,82%
4	47,61	48,56	0,95	1,96%
5	41,2	42,1	0,90	2,14%
6	40,85	41,29	0,44	1,07%
7	43,28	43,71	0,43	0,98%
8	47,54	48,46	0,92	1,90%
9	45,25	45,66	0,41	0,90%
10	46,22	46,5	0,28	0,60%
11	48,04	49,73	1,69	3,40%
12	47,68	48,56	0,88	1,81%
Mean	**46,12**	**46,95**	**0,82**	**1,73%**

Table 3. Increased hemoglobin after interval training

Subject	Hemoglobin (gram%)		Hemoglobin Increase	Percentage of Hb Increase
	Pre-test	Post-test		
1	16,6	16,9	0,30	1,78%
2	18,4	19,2	0,80	4,17%
3	18,8	19,5	0,70	3,59%
4	16,4	18,6	2,20	11,83%
5	15,2	15,3	0,10	0,65%
6	16,8	17,7	0,90	5,08%
7	15,6	16,7	1,10	6,59%
8	18	19,5	1,50	7,69%
9	15	17,7	2,70	15,25%
10	15,8	16,2	0,40	2,47%
11	20,2	22,3	2,10	9,42%
12	15,1	15,6	0,50	3,21%
Mean	**17**	**17,9**	**1,11**	**5,98%**

Based on the results of the study, giving interval training treatment for 16 times of training was able to increase VO2Max. Interval Training is a training with a rest break between each activity [7]. Interval training combines work and rest, with moderate to high intensity, with rest or pauses in each set, it is expected that fitness will recover and be ready for moderate to high intensity activities in the next set. Different from continuous training which is done with light to moderate intensity so that there is no rest or pause in each activity. Interval training is divided into intensive interval training and extensive interval training, namely interval training with high intensity so that it can increase speed endurance and extensive interval training, namely interval training with moderate intensity that can increase endurance. In interval training, it is necessary to pay attention to providing the right rest duration in order to get optimal results, intensive interval training requires a longer rest duration than the work duration in order to provide maximum recovery of the pulse and muscle fatigue, while extensive interval training requires the same or shorter rest duration than the work duration because the goal is to increase endurance so that the intensity is moderate and the rest is not too long.

Based on the results of the study, giving interval training treatment for 16 times of exercise was able to increase hemoglobin levels. Previous research said that increasing hemoglobin levels through nutrition by consuming foods high in iron such as spinach, fish eggs [12]. Another study said that a mixture of guava and spinach was able to increase hemoglobin by 0.96 gr/dl [13]. Aerobic exercise with light intensity for 30 minutes for 3 times a week was able to increase hemoglobin [14]. In the previous study, it was not mentioned what aerobic activity was used to increase hemoglobin levels, the forms of aerobic exercise are gymnastics [15]. Walking, jogging, cycling and swimming are forms of aerobic exercise for cardiovascular health [16] This study provides new knowledge that increasing hemoglobin apart from foods containing iron can also be done through interval training. The process of hemoglobin formation and producing red blood cells through production in the spinal cord physiologically. Lack of red blood cells or anemia can reduce oxygen consumption by the body so that the body will easily get tired, lethargic and quickly experience fatigue [10]

CONCLUSION

Increasing endurance in addition to training can also be done by consuming nutrients containing iron to increase hemoglobin levels, with increasing hemoglobin levels, oxygen consumption will also be greater which is distributed throughout the body. Increasing hemoglobin levels in addition to foods containing iron such as spinach, dates, red meat, eggs but can also be done by doing interval training with moderate intensity. To increase VO2Max and optimal hemoglobin levels, you can combine interval training and consumption of foods containing iron.

REFERENCES

[1] Dhuha AA, Yogaswara A, Abubakar SFBS, et al. Tingkat VO2Max Atlet Taekwondo Kota Semarang Dalam Menghadapi PORPROV 2023. *J Sport Sci Fit* 2023; 9: 50–57.

[2] Dhuha AA, Sulaiman, Pramono H. The Effect of Endurance and Leg Muscle Strength Training Method on the Increase of VO2Max Article Info. *J Phys Educ Sport* 2020; 9: 275–280.

[3] Warni H, Arifin R, Bastian RA. Pengaruh Latihan Daya Tahan (Endurance) Terhadap Peningkatan Vo2Max Pemain Sepakbola. *J Pendidik Jasm dan Olahraga*; 16. Epub ahead of print 2017. DOI: 10.20527/multilateral.v16i2.4248.

[4] Dhuha AA, Yogaswara A, Abubakar SFBS, et al. Pengaruh Interval Training Terhadap Peningkatan Vo2Max Atlet Taekwondo Kota Semarang. *J Sport Sci Fit* 2024; 9: 122–127.

[5] Ramadan W, Sidik DZ. Pengaruh Metode Circuit Training Terhadap Daya Tahan Cardiovascular Cabang Olahraga Atletik Nomor Lari Jarak Jauh. *J Kepelatihan Olahraga* 2019; 11: 101–105.

[6] Brastangkara G, Jatmiko T. Pengaruh Latihan HIIT (High Intensity Interval Training) dan Continuous Running Terhadap Perubahan Denyut Nadi Basal dan VO2 Max Pada Mahasiswa Aktif Non-Atlet. *J Prestasi Olahraga* 2019; 1: 1–8.

[7] Perdana A. Pengaruh metode latihan interval ekstensif dan metode latihan interval intensif terhadap vo2maksimal Effects of the extensive interval training method and the intensive interval training method on VO2max. *Sport Educ Technol* 2023; 1: 7–12.

[8] Putra MA, Fitria R, Putri RE. Pengaruh High Intensity Interval Training (HIIT) terhadap Persentase Lemak Tubuh Wanita Menopause Penderita Obesitas. *Gelangg Olahraga J Pendidik Jasm dan Olahraga* 2018; 2: 158–166.

[9] Anugrah Rais MD, Arif F, Arifuddin MF, et al. Metode Otomatis untuk Menghitung Sel Darah Merah Menggunakan Image Processing. *J Embed Syst Secur Intell Syst* 2022; 3: 102.

[10] Nurdini DA, Probosari E. Tingkat kecukupan zat gizi dan kadar hemoglobin pada atlet sepakbola. *J Nutr Coll* 2017; 6: 28–34.

[11] Debbian A, Rismayanthi C. Profil Tingkat VOlume Oksigen Maksimal dan Kadar Hemoglobin Pada Atlet Yongmoodo Akademi Militer Magelang. *J Olahraga Prestasi* 2016; 12: 19–30.

[12] Fauziandari EN. Efektifitas Ekstrak Daun Kelor Terhadap Peningkatan Kadar Hemoglobin Pada Remaja Putri. *J Kesehat Karya Husada* 2019; 7: 24–29.

[13] Winarni LM, Lestari DP, Wibisono AYG. Pengaruh Pemberian Jus Jambu Biji Merah Dan Jeruk Terhadap Peningkatan Kadar Hemoglobin Pada Ibu Hamil Anemia: A Literature Review. *J Menara Med* 2020; 2: 119–127.

[14] Putri, Febriyaningrum A, Kaidah S, et al. Literature Review : Pengaruh Latihan Aerobik Intensitas Sedang Terhadap Kadar hemoglobin. *Homeostasis* 2021; 4: 435–446.

[15] Candrawati S, Sulistyoningrum E, Ap B, et al. Senam Aerobik Meningkatkan Daya Tahan Jantung Paru dan Fleksibilitas. *J Kedokt Brawijaya* 2016; 29: 69–73.

[16] Dhuha AA, Yogaswara A, Sadidah Z. Tingkat Kebugaran Pelari Rekreasi Di Kota Semarang. 2023; 08: 92–102.