IJBPAS, March, 2015, 4(3): 1616-1626

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

THE EFFECTS OF FIVE WEEK INTERVAL TRAINING WITH HIGH INTENSITY COMPARED TO HIGH VOLUME TRAINING ON AEROBIC AND ANAEROBIC POWER OF ADULT SOCCER PLAYERS

SOOLMAZ SALARI[1*] AND MASSOUD MOENI SHABESTARI[2]

1: Department of Exercise Physiology, Jahrom Branch, Islamic Azad University, Jahrom, Iran

2: Department of Exercise Physiology, Karaj Branch, Islamic Azad University, Karaj, Iran

***Corresponding Author: E Mail: Soolmazslr@yahoo.com; Tel: +989336549500**

ABSTRACT

The purpose of this study was the effects of five week interval training with high intensity compared to high volume training on aerobic and anaerobic power of adult football players. 30 football player active male volunteers were divided into two experimental groups 1 and 2, were enrolled in this study. Exercise tests to determine VO2max and maximal anaerobic power were used for pre and post test. Subjects for 5 weeks of paid training. Data analyzed by independent t-tests and paired with a significant level of $P<0.05$. The results showed that in both groups after exercise VO2max an anaerobic power significantly improved ($P<0.05$). Also, the significant differences between the groups were observed in anaerobic power. However, no significant differences were observed between the two groups in VO2max. findings suggest that a period of intense interval training with very low volume improves anaerobic performance. Therefore, the use of HIT training in soccer players during training and competition may lead to improved performance.

Keywords: High intensity training, High volume training, VO2max, Anaerobic power, Soccer player

INTRODUCTION

Champions' training plans must be adjusted according to physical and physiological characteristics of athletes and scientific theories. These plans must be based on the

requirement of each special sport and factors such as involving energy machines, movement patterns and physiological characteristic are considered effective on operation **[1]**. On the other hand, athletes in order to achieve maximum fitness in a particular period, often need a training plan after a period of inactivity **[2]**. Football is one of the most popular team sports in the world which is especially common among general public. Its complex nature is integrated with technique, tactic and mental skills. Many studies about football's operation have focused on technique and tactics and physical fitness such as endurance, strength and speed, particularly in the different age groups have been overlooked. With regards to this point that football consists high and low intensity which lead to the changes in consuming oxygen during training and match, training plans are usually designed in a way in which players take on the upper level of aerobic capacity **[3]**.

One of the methods of improving the performance of aerobic is interval training which is classified in different kinds. High Interval Training (HIT) or Speedy Interval Training (SIT) are the newest interval training methods which have attracted the attention of sport science researchers in recent years **[4]**. Although there is no Comprehensive definition for HIT, it is mostly defined as repeated instances or short interval activities with high intensity or an intensity close to which VO2peak (%90 of VO2peak) is obtained. With regards to the intensity of training, an HIT attempt may take from some seconds to some minutes in which different instances get separated by resting some minutes or activity with low intensity **[1]**. Through different studies, the power of high interval training has been confirmed in fast improvement of sport power and skeletal muscle energy metabolism. Interval training is one of the most general training methods for improving endurance operation in the season before match. There is a minimum for training intensity in this season in which training with less intensity with every training volume wont' have any useful effects. The amount of 70 to 100 percent Vo2max, lactate threshold or vVo2max (the minimum speed during which testing reaches to highest amount of consuming oxygen) is considered the most pleasant training intensity for athletes **[5]**. Intense interval training increases energy substrate concentration and enzyme activities related to anaerobic metabolism, and then along with increasing speed repetitions and interval operation and returning to the first state between the instances of activity, the need of muscular cell

and metabolic path change, in a way in which aerobic and anaerobic systems are simultaneously involved in ATP rebuilding. Therefore, using such training, we can expect wide range of functional and metabolic compatibilities. In spite of strength efforts in which short intense efforts are usually done against a heavy resistance for increasing skeletal muscle mass, HIT is usually followed with activities such as bike riding or running that don't lead to a marked hypertrophy in the fiber **[1]**. Low volume is one of the features of these training.

Although continuous aerobic training is scientifically accepted as a method for improving aerobic capacity, interval training with high intensity on young football players for determining its effects on aerobic power and physiological factors related to operation in preparation period and competitions, have been studied much less. With regards to this fact that considering the preparation level of players, preparation period before competitions takes 4 to 6 weeks, intense interval training can be effective in preparing players and trainers can have more time for increasing tactical and strength readiness. Thus, the researcher is searching the answer of this question that "Do 5 week interval training with high intensity compared to training with high volume have different effects on aerobic and anaerobic power of football players?"

METHODOLOGY

The current research is a kind of applied research and was done in a way of quasi-experimental pretest-posttest without control group. The statistical society of this study consists of all adult players football clubs. In the current study, we used a convenience sampling method. Among adult team players, football clubs which were qualified were chosen and coincidentally were divided into two groups of high interval training (N=15) and continuous training with high volume (N=15).

Data collection

For measuring research dependent variables, we have used Shuttle run 20 meter test for measuring aerobic power and Rast test for measuring anaerobic power before and after training.

Shuttle run 20 m test

In a suitable space area 20 meter in length (within the proposed 10 meter width), is characterized by a conical barriers. Then examinees after mental and physical preparation, stand at the end of one of the marked 20 meter lines. By hearing the first beep, they move slowly toward the end of 20 meter road, so that by hearing the second beep, they have to reach to the end of 20 meter road.

If one person, before hearing the second beep, reaches to the end of 20 meter road, he must wait until he hears the next beep then again returns to the next direction and 20 meter line. They set the speed of their steps and with the increase of the numbers of sweep round and reduction of time between two beeps, they simultaneously increase running speed till they are not able to continue the test. If the examinees are not able to reach to 20 meter line before hearing beep, then after two sequential rounds or three non-sequential rounds, he is asked not to continue the test. The number of full sweep rounds of the last record that reaches to 20 meter line, immediately are recorded on the sheet.

Rast test

Rast test is a running test in the form of fast and anaerobic running. The test is run by the University Velour Hampton for athletes 'anaerobic performance. This test can be also applied in the athletes whose sport skills are based on running. The aim of this test is to evaluate indicator of exhaustion in athletes. In addition, this test is used to evaluate the development of anaerobic power during training plans.

The method of test performance

The examinee's weight is measured before test.

The examinee warms up 10 min before test.

The test starts after 5 min rest.

By start command, examinee runs 35m intervals specified by the cones at top speed and between each interval, a 10 second recovery is given to examine.

Examiner calculates and records the covering time of each 35 meter by hundredth of a second.

Finally parameters of interest are calculated by using estimating equations. In order to measure anaerobic power and the indicator of exhaustion, estimating equations are as fallow: The maximum of anaerobic capacity: weight product multiplied in distance square divided by time in cube of three. The indicator of exhaustion: maximum power minus minimum power divided by total traveled distance.

Method

At first, the examinees filled the general information and health questionnaire and signed a written testimonial for participating in this study. Then the researcher explained the different steps of study and the conditions of doing that study to examinees. On the day of test, the examinees after arriving to the test place and resting 15 minutes, the variables of their body measurements were evaluated and the data related to height, weight and body mass index were measured. Then examinees coincidentally were divided into two groups. In order to prevent exhaustion effect and the

depletion of energy stores of examinees, aerobic and anaerobic tests for measuring Dependent variables were done in two separate days.

As it was mentioned in the study outline, the participants began the training with 5-10 min warming up steps in which consists of flexibility training, Short submaximal speed, and coordination of team movements. After that, players reviewed individual tactics and techniques and then began to exercise. Before training, the examinees got familiar with the way of measuring heart beat for controlling during doing exercise. In this way in which at first maximum heart rate was estimated 220, using age formula and the examinees were asked to measure carotid pulse after each run in order to ensure that the intensity of training is followed up.

Table 1: Plan pattern of interval training with high intensity (Sperlich *et al*., 2011)

TABLE 1. Endurance training program and duration of each session for 5 weeks of HIIT and HVT.*

	HIIT		HVT	
Session	Program	Total *T* (min)	Program	Total *T* (min)
1	8 × 1-min + 1-min break, 6 × 1-min + 1-min break	29	6 × 6-min + 3-min break	51
2	4 × 4-min + 3-min break	29	4 × 12-min Fartlek + 2-min break	54
3	4 × 4-min + 3-min break	29	2 × 30-min Fartlek + 5-min break	65
4	12 × 30-s Sprint, 30-s break, 6 × 2-min + 2-min break	31	4 × 12-min Fartlek + 2-min break	54
5	4 × 4-min + 3-min break	29	3 × 15-min Fartlek + 3-min break	51
6	5 × 800-m + 140-s break	25	2 × 25-min Fartlek + 5-min break	55
7	10 × 400-m + 90-s break	30	Continuous run of 8.9 km	60
8	4,1,1,4,2,4-min + 2-min break	26	5 × 10-minFartlek + 1-min break	55
9	15 × 200-m + 80-s break	29	2 × 10-min Fartlek + 3-min break, 2 × 20-min Fartlek + 3-min break	69
10	12 × 30-s sprint, 30-s break, 6 × 2-min + 2-min break	31	3 × 15-min Fartlek + 3-min break	51
11	4 × 4-min + 3-min break	29	Continuous run of 8.9 km	60
12	4 × 4-min + 3-min break	29	2 × 30-min Fartlek + 5-min break	65
13	4 × 4-min + 3-min break	29	2 × 25-min Fartlek + 5-min break	55
Mean ± *SD*		28.8 ± 1.7		57.3 ± 5.9

*HIIT = high intensity interval training; HVT = high volume training.

Statistical

All the findings were reported by the average and standard deviation. Kolmogorov-Smirnov test was used for studying the normality of data distribution in which if natural, parametric tests were used. The difference between before and after training in groups was measured by paired t test and the difference between groups were measured by independent t test. All of statistical operations were done by SPSS 20 software.

RESULTS

As it is shown in **Table 2**, VO2max in interval training group shows a significant increase in posttest, therefore, HIT plan led to a significant increase of anaerobic power in men football players.

Anaerobic Power in interval exercise group showed a significant increase in post-exercise, Thus, the HIT significantly increased anaerobic power in men's soccer **(Table 3)**.

As it is shown in **Table 4**, VO2max in continuous training group shows a significant increase in posttest therefore. So high volume continues training led to a significant increase of VO2max in men football players.

As it is shown in **Table 5**, anaerobic power shows a significant increase in continuous training group in posttest.

So high volume continuous plan led to a significant increase of anaerobic power in men football players.

As it is shown in **Table 6**, VO2max shows a significant increase in both groups in posttest, while out-group changes are not significant. So, there is no significant difference between the effects of HIT plan and high volume training on VO2max in men football players.

As it is shown in **Table 7**, anaerobic power shows a significant increase in both groups in posttest, out-group changes are also significant. So, there is a significant difference between the effect of HIT plan and high volume training on aerobic power.

Table 2: Maximum oxygen consumption in Pre and Posttest

Variable	Group	pretest	Posttest	Within the group P value
VO2max ($ml\ kg^{-1}min^{-1}$)	Interval	53.8±3.9	*57.1±2.9	0/000

***Significant difference compared to pretest**

Table 3: Maximum oxygen consumption in Pre and Posttest

Variable	Group	pretest	Posttest	Within the group P value
Anaerobic power	Interval	536.4±86.2	*581.5±22.8	0/000

***Significant difference compared to pretest**

Table 4: Maximum oxygen consumption in Pre and Posttest

Variable	Group	pretest	Posttest	Within the group P value
VO2max ($ml\ kg^{-1}min^{-1}$)	Continuous	54.6±3.5	*57.6±2.5	0/002

***significant difference compared to pretest**

Table 5: Maximum oxygen consumption in Pre and Posttest

Variable	Group	Pretest	posttest	Within the group P value
Anaerobic power	Continuous	541.5±70.3	* 560.1±16.3	0/000

***Significant difference compared to pretest**

Table 6: Maximum oxygen consumption in Pre and Posttest

Variable	Group	Pretest	Posttest	Within the group	Between-group
				P value	P value
VO_{2max} ($ml\ kg^{-1}min^{-1}$)	Continuous	54.6±3.5	*57.6±2.5	0/002	0/97
	Interval	53.8±3.9	*57.1±2.9	0/000	

*significant difference compared to pretest

Table 7: The climax of examinees' aerobic power in pretest and posttest

Variable	Group	Pretest	Posttest	Within the group	Between-group
				P value	P value
Anaerobic pow	1	536.4±86.2	*581.5±22.8	0/000	**0/003
	2	541.5±70.3	*560.1±16.3	0/000	

*significant difference compared to pretest

DISCUSSION

Intense interval training is an efficient solution in improving the power of aerobic and anaerobic energy systems **[1, 6]**. It is shown that these exercises simultaneously increases oxidative and glycolytic enzymes **[1, 7]**. One step of this activity mostly is done by anaerobic paths, but it is shown that when activity steps are fallowed with short resting frequencies, the relative contribution of aerobic metabolism to the produced energy increases in which it is due to the severity of oxygen dynamism **[8]**. 5/5 % growth of maximum consuming oxygen in interval training with high intensity (P=0/002) and 5/8 % growth of maximum consuming oxygen in group 2 (P= 0/000) are aligned with VO2max increase in the studies which used active examinees after training **[9-11, 16]**. Improvement in VO2max can be because of the increase in oxygen delivery or consumption to active muscles as well as increase in capillary density and mitochondrial net **[12]**. Larsen *et al* (2005) reported lack of changes in plasma volume and hematological parameters in response to an intense interval training program. They suggested that the environmental adaptations, compared to central adaptations, are more responsible for improving performance **[13]**.

As many studies have reported the increase of activity of oxidative enzymes indicate an increase in aerobic power **[7, 14-16]**. Aligned with the findings of present study, Mac Dugal *et al* (1998) showed that 7 week HIT with Wingate protocol leads to VO2max increase(7). **Larsen and *et al* (2002)** reported that 4 week HIT leads to the significant increase (3%) of VO2max **[12**]. **Rakobowchuk and *et al* (2008)** reported 6 week HIT leads to a significant increase in VO2max **[17]**. In addition, Baily *et al* (2009) reported that 2 week HIT leads to a significant increase of VO2max. naturally, some studies also reported the lack of change in VO2max following HIT **[18]**, such as Linossier and *et al* (1993) reported lack of change of VO2max after 7 weeks (5 steps

with high intensity and 55 second rest between steps) **[16]**. In addition, Larsen and et al (2002) and Burgomaster and *et al* (2005) showed that 2 week HIT doesn't lead to a significant increase of VO2max **[12, 14]**. The lack of change of VO2 peak in these studies can be due to the use of trained individuals as examinee or short period of training (2 weeks) or the small number of training sessions. Generally, improvement in aerobic power in both groups may be due to the fact that the players were in pre-season training and had returned to training after a period away, as a result, anaerobic power had a significant improvement in short period. In other words, these changes could be with less fluctuation during season. 8/4% growth of anaerobic power in group of interval training with high intense (P=0/000) and 3/5 % growth of anaerobic power in group of continuous training with high volume (P=0/000) were observed in this study. Moreover, improvement of anaerobic power in interval training group with high intensity had a significant difference with continuous training group with high volume. Although VO2max is one of the important factors related to aerobic performance, anaerobic power in football players is of much importance during fast and short starts in the equal amount of maximum consuming oxygen, in which can be used as combinational variable of VO2max and Motion Economy (ME) in explanation of athletes' operational differences **[19]**. The increase of aerobic power in elite athletes mostly is due to ME improvement and in non-elite athletes and active people is due to the increase of VO2max, ME improvement or both **[20]**. Mechanisms associated with the increase of aerobic power after HIT, the increase of the storage elastic muscle, neuromuscular adaptations including increase of calling motor units, frequency and synchronization of motor units, which ultimately lead to increase muscular power, performance and coordination **[12]**. Improvement of the efficiency of neural adaptation, delays fatigue and enables athletes to bear higher levels of lactate production **[21]**.

Larsen *et al* (2002) reported a significant increase in aerobic power with 4 weeks of HIT in 10 trained cyclists. Duffield *et al* (2006) showed that 8 week HIT (3 sessions in week) leads to a significant increase of anaerobic training in women **[22]**. Gross *et al* (2007) reported 7% significant increase of anaerobic power with 3 week intense interval training (Consecutive or non-consecutive days of practice) in trained cyclists **[23]**. Dawson *et al* (1998) suggested that the increase observed in the running to

exhaustion after a short sprint training may be due to improvement in muscle buffering power in muscle **[24]**. In this relationship Weston *et al* (1997) observed a significant increase of skeletal muscle buffering power only after 3 week HIT **[25]**. They also found that there is a significant relationship between 40 km trail running time and skeletal muscle buffering power in highly trained cyclists. These findings suggest that improvement of aerobic performance in p HIT may be due to the increase of ability to buffer hydrogen ions (H +).

Overall, the present research studied the changes of some aerobic and anaerobic performance variables in two plans of 5 week intense interval training. The most crucial finding of this study was this point that a period of intense interval training with regards to low volume leads to the improvement of anaerobic and aerobic performance. Therefore, for increasing the effectiveness of HIT in football, there isn't too much need to increase training volume, but we can devote more time to special tactics and training. It is Interesting that tactical exercises can be performed with high intensity, so the effect of exercise was significantly predictable in the conditions of completion.

REFERENCES

[1] Gibala MJ, Little JP, van Essen M, *et al*. 2006. Short-term sprint interval versus traditional endurance training: similar initial adaptations in human skeletal muscle and exercise performance. J Physiol; 575(Pt 3):901-911.

[2] Rodas G, Ventura JL, Cadefau JA, *et al*. 2000. A short training programme for the rapid improvement of both aerobic and anaerobic metabolism. Eur J Appl Physiol; 82(5-6):480-486.

[3] Gibala MJ, McGee SL, Garnham AP, *et al*. 2009. Brief intense interval exercise activates AMPK and p38 MAPK signaling and increases the expression of PGC-1alpha in human skeletal muscle. J Appl Physiol; 106(3):929-934.

[4] Bailey SJ, Wilkerson DP, Dimenna FJ, et al. 2009. Influence of repeated sprint training on pulmonary O2 uptake and muscle deoxygenation kinetics in humans. J Appl Physiol; 106(6):1875-1887.

[5] Sperlich B, De mare M, et al. 2011. Effects Of 5 Weeks Of High-Intensity Interval Training Vs. Volume Training In 14-Year-Old Soccer Players. Journal of Strength and Conditioning Research; 25(5)/1271–1278.

[6] Rodas G, Ventura JL, Cadefau JA, et al. 2000. A short training programme for the rapid improvement of both aerobic and anaerobic metabolism. Eur J Appl Physiol; 82(5-6):480-486.

[7] MacDougall JD, Hicks AL, MacDonald JR, et al. 1998. Muscle performance and enzymatic adaptations to sprint interval training. J Appl Physiol; 84(6):2138-2142.

[8] Glaister M. 2005. Multiple Sprint Work. Physiological Responses, Mechanisms of Fatigue and the Influence of Aerobic Fitness. Sports Med; 35(9):757-777.

[9] Ross A, Leveritt M, Riek S, 2001. Neural Influences on Sprint Running: Training Adaptations and Acute Responses. Sports Med, 31(6): 409-425.

[10] Burgomaster KA, Howarth KR, Phillips SM, et al. 2008. Similar metabolic adaptations during exercise after low volume sprint interval and traditional endurance training in humans. J Physiol; 586(1):151–160.

[11] Gibala MJ, McGee SL. 2008. Metabolic adaptations to short-term high-intensity interval training: a little pain for a lot of gain? Exerc Sport Sci Rev; 36(2):58-63.

[12] Laursen PB, Blanchard MA, Jenkins DG. 2002. Acute high-intensity interval training improves Tvent and peak power output in highly trained males. Can J Appl Physiol; 27(4):336-348.

[13] Laursen PB, Shing CM, Peake JM, et al. 2005. Influence of high-intensity interval training on adaptations in well-trained cyclists. J Strength Cond Res; 19(3):527-533.

[14] Burgomaster KA, Heigenhauser GJ, Gibala MJ. 2006. Effect of short-term sprint interval training on human skeletal muscle carbohydrate metabolism during exercise and time-trial performance. J Appl Physiol; 100(6):2041-2047.

[15] Barnett C, Carey M, Proietto J, et al. 2004. Muscle metabolism during sprint exercise in man: influence of sprint training. J Sci Med Sport; 7(3):314-322.

[16] Linossier MT, Denis C, Dormois D, et al. 1993. Ergometric and metabolic adaptation to a 5-s sprint training programme. Eur J Appl Physiol Occup Physiol; 67(5):408-414.

[17] Rakobowchuk M, Tanguay S, Burgomaster KA, et al. 2008. Sprint interval and traditional endurance

training induce similar improvements in peripheral arterial stiffness and flow-mediated dilation in healthy humans. Am J Physiol Regul Integr Comp Physiol; 295(1):R236-242.

[18] Bailey SJ, Wilkerson DP, Dimenna FJ, et al. 2009. Influence of repeated sprint training on pulmonary O2 uptake and muscle deoxygenation kinetics in humans. J Appl Physiol; 106(6):1875-1887.

[19] Demarle PA, Heugas AM, Slawinski JJ, et al. 2003. Whichever the initial training status, any increase invelocity at lactate threshold appears as a major factor in improved time to exhaustion at the same severe velocity after training. Arch Physiol Biochem; 111(2):167-176.

[20] Billaut F, Bishop D. 2009. Muscle fatigue in males and females during multiple-sprint exercise. Sports Med; 39(4):257-278.

[21] Creer AR, Ricard MD, Conlee RK, et al. 2004. Neural, metabolic, and performance adaptations to four weeks of high intensity sprint-interval training in trained cyclists. Int J Sports Med; 25(2):92-98.

[22] Duffield R, Edge J, Bishop D. 2006. Effects of high-intensity interval training on the VO2 response during severe exercise. J Sci Med Sport; 9(3):249-255.

[23] Gross M, Swensen T, King D. 2007. Nonconsecutive- versus consecutive-day high-intensity interval training in cyclists. Med Sci Sports Exerc; 39(9):1666-1671.

[24] Dawson B, Fitzsimons M, Green S, et al. 1998. Changes in performance, muscle metabolites, enzymes and fibre types after short sprint training. Eur J Appl Physiol Occup Physiol; 78(2):163-169.

[25] Weston AR, Myburgh KH, Lindsay FH, et al. 1997. Skeletal muscle buffering powerand endurance performance after highintensity training by well-trained cyclists. Eur J Appl Physiol Occup Physiol; 75(1):7-13.