A COMPARATIVE STUDY OF INTERVAL TRAINING EFFECTS ON THE INDICATORS OF THE AEROBIC CAPACITY OF FOOTBALL PLAYERS UNDER 19 YEARS OLD

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Abstract

The study aimed to know the effect of interval training on the indicators of aerobic capacity, and knowing the existence of variances between the change parentages of these capabilities after the training, as that the researcher supposed that there are variances with statistical significance between pre and post measurement in aerobic capabilities after interval training, and according to the nature of the research that depends on experimental method, it has been chosen a sample research non randomly which include twenty four players from the team of Widad Mostaganem under the age of nineteen that they underwent to the training program with interval method for eight weeks which contains three quotas in the week, while the pre and post tests have conducted in order to measure their capabilities aerobic, as the results showed the existence of variances with statistical significance between pre and post measurement for the research sample and in favor of post-test, as that they showed the existence of variances with statistical significance between the change parentages of aerobic capabilities for maximum aerobic speed and anaerobic threshold.So we conclude that the interval training improved aerobic capabilities by increasing the ($VO_{2MAX,}$ VAM,AT and FC_{MAX})and the greatest influence be into the anaerobic threshold(AT) and the maximal aerobic speed(MAS) .

Key Words: interval training, Maximum oxygen uptake, maximal aerobic speed, aerobic threshold.

1. INTRODUCTION

Physical or functional preparation of body systems is very important to reach the best sport achievements. Development of skilled levels and amazing records we find in different sports certainly came as a result of the development of various sport and physical sciences and following right scientific methods by trainers attempting to make maximum use of human energy (Habib, 2006: 98). The interval training method is considered one of the most important methods used by trainers in developing functional abilities of players. Resan Kharbit, 2014 refers that it is one of the methods that develop aerobic capacity that is reflected on the operation of blood circulation (Kharbit, 2014: 174). The evaluating studies of the level of physical and functional efficiency of various body systems and organs are among the most important trends on which researchers in sport training physiology focused in order to determine optimal evaluation of physical and functional efficiency level of players in different aerobic and anaerobic sport events. This, in turn, reflects the level of functional adaptations of the various body systems due to specifications of sport events and preparation level of athletes. The aerobic capacity is considered an indicator of the functional condition of both circulatory and respiratory systems. Eyad Mohamed Abdallah et al, from Moayed Abdelhamid Al Hayali say that: "Oxygen plays a vital role in energy production processes, especially aerobic energy, and in turn, the body's ability to perform the effort and efficiency of both circulatory and respiratory systems (Eyad, 2001: 145). Among the most important indicators that express the athlete's aerobic capacity there are maximum oxygen consumption VO2 MAX and the **FC_{MAX}**. Abul Ela Ahmed Abdelfattah and Ahmed Nasreldin Elsayed, 2003 refer that levels of aerobic energy differ between its maximum and less than this current level. The term maximum oxygen consumption "VO2 MAX" is given as a measurement of the maximum aerobic capacity and this is expressed in the maximum amount of aerobic energy that can be produced by individuals in a single minute, but maximum aerobic capacity is not the main base of the performance of most sport activities. Many of these activities are practiced at levels less than maximum oxygen consumption "VO2 MAX" at limits of not less than 80% of it, so this capacity is called the **FC_{MAX}** (Sayed, 2003: 214). Al Hazaa Mohamed Al Hazaa refers that the **FC_{MAX}** is a decisive factor in the individual's ability of performing an exhausting exercise at a high percentage of maximum oxygen consumption "VO2 MAX" without being included in anaerobic metabolic processes (Hazaa, 1989: 14). Since football is one of the load activities that depend on efficiency of circulatory and respiratory systems including a combination of aerobic and anaerobic endurance and since training methods are set to develop and enhance physical and functional capacities to make players reach the best performance in the pitch, the researcher found that this is achieved through interval training on aerobic capacities of football players and the difference in percentages of these capacities.

Problem of the Study:

There are many studies that discussed the effect of interval training on physiological aerobic capacities of football players (J. Helgerud) (E. Micu, 2007, 2001) as interval training is one of the most effective training methods in making physiological changes such as maximum aerobic speed (A. Gharbi, 2010) and maximum oxygen consumption "VO2 MAX" at practitioners and non-practitioners of sports as well as the **FC_{MAX}** (J. Hekgerud, 2001) and (M. Siahkouhian, 2013). Both the **FC_{MAX}** is and the **FC_{MAX}** are two important indicators to express the aerobic capacity for football players (J. Meddelli, 1989). As various studies tackled physiological effects and aerobic capacities of interval training, they did not tackle the difference between these differences. Our study depends on identification of these differences between the effects of interval training for eight weeks on aerobic capacities of football players under 19 years old, so the following questions were posed:

Are there statistically significant differences between indications of aerobic capacity before and after interval training for football players under 19 years old?

Are there statistically significant differences between percentages of enhancing aerobic capacity indicators after interval training of football players under 19 years old?

Goals of the Study:

This study aims to identify:

- The extent of effect of interval training on football players under 19 years old.
- The differences between enhancing aerobic capacity percentages for football players under 19 years old.

Hypotheses of the Study:

- There are statistically significant differences between pre and post measurements for the sake of the post-measurement of indicators of aerobic capacity of football players under 19 years old.
- There are statistically significant differences between percentages of enhancing indicators of aerobic capacity of football players under 19 years old.

Terminology of the Study:

Interval Training: It is a training system that is characterized with consecutive exchange between fatigue and rest. The term "interval" is related to the break period between the training and the following training (Kamal, 2004).

Aerobic Capacities: It is the determining factor of the level of long time endurance. On the other hand, the level of aerobic capacity is determined by maximum oxygen consumption VO2 MAX (Al Maksoud, 1992: 223). Indicators of maximum aerobic capacity are maximum oxygen consumption VO2 MAX, maximum aerobic speed and maximum aerobic capacity. As for the **FC_{MAX}**, it represents the aerobic capacity less than maximum.

The FC_{MAX}: It is the level of body loads where the rate of moving the lactic acid from muscles to blood in a degree more than the rate of disposing it. This means that it is the point of moving from obtaining energy sources from aerobic metabolic processes to the stage of obtaining energy sources from anaerobic metabolic processes (Said, 1998: 23). It is also the intensity of the used training as to make the rate of spreading the lactic in blood more than the rate of its transportation from the blood (Al Kott, 2002: 52).

Maximum oxygen consumption VO2 MAX: It is the biggest amount of oxygen consumption during muscle operation using more than 50% of body muscles (Eldin, 2003: 215). It is also the amount of oxygen than can be consumed during maximum effort intensity (Vaast, 2008: 21).

Maximum Aerobic Speed (VMA): It is the speed that reached by players at their level of maximum oxygen consumption VO2 MAX (B. Turpin, 2002: 186).

2. METHODOLOGY & FIELD PROCEDURES OF THE STUDY:

Methodology: The researcher adopted the empirical method as it is proper for goals of the study.

Sample of the Study:

- The sample of the study consisted of 24 football players in Wedad Mestghanim club in the regional division.
- Their ages are between 0,5±18,5 years old, weights of 1,5±68 kg and length of 1,13±168,5 cm.
- Grading in training at all age categories.

Temporal Frame: 04 Aug 2013 to 30 Sept 2013 (preparation period).

Spatial Frame: The program was applied in Wedad Mestghanim club's playground. Laboratory tests were conducted in a lab of evaluating the program of physical and sport activities related to the institute of sciences and techniques of physical and sport activities at Mestghanim.

Tools of the Study: This study required the use of a set of tools including:

Automatic Movement Device, a "Poler" clock to follow heart pulses, "Sonore" device for rhythm adjustment, equipment related to training, recording forms and "Lactat Pro" device to measure the lactic percentage in blood.

The Experiment:

Tests were conducted after the first week at the beginning of the second week. Then, interval training program was applied along 7 weeks by 4 training units a week in the preparation stage (3 weeks of general physical preparation, 4 weeks of special physical preparation). Exercises were applied as a part of the main stage of the training unit. The duration of a single unit is between 90 and 120 minutes. Poler clock was used to measure the pulse as a physiological indicator of training intensity during the training session. Incomplete (active) rest to make heart pulses from 120 to 130 pulses/min (Dr. Al Hasnawy, 2014: 91 – 92). Load increase shall be consistent with intensity and frequencies' increase for each exercise. The percentage of interval training percentage was more than 70% of total main stages of the training program. Post-tests were conducted right after finishing application of the training program.

The Used Tests:

Test 1: The lucléger 1982 test for the purpose of measuring maximum oxygen consumption VO2 MAX through equation.

VO2MAX (ml/kg. min) = 31, 025 + (3,238 x running speed km/h) – (3,248 x age in years) + 0,1536 (age x speed) (185 – 184, 2002 b. turpin).

Test 2: The SL_2 test and the Maximum Aerobic Speed (VMA) in laboratory. This is done through determining the starting point of lactic acid accumulation in blood (0BLA). (Sjodin 1981) and consistent speed to make the tested reach exhaustion stage (VMA) through conducting a graded endurance test on the moving walking device till stoppage due to exhaustion. The tested athlete warms-up for 10 minutes with slight intensity with heart pulse not more than 130 beat / minutes. Next, he runs on four stages and each stage is 4 minutes with increasing speed of 2 km/h with 69 seconds break separating between stages. In the break, the amount of lactic acid in blood is read through the (Lactate Pro) device by taking a sample from fingers after sterilization with watching heart pulses (FC) along the test. After that, a chart is drawn for lactic acid and heart pulses with velocity significance determining: SL, V_{SL}, FC_{SL} at immediate escalation point with a great angle at top of the chart (Sjodin 1981), VMA, and FC_{MAX} represented in the chart's stoppage point showing that the player reached exhaustion stage (Reilly 2007, 157).

Statistical Studies:

The researchers used T Students test to determine differences between pre and post tests of the training program. In addition, percentage was used to determine the percentage of change in each indicator of aerobic capacity. The F test and LSD test were also used to determine differences between percentages of aerobic changes after training and then counting via SPSS program.

Index	VMA(km/h)		VO2MAX(ml/min/kg)		SA				FCmax(bpm)	
					FCSA(bpm)		VSA(km/h)			
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Mean	14,20	15,83	57,68	58,18	179,5	176	12,98	14,46	200	194
S.D	0,75	0,63	4,69	4,45	4,93	4,83	0,66	0,66	1,82	7,81
T Counted	3,94		4,61		2,09		1,82		0,091	
T Tabulated	1,71									
Freedom Degree	23									
Significance	Significant		Significant		Significant		Significant		Insignificant	

Showing Results:

Table (1): Difference between pre and post tests of aerobic capacity indicators

Significance level: 0.05

VMA: Maximum aerobic velocity, $VO2_{MAX:}$, SA: the anaerobic threshold , FC_{SA} is the anaerobic threshold rate of pulse, V_{SA} is the velocity of the anaerobic threshold and FC_{MAX} is maximum pulse rate.

From tables (1) and (2) we notice that the T counted value of $VO2_{MAX}$ is 3.94, VMA is 4.61, FC_{SA} is 2.09 and the FC_{MAX} is 1.82 which is bigger than the T tabulated value (1.71) except heart pulses consistent with $VO2_{MAX}$ as the T counted value (0.091) is smaller than the tabulated, we can find that:

- There are statistically significant differences at significance level 0.05 between pre and post tests of maximum aerobic velocity (VMA) for the sake of post-test with an average of 0,75±14,20 km/h before training, 4,49±57,68 mmol/min/kg and 4,45±58,18 mmol/min/kg mmol/min/kg after training with improvement percentage of 0.91%.
- As for the SA, there are statistically significant differences between pre and post tests of for the sake of post-test as the FC_{SA} was 4,93±179,5 pulse/min before training to become 4,83±176 pulse/min after training with a decrease of 2.05%.
- V_{SA} became 0,66±12,98 km/h before training and 0,66±14,46 km/h after training with improvement percentage of 10.13%
- We also noticed that there are no significant differences at 0.05 significant level between pre and post tests of FC_{MAX} as it was 1,82±200 pulse/min before training and 7,81±194 pulse/min after training with a decreasing percentage of 4.96%.

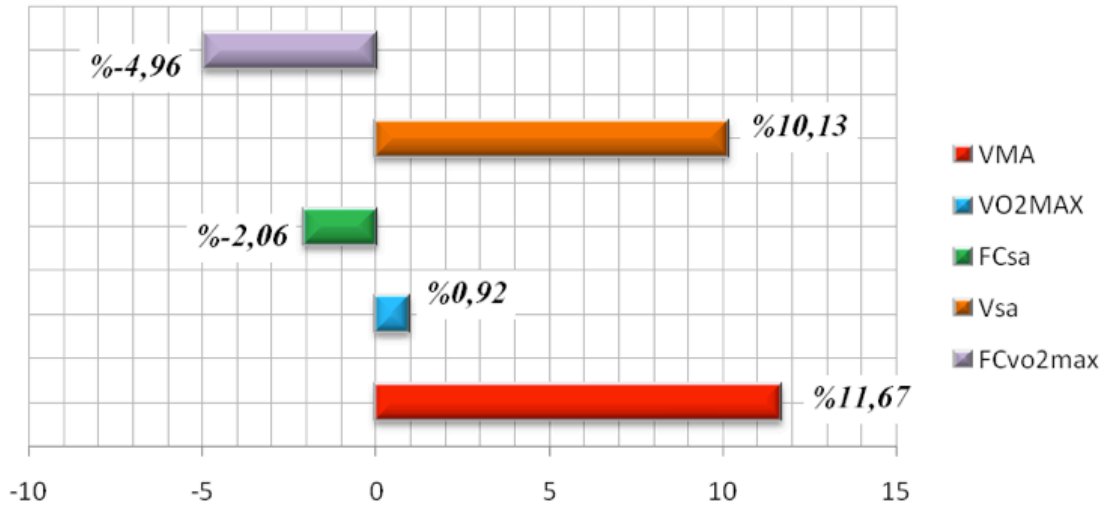

Figure (2): Change percentage in Aerobic Capacity Indicators after Interval Training

VMA: Maximum aerobic velocity, $VO2_{MAX:}$, SA: the anaerobic threshold , FC_{SA} is the anaerobic threshold rate of pulse, V_{SA} is the velocity of the anaerobic threshold and FC_{MAX} is maximum pulse rate.

Table (2): Contrast Analysis between percentages of aerobic capacity indicators for the sample of the study

Contrast Analysis						
Contrast source	Total squares	Freedom degree	Average squares	F Counted	**Significance Level**	F Tabulated
Inter-groups	2 199,95	4,00	1 315,29	5,70	0,05	2,45
Intra-groups	11 090,27	115,00	96,44			

Total	13 290,22	119,00				

Table (3): Difference between percentages of aerobic capacity change after interval training by the LSD test

		VO_{2MAX}	FC_{SA}	V_{SA}	FC_{MAX}	VMA
	Average	0,92	2,06	10,13	4,96	11,67
VO_{2MAX}	0,92	0,00	1,14	9,21***	4,05	10,75*****
FC_{SA}	2,06		0,00	8,08**	2,91	9,61****
V_{SA}	10,13			0,00	-5,17	1,54
FC_{MAX}	4,96				0,00	6,71*
VMA	11,67					0,00

VMA: Maximum aerobic velocity, $VO2_{MAX:}$, SA: the anaerobic threshold , FC_{SA} is the anaerobic threshold rate of pulse, V_{SA} is the velocity of the anaerobic threshold and FC_{MAX} is maximum pulse rate.

Through table (2), we notice that the counted F value is 5.70 which is more than the tabulated F value (2.45). This shows that there are statistically significant differences between percentages of change in aerobic abilities' indicators of football players under 19 years old. From this, the LSD test was conducted among variables through table (3) as it found that the biggest difference among averages in LSD value (5.61) is for the sake of VMA and FC_{MAX} which shows that there are statistically significant differences between for the VMA and the V_{SA}.

3. Discussing Results:

Results of First Hypothesis:

The researcher proposed that there are statistically significant differences between pre and post measurements for the sake of the post-measurement of indicators of aerobic capacity

Table (1) shows that the intervals training program affected all indicators of aerobic capacity except the $FC_{MAX.}$ In terms of statistically significant variables for the sake the post-test, change percentage (table 2) was as follows:

- The VMA is 11.66%, the $VO2_{MAX}$ is 0.91%, the FC_{SA} is -2.05% and the V_{SA} 10.13.
- As for the FC_{MAX}, although there are no statistically significances for its post-test, it decreased by -4.96% which refers that it was affected by the interval training program.
- Improvement of $VO2_{MAX}$ was asserted by multiple studies including the study of "Abdelghany Mathar" (Mathar, 2010), D. Ferrari Bravo et al, 2008 and Jan Helgrido et al, 2007. The researcher found that this improvement is resulted from the interval training on the circulatory and respiratory systems which led to increase the ability of the muscle to absorb the biggest amount of oxygen and the ability of the circulatory system to bear the biggest oxygen amount and transport it to muscles. This is also explained by the increase of heart's ability in terms of the amount of pumped blood and pumping power. All of these are functional changes that help improve the $VO2_{MAX}$. Results of the study were also different from results the study of E. Micu, et al, 2007).
- As for the VMA, the interval training had a significant effect which is shown by multiple studies such as A. Gharbi, 2010, Gegory, 2004 and Abdelrazek Budowany's study (Budowany, 2012). It explains this significant improvement with the improvement in aerobic capacity for the sample of the study. In addition, improvement of $VO2_{MAX}$ led to improve maximum aerobic capacity as this latter is just the least velocity consistent to reach $VO2_{MAX}$ which is explained in figure (3) (Monod, 2009).
- As for the (VA), its results agree with other studies including Mathar, 2010, Ayman Ahmed Elbadrawy, (Elbadrawy) 2008, D. Ferrari, Bravo et al 2008, Jan Helgrid et al, 2007 and the study of M. Siahkouhian, 2013. All of them referred that the improvement of the SA due to legalized training programs in the interval training. The researcher found that this improvement is due to the increase in players' ability to get rid of lactic acid as work in presence of lactic acid in blood with high concentration allows the SA to appear late as the interval training, by nature, is based on physiological basis which is training on conditions of lactic acid accumulation in blood. The nature of breaks of this type of training does not allow to make players completely recover, so functional systems adapt accordingly which is explained by the study of Rahim, Rowih, Habib (Habib 2006) as among its most important results that: the lactic acid exercises led to the ability to endure lactic accumulation in blood for the longest period during performance.

- As for the FC_{MAX}, it was noticed that there is no significant differences of the effect of interval training which agrees with the study of Karoly SPY et al, but there is a decrease percentage of 4.96%. The researcher found that this decrease is due to the growth of heart size and increase in its wall thickness. This leads to slow heart pulses and increase in maximum pulses of the player which is asserted by the study of Hilgrid et al (Jan, 2007).
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Thus, the first goal of the study is achieved and we became able to assert the first hypothesis of the study: there are statistically significant differences between pre and post measurements for the sake of the post-measurement of indicators of aerobic capacity for football players under 19 years old.

4. Discussing Results of the Second Hypothesis

The researcher proposed that there are statistically significant differences between percentages of enhancing indicators of aerobic capacity.

Indicators of aerobic capacity are divided into: maximum aerobic capacity indicators ($VO2_{MAX}$, VMA and the PMA) and: sub-maximum aerobic capacity indicators (SA) and they can be shown through FC_{SA}, V_{SA}, SL_2 or a percentage of $VO2_{MAX}$.

Through comparison between percentages of change toward improvement between the two types of aerobic capacity, we notice that in tables (2) and (3) there are statistically significant differences between change percentages of aerobic capacity indicators. Both VMA and V_{SA} improved by 11.66% and 10.13% consecutively, while the $VO2_{MAX}$ improved by 0.91% and FC_{MAX} by 4.46%. This shows that $VO2_{MAX}$ is not the most accurate indicator in determining aerobic capacity, but both VMA and V_{SA} are the most accurate in determining aerobic capacity of football players and in legalizing training loads. This was asserted by Aboelela Ahmed Abdelfattah as: the V_{SA} is the factor which distinguishes load players if their efficiency was equal in $VO2_{MAX}$. This fact was noticed in a great number of players such as Derrick Clayton, the Marathon player who had less $VO2_{MAX}$ than his opponents, but more in V_{SA} as with a value of 90% of $VO2_{MAX}$. Therefore, he excelled over his competitors as he runs at a high level of $VO2_{MAX}$ without increase in lactic acid accumulation (Sayed, 2003: 229). Figure (4) shows changes of aerobic capacity after training. Thus, we achieved the second goal from the study and managed to assert the second hypothesis: there are statistically significant differences between percentages of enhancing aerobic capacity indicators after interval training of football players under 19 years old.

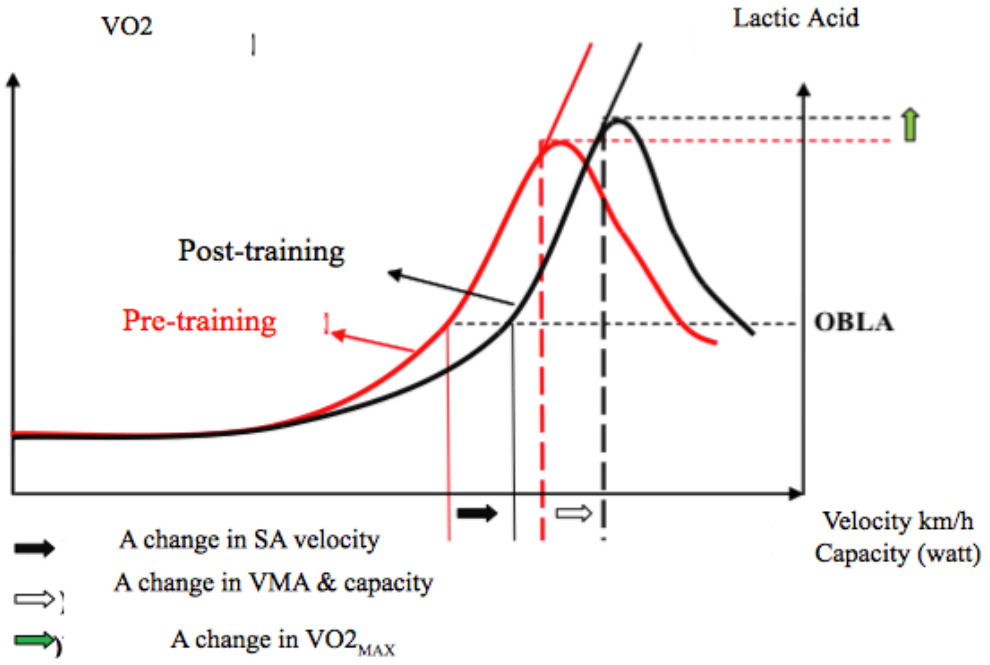

Figure (4): Changes in $VO2_{MAX}$, VMA and SA after interval training

(OBLA): The lactic acid accumulation starting point in blood = SA is the anaerobic threshold

5. Conclusions:

The researcher concluded the following:

- Interval training has a significant effect on improving aerobic capacities of football players under 19 years old.
- The VMA and the V_{SA} are the most affected by interval training than $VO2_{MAX}$ and its consistent heart pulses at training of football players under 19 years old.

Proposals & Recommendations:

- Using interval training in developing aerobic capacities for football players.
- Legalizing training loads by depending on VMA and V_{SA}.
- Conducting more researches to study the effect of interval training on both physical and functional requirements of football players and in all types.
- Conducting more researches to study the effect of other training methods on aerobic capacities for football players in all types.
- Depending on both SA and VMA to determine the level of aerobic capacities for football players.

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