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RESEARCH ARTICLE

The Effect of Anaerobic Differential Threshold Training on Some Physiological Variable among Soccer Players Ages U17 for Winner Sporting Club

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ABSTRACT

The study aimed to determine the extent of the effect of anaerobic differential threshold training in order to prepare exercises according to the differential threshold for U17 younth soccer players of the Winner Sporting Club. The study concluded that there was a positive effect of anaerobic differential threshold training, which led to the improvement and development of the studied physiological variables (Heart rate, prolonged anaxic capacity, anoxic capacity and maximum oxygen consumption (V02 max).

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1. INTRODUCTION

Despite the scientific progress in sports training, many scientific facts remain undiscovered. These discoveries are essential for the overall development of sports and, specifically, football. Continuous research is necessary to find the best ways and methods to enhance the game of football. Among these studies is the research currently in our possession.

1.1 Problem statement:

How do aerobic and anaerobic exercises (anaerobic differential threshold training) affect some physiological variables (heart rate, prolonged anoxic capacity, oxygen capacity and maximum oxygen volume (Vo2 max) ….) before and after the effort?

1.2 Research sub-questions:

1. Is there a notable statistical variance in heart rate before and after the experiment within the experimental group?
2. Does the prolonged anoxic capacity exhibit a significant statistical change from the initial to final measurements in the experimental group?
3. Is there a meaningfyl statistical alteration in oxygen capacity when comparing pre-experiment and post-experiment values in the experimental group?

4. Can a significant statistical difference be observed in the maximum volume of oxygen between the beginning and end measurements among the experimental subjects?

2. HYPOTHESES

2.1 General hypothesis: There is a statistically significant positive effect of anaerobic differential threshold training on increasing some physiological variables (heart rate, prolonged anoxic capacity, oxygen capacity and maximum oxygen volume (Vo2 max) …).

2.2 Specific hypotheses:

2.2.1 First specific hypothesis: There is a notable statistical variance in heart rate before and after the experiment within the experimental group in favor of post measurements.

2.2.2 Second specific hypothesis: The prolonged anoxic capacity exhibits a significant statistical change from the initial to final measurements in the experimental group in favor of post measurements.

2.2.3 Third specific hypothesis: There is a meaningfyl statistical alteration in oxygen capacity when comparing pre-experiment and post-experiment values in the experimental group in favor of post measurements.

2.2.4 Fourth specific hypothesis: A significant statistical difference can be observed in the maximum volume of oxygen between the beginning and end measurements among the experimental subjects in favor of post measurements.

3. STUDY OBJECTIVES:

1. Prepare a training program according to the different threshold for all football players.
2. Discorving the extent of the effect of the anaerobic differential threshold training program on some physiological variables.
3. Developing training programs for the purpose of achieving and developing the performance level of football players.

4. STUDY IMPORTANCE:

1. Discovering the best methods and strategies for developing the game of football.
2. Improving the level of physiological indicators and capabilities.
3. Developing the work of both the circulatory and respiratory systems to achieve ideal adaptation to the player's various body organs.
4. Identify the physiological changes that updated training programs cause from time to time to biological and chemical functions in order reach the best desired results.
5. Devoloping the proportion of both aerobic and anaerobic energy through training curricula updated from time to time.
6. Good physiological preparation leads to the development of the mixed energy system by increasing the efficiency of skeletal muscle cells, which leads to increased efficiency.

5. STUDY CONCEPTS:

5.1 Anaerobic threshold:

It is intensity of exercise at which the concentration of lactate and/or lactic acid in the blood begins to increase rapidly when physical effort is exerted. Glucose is consumed to provide the body with energy and turns into lactate (Gladden, Hernandez, 2007 p. 558:4).

- ***Procedural definition:*** It measures the muscle's level of tolerance for effort over a long period of time. Above that, lactate acid begins to accumulate in the blood.

5.2 Training:

It is a special, organized process of balanced, comprehensive environmental education that aims to bring the individual to the highest possible level in the chosen type of sporting activity. It also contributes greatly to preparing the individual for work, production, and defense of the homeland (Dr Abdul Raouf Muhammad Qasim Al-Rawabdeh).

- ***Procedural definition:*** They are pedagogical educational processes aimed at preparing athletes to reach higher levels at all physical, technical, tactical and psychological levels, through systematic and precise improvement of training programs that bring about morphological and physiological changes that lead to raising their efficiency to achieve great sporting achievements.

5.3. Physiological variables:

In our study, we mean the following variables: Heart rate, Prolonged anoxic capacity, and maximum oxygen volume (Vo2 max).
A-Heart rate: the number of contractions per minute. (Mohamed Ibrahim Shehata, 2008, P.69).
B-Long anoxic capacity in one kilogram and its unit is Watts/kg.(Saad Moneim Al-Sheikhly,2018,P.6).
C-Maximum oxygen volume (Vo2 max): means the maximum volume of oxygen consumed in liters or milliliter per minute relative to body weight in kilograms. (Karima Hussein Aliwi,2014,P.108).

- ***Procedural definition:*** It is a group of physiological phenomena that occur in the player's body, represented by heart rate, prolonged anoxic capacity, oxygen capacity, and maximum oxygen volume(Vo2 max) before and after physical effort.

5.4 Soccer:

It is a team sport, practiced by all people. (Rumi Jameel, 1986).

- ***Procedural Definition:*** It is a team sport for healthy football players without chronic diseases, who have similar age characteristics and are characterized by similar technical, tactical, psychological and physical kills.

6. PREVIOUS STUDIES

6.1 First study:

The 2007 study by Azab aimed to determine standardized training loads for the arms and legs and their effects on blood pressure responses and certain cardiac functions, in a comparative analysis. The findings indicated that there were significant differences between the average pre-training values showing more favorable results for systolic blood pressure, diastolic pressure, and cardiac output and pulse volume. (Azab Mahmoud Suleiman, 2007).

6.2 Second study:

A study by Hamid Abdel Fattah Khashaba and other (1993) under the title" The Effet of a Proposed Training Program on some Morphological (Body Weight, Body mass percentage, Fat) and Physiological (Heart Beat and blood pressure) Variables in the Elderly. The researcher adopted the experimental method with one group by measuring, Before and After, the aim of the study was to determine the effect the training program on rates, indicators, morphological and physiological measures, where the results concluded that there is an effect on the effectiveness and efficiency of the heart and circulatory-respiratory system among the individuals of the drawing sample, and the compulsory concentration and focus on sports programs.(Adapted by Brisan and Al-Ansar, 2001,P. 166) .

6.3 Third study:

The 2018 study conducted by Dr. Saad Moneim Al-Sheikhaly, titled "The Effect of Anaerobic Differential Threshold Training on Some Physiological Variables," concluded that anaerobic differential threshold training has a positive impact. This training led to improvements in physiological variables under study. It was found that the physical exertion involved enhance the circulatory system's capacity, owing to the alternation between periods of activity and rest. (Adapted from the First International Scientific Conference, University of Diyala, 2018).

7. METHODOLOGICAL APPROACHES:

7.1 Study method:

In his study, the researcher relied on the experimental method by making a comparison of one group using pre-and post-test, to suit the nature of the research.

7.2 Study population and sample:

(400) Players were included in a sample of 20 individuals from the study population, which is a category of football players aged U17 for the Winner Sporting Club. The research sample was chosen intentionally, to form a percentage of 5 percent of the study population, by resorting to several a priori procedure, namely:

- Excluding people with chronic diseases (obesity, diabete, smokers, health problems).
- Approval from the cardiologist to allow players to practice sports activity.

7.3 Survey study:

The researcher undertook a preliminary study aimed at discerning the advantages and disadvantages encountered during the original investigation. The study also assessed the appropriateness of the tests and measurements for the research sample members, the time required, and the reliability of the tools and equipment utilized. Furthermore, it sought to manage and delineate the responsibilities of all research team members. This was accomplished through a trial run conducted at 4:15 pm on Tuesday, October 4, 2023, during which all tests and measurements were evaluated.

7.4 Scientific principles of the study:

We dealt with physiological tests on the facts to ensure their scientific transfer, where a random sample was selected from the same research community in order to extract the scientific parameters used in the research, and this is to ensure the stability and validity of the test.

8. TOOLS AND EQUIPMENT USED IN THE STUDY

8.1 Research tools:

Stethoscope, number: 02, blood pressure device, number:01 ,track and field, electronic watch, number: 03, whistle, electronic sensor.

8.1.1 Heart rate measurement: With the help of team members, the researcher measured the heart rate, based on counting the number of heartbeats in an area slightly above the wrist area, where the radial artery (Artere radiale) is located. Using the sensory method, the number of heartbeats is counted for a period of (15 seconds), then we multiply by 4 to obtain Heart rate per minute before and after exercise physical.

8.1.2. Vertical jump test for 45 seconds:

Test objective: Measure long-term anoxic capacity.

Description of the test: The athlete performs a vertical jump for 45 seconds without interruption. We calculate the number of jumps and the total flight time during all the jumps, then we apply the following law:

Mechanical power (W/kg)=9,8 T 45/4.A(45-T).

Where: T=total flight time during all jumps. A=number of jumps in 45 seconds.

8.1.3 Test ran 2414 m:

Test objective: Measure oxygen capacity.

Description of the test: The athlete runs a distance of 2414 meters, starting from the strating line until the end of the previously indicated distance, and the running is done in a group manner for one attempt only.

Recording: The trainer then calculates the time in minutes and its parts, then puts them in a data entry table in the SPSS program to obtain statistical standards.

How to calculate V02 max: Through the following table (1), we can determine the maximum relative oxygen capacity.

Table 1: The mile and a half test at 2414 m to determine the maximum relative oxygen volume (Gene M. 1990/22-25 Adams)

V02max (min/kg /ml)	Test distance time (minutes)	(min/kg /ml) V02max	Test distance time (minutes)
39	*13.00-12.31*	*75*	*7.31*
37	*30.13-13,01*	*72*	*8.00-7.31*
36	*14.00-13.31*	*67*	*8.30-8,01*
34	*14.30-14.01*	*62*	*9.00-8.31*
33	*15.00-14.31*	*58*	*10.00-9.31*
31	*15.30-15.01*	*52*	*10.30-10.01*
28	*16.30-16.01*	*49*	*11.00-10.31*
27	*17.00-16,31*	*46*	*11,30-11,01*
26	*17.30-17.01*	*44*	*12.00-11.31*
25	*18.00-17.31*	*41*	*12.30-12.01*

9. TRAINING PROGRAM:

The training program underwent two stages:

- **First Stage:** Preliminary design of the training program.
- **Second Stage:** Presenting it to specialists (doctors, athletes, professors) for the arbitration and modification process, to produce the program in its final form (attachment to the training program arbitration form).

We have implemented the training program during the general preparatory stage for a period from 10/14/2023 until 11/18/2023, with (3) training units each week (Tuesday, Friday, Sunday), meaning 15 training units and that each A training unit lasts one hour at most, as we find a rest period between repetitions and sets (120d/min) Based on this, the percentage of anaerobic differential threshold training was determined from 15 training units, where we increased the training volume

for the first, second, third, and fourth weeks, and in the fifth week there is an excess compensation phase (see Appendix 1).

9.1 Pre- tests: On 10/11/2023, pre-tests and measurements were performed in a state of rest, that is, before any physical effort (before the warm-up). The heart rate was measured before the 2414 m test, immediately after the effort, then after 1 minute, then after 2 minutes, and after 3 minutes. Its purpose was to know the period returning the pulse to normal for the recovery period and in the same way as the jump test The vertical for a period of 45 seconds, whose goal was previously mentioned, which is to measure the long-term anoxic capacity, while the goal of the 2414 m test is to measure the oxygen capacity (note Table No (1)).

9.2 Post- tests: On the next day, 10/12/2023, the researcher conducted post-tests and measurement, taking into account ability and in the same conditions in which the pre-tests and measurements took place, with the aim of giving the credibility of the results obtained.

10. STUDY DOMAINS:

10.1 Human domain: For U17 football players (400 players) who are healthy and without chronic diseases (illness, obesity…) and who are able to practice regular sporting activity, aged about 17 years, who belong to the Winner Sporting Club .

10.2 Temporal Domain: The study continued from 10/11/2023 to 12/03/2023.

10.3 Spatial Domain: Daly Ibrahim University Football Stadium.

11. STATISTICAL MEASUREMENTS:

The ready-made statistical system (SPSS) was used to complete the dependent statistical transactions and treatments assigned to the research results.

12. PRESENTATION AND DISCUSSION OF STUDY RESULTS:

12.1 Presentation and analysis of the study results:

12.1.1 View and analyze heart rate results: Table No. (2): shows the results of the heart rate before and after (giving the curriculum), before and after (before giving the exercises and after giving the exercises), and after 1 minute, 2minute, and 3 minutes of effort.

Table 2: Shows the heart rate at different period

Variables / Statistical parameters		Measuring unit	Before		After		Calculated Value (t)	Sig	Indication
			Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
Heart rate	Before Presenting The program	Blow / min	67.10	1.93	174.5	3.710	112.28	0.00	Sign.
	After Presenting The program	Blow / min	63.8	1.861	172.10	4.010	115.017	0.00	Sign.
	Pre-test (before and after The exercises)	Blow / min	65.22	1.93	61.82	1.849	2.281	0.00	Sign.
	Post-test (before and after The exercises	Blow / min	174.72	3.708	172.22	4.055	1.711	0.237	Sign.
	After 1 minute of effort	Blow / min	164.3	2.501	149.21	1.496	12.342	0.00	Sign.
	After 2 minutes of effort	Blow / min	153.3	2.322	139.41	2.768	11.173	0.00	Sign.
	After 3 minutes of effort	Blow / min	137.8	3.426	122.61	1.413	11.952	0.00	Signi

- **Before and after implementing the program:** It is observed that the arithmetic means and standar deviations prior to the effort are (67.10-1.93), respectively, while post-effort they are (174.5-3.710). The calculated (t) value is 112.728, which exceeds the significance threshold (sig)(0.00) at (9) degrees of freedom with a significance level of (0.05). This indicates that there are statistically significand differences between the pre-and post-measurement results, with the post-measurement results showing more favorable outcomes.
- **After implementing the program:** It is observed that the arithmetic means and standar deviations prior to the effort are (63.80-1.861), respectively, while post-effort they are (172.10-4.010). The calculated (t) value is 115.017, which exceeds the significance threshold (sig)(0.00) at (9) degrees of freedom with a significance level of (0.05). This indicates that there are statistically significand differences between the pre-and post-measurement results, with the post-measurement results showing more favorable outcomes.
- **Pre-test (before and after introducing the exercise):** It is observed that the arithmetic means and standard deviations prior to the effort are (65.22-1.93), respectively, while post-effor they are (61.82-1.849). The calculated (t) value is 2.281, which is above the significance threshold (sig)(0.00) at (9) degree of freedom (9) with a significance level of (0.05), This indicates that there are statistically significant differences between the pre- and post-

measurement result before introducing the exercises, with the post-measurement results being more favorable.

- **Post-test (before and after introducing the exercis**e): It is noted that the arithmetic means and standard deviations before the effort are (174.72-3.708), respectively, while after the effort they are (172.22-4.055). The calculated (t) value is 1.711, which is above the significance threshold (sig)(0.237) at (9) degree of freedom with a significance level of (0.05). This suggests that there are statistically significant differences between the pre- and post- measurement results after providing the exercises, with the post-measurement results being more favorable.

- **Heart rate after one, two, and three minutes of effort:**
- **After one minute:** The arithmetic means and standard deviations before the effort are (164.30 -2.501), respectively, while after the effort they are (149.21-1.496). The calculated (t) value is 12.342, which is greater than the significance threshold (sig)(0.00) at (9) degree of freedom with a significance level of (0.05). This indicates that there are statistically significant differences between the pre- and post-measurement results after one minute of effort, with the post-measurement results being more favorable.
- **After two minutes:** The arithmetic means and standard deviations before the effort are (153.30-2.322), respectively, while after the effort they are (139.41-2.768). The calculated (t) value is 11.173, which is greater than the significance threshold (sig)(0.00) at (9) degree of freedom with a significance level of (0.05). This indicates that there are statistically significant differences between the pre- and post-measuement results after two minutes of effort, with the post-measurement results being more favorable.
- **After three minutes:** The arithmetic means and standard deviations before the effort are (137.80-3.426), respectively, while after the effort they are (122.61-1.413). The calculated (t) value is 11.952, which is greater than the significance threshold (sig)(0.00) at (9) degree of freedom with a significance level of (0.05). This indicates that there are statistically significant differences between the pre- and post-measurement results after three minutes of effort, with the post-measurement results being more favorable.

12.1.2 Display and analyze the results of prolonged oxygen capacity, oxygen capacity, and maximum relative oxygen volume(V02 max) :

Table 3: shows the prolonged anoxic capacity, the oxygen capacity, and the maximum relative oxygen volume (V02 max) before and after physiological effort.

Variables / Statistical parameters	Measuring unit	Before		After		Calculated Value (t)	Sig	Indication
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
Long term Anoxic capacity	Watts / kg	5.944	0.633	5.304	0.322	4.138	00.00	Signi.
Oxygen capacity	min	13.16	0.635	12.84	0.85	8.478	00.00	Signi.
Maximum Relative oxygen	Ml/kg / min	39.77	1.045	36.37	1.282	10.912	00.00	Signi.

We observe from Document No. (3) that the initial arithmetic means and standard deviations for the measurements of extended anoxic endurance, oxygen capacity, and maximum relative oxygen volume (V02 max) are (5.944-13.16-39.77) respectively, with corresponding standard deviations of (0.633-0.635-1.045). Regarding the follow-up measurements, the arithmetic means for extended anoxic endurance, oxygen capacity, and maximum relative oxygen volume (V02max) are (5.304-12.84-36.37) respectively, and the standard deviations are (0.322-0.85-1.282) respectively. The computed (t) values are (4.138-8.478-10.912), which exceed the critical significance (sig) values of (0.00-0.00-0.00) at (9) degree of freedom and a significance threshold of (0.05). This suggests that there are statistically significant differences between the pre-test and post-test results across all variables, with the post-test results showing improvement.

12.2 Discussion of results:

12.2.1 Discussing the results of tests and measurements of the cardiac and post-cardiac heart rate variable for individuals in the research sample:

By presenting the results of Table (2), which showed that there were statistically significant differences between the results of the pre-and post-tests in favor of the post-test for the sample members regarding the heart rate variable, where the researcher attributes the presence of a positive effect to the exercises with the anaerobic threshold characteristic that were implemented by the sample members. Research i.e. training Regular heart rate causes a decrease in the pulse rate, which leads to functional adaptation in the circulatory and respiratory systems which leads to improving the work of the heart, making it more efficient in its work, and meeting the body's needs for food and oxygen with fewer beats.

12.2.2 Discussing of the results of tests and measurements for the variables of prolonged oxygen capacity, oxygen capacity, and maximum relative oxygen volume (V02 max):

By presenting the results of Table (3), which showed that there were statistically significant differences between the results of the pre-and post-tests in favor of the post-test for the sample members for the variable of prolonged anoxic capacity, where the researcher attributes the reason for this to the fact that anaerobic energy is the basic energy of a football player despite the fact that the match time is classified Ball game the foot is an aerobic activity, and the lactic acid system is primary anaerobic system. As for the variable oxygen capacity, the researcher attributes it to the fact that player relies on the phosphate energy source of ATP through his performance of anaerobic activity during training or match, while the largest source of rebuilding ATP is during the middle stage of performance, relying on the aerobic system.

As for the reason for the differences between the results of the pre-and post-tests for the maximum oxygen volume variable (V02max), the researcher attributes it to the fact that sports training in general and anaerobic differential threshold training in particular and the regulator contribute to an increase in the level of maximum oxygen volume (V02 max), which leads to reducing the concentration of lactic acid in the blood significantly during physical exertion among those practicing sport (soccer) and coaches on a regular basis, as the latter is considered an indicator, standard, and conclusive evidence and good evidence of the level of physical fitness in general and the functional and physiological efficiency of the player. This all reflects on the muscles to do with ideal dynamic effort (moderate) to high intensity and for long periods of time.

13. GENERAL CONCLUSION

Through the results obtained during this study, we conclude the following:

1. There is a positive effect of the anaerobic threshold training in improving and developing the studies physiological variables, which are heart rate, long-term anoxic capacity, oxygen capacity, and maximum relative oxygen volume (V02max).

2. The ability to perform subsequent repetitions with great efficiency during the training stages despite the lack of oxygen (oxygen debt) for the phosphate and lactic energy systems.
3. Good distribution of physical effort during exercises in general and exercises specific to the anaerobic differential threshold leads to improving the maximum oxygen volume (V02max).
4. There is a positive effect in increasing the heart rate of this sample, and this is achieved through adherence in an organized manner to anaerobic differential threshold exercises.

14. RECOMMENDATION

Through this study, the researcher concluded the following recommendation:

1. Establishing physiological term, laws, standards, tests and measurement that are among the first priorities in the training curricula for football players, because of their positive, stimulating effect on the body's performance during the various stages of physical preparation.
2. Studies such as these frankly demonstrate the reality of true standards and indicators through the external and internal variables that occur in the body and the real effects resulting from the physical effort that occurs during training and even during competitions.
3. It is necessary to study other physiological variables to enhance the results of this study, in order to always search for new or new methods that achieve the desired goals with least effort and the lowest price.
4. Relying on the variable (heart rate) to codify and standardize training methods, strategies and curricula because of their effective and powerful role in increasing and raising the physical performance of football players.

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Appendix No. (1)
The training curriculum for anaerobic threshold training of (70) percent and aerobic Threshold differential of (30) percent

Vocabulary of The training curriculum	Training Unit	Day	Iintensty (percentage)	Training Volume	The Week	T
2 . (4 . 200 m)	1	Tuesday	80			
3 . 1240 m	2	Friday	75	7600	First	1
2 . (3 . 400 m)	3	Sunday	85			
(2 .200)(4 .150)	4	Tuesday	85			
2 . 2000 m	5	Friday	75	9600	Second	2
(4 . 400 m)	6	Sunday	90			
4 . 600 m	7	Tuesday	90			
4 . 1200 m	8	Friday	75	7600	Third	3
2 . 400 m	9	Sunday	95			
(4. 300)(4. 200 m) (4. 150)	10	Tuesday	95			
2 . 3000 m	11	Friday	75	8600	Fourth	4
4 . 400 m	12	Sunday	90			
(4. 150m)(5. 200m)	13	Tuesday	85			
2 . 2000 m	14	Friday	75	6600	Fifth	5
2. (5. 300)m	15	Sunday	90			