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The effect of Hyperoxic training on arterial blood gases in male 5000-meter runners

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Abstract

The importance of the research lies in utilizing the method of Hyperoxic training, which involves conducting aerobic exercises under the influence of oxygen saturation higher than the saturation level of atmospheric air, which is 21%. This is achieved by using oxygen cylinders (oxygen gas) with a saturation level ranging from 50 to 70%. It is used either through running on a treadmill or engaging in aerobic exercise on a stationary bike. The problem of the research is that most local runners are trained according to traditional training methods such as continuous training or low-intensity interval training. This has led to Iraqi national teams lagging behind their counterparts from Arab and Asian countries. The researcher also noticed the lack of Iraqi literature, to his knowledge, on studies investigating the effect of acute and cumulative physical exertion on arterial blood gases. The study aims to determine the effect of Hyperoxic training methods on arterial blood gases and the level of completion time for a 5000-meter run for male runners. The research community included long-distance runners from Al-Furat Sports Club and Akkad Sports Club in Thi Qar Governorate for the sports season 2023-2024. The most important conclusions were that Hyperoxic training method has a positive effect on reducing the accompanying decrease in arterial blood gas levels after exertion, reducing lactate levels, and improving completion time ratios. As for recommendations, it is necessary for coaches of medium and long-distance runners to focus on Hyperoxic training methods to enhance the efficiency of the respiratory and circulatory systems. Additionally, conducting a similar study to understand the effect of Hyperoxic training method on muscle electromyography is recommendedLanguage is not only an intellectual endeavor; it is also a reflection of society. It is the best means that can be used to transmit societal practices, traditions, and beliefs to others.

Keywords

Effect ،hyperoxic ،training ،arterial ،blood, ،gases ،runners

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1-1 Introduction and Research Importance:

Aerobic capacity training is characterized by not requiring maximum speed or maximum force to perform physical activities. Instead, it demands sustained performance for a long period. Therefore, it is one of the most important physical requirements that can be developed for individuals interested in general physical fitness and endurance sports. Developing aerobic capacities in endurance races aims to increase the capacity of supportive functional systems for gas transport, notably the respiratory and circulatory systems. These training methods also aim to enhance the blood's capacity to carry and transport gases to deliver a larger quantity to the working tissues. Hence, scientific institutions have sought to develop training methods to support this vital system and consequently enhance performance levels. Due to the significant role arterial blood gases play in ventilation efficiency, oxygen delivery to tissues, and acid-base balance, they are essential components of fitness programs aimed at overall health and improving the respiratory and circulatory systems' capacity to provide muscles with the required energy in terms of quantity and speed.

All studies conducted on this method have agreed on its significant benefits in increasing arterial blood gases. The researcher sees the study's importance lying in delving into one of the newest training methods globally within the local scope, transferring modern training experiences worldwide to our Iraqi and Arab libraries.

1-2Research Problem:

The researcher observed that most local runners are trained using traditional training methods such as continuous training or low-intensity interval training. This has resulted in Iraqi national teams lagging behind their counterparts from Arab and Asian countries. Additionally, the researcher noticed a lack of studies in the Iraqi library, to his knowledge, investigating the effect of physical exertion on arterial blood gases. Therefore, the researcher decided to utilize one of the modern training methods, represented by Hyperoxic training, as an additional training stimulus to enhance the research community's capacity and consequently improve their performance levels.

1-3Research Objectives:

1. To determine the effect of Hyperoxic training method on arterial blood gases among 5000m male runners.
2. To determine the effect of Hyperoxic training method on the completion time of 5000m running among male runners.

1-4 Research Hypotheses:

1. The Hyperoxic training method has a positive effect on arterial blood gases among 5000m male runners.
2. The Hyperoxic training method has a positive effect on the completion time of 5000m running among male runners.

1-5 Research Fields:

1-5-1 Human Field: Endurance runners from Al-Furat Sports Club and Akkad Sports Club for the long-distance running season 2023-2024.

[2]

1-5-2 Spatial Field: Al-Furat Sports Club Stadium.

1-5-3 Temporal Field: The period between 21/8/2023 and 10/12/2023.

2- Research Methodology and Procedures:

2-1Research Method:

The researcher utilized the experimental method with the matched-group design (control and experimental) with pre-test and post-test to suit the nature of the research problem.

2-2Research Population and Sample:

The researcher identified the research population deliberately, consisting of advanced runners (from Al-Furat Sports Club and Akkad Sports Club) in track and field for the sports season (2023-2024) in Thi Qar Governorate, totaling 12 runners.

2-3Homogeneity of Research Sample:

To ensure starting from a single baseline and to verify that the results are moderately distributed among the individuals of the research sample, allowing the experimental method to have an effect in creating differences between the research groups, the researcher conducted homogeneity testing for both groups using measures such as the mean, standard deviation, and coefficient of variation in variables (age, height, body mass, and training age).

As indicated in Table (١), it shows the means and standard deviations of the researched variables (Age, Height, Body Mass, Training Age) for the research sample.

2-

Variables	Unit of Measurement	Mean	Standard Deviation	Coefficient of Variation
Age	Month	252.64	7.176	2.84
Height	Centimeter (cm)	172.667	2.944	1.70
Body Mass	Kilogram (kg)	68.465	2.46	3.59
Training Age	Month	60.23	4.15	6.89

3 Data

Collection Methods and Instruments Used in the Research:

2-3-1 Data Collection Methods:

1. Arabic and foreign sources and references.
3. The World Wide Web (Internet).
4. Observation.
5. Personal interviews.

Testing Instruments:

1. Arterial Blood Gas (ABG) analysis device.
2. Treadmill machine (Chinese-made).
3. Oxygen cylinders (3 in total).
4. Oxygen masks according to medical standards.
5. Firing gun.
6. Device for measuring height and weight (Italian-made).
7. Digital camera for recording tests (SONY HDD).

[3]

8. Cool boxes (3 in total) for blood cooling.

2-4 Field Research Procedures:

2-4-1. Identification of Research Variables:

After reviewing relevant sources, studies, and recommendations from the Approval Committee and some experts in the field, the researcher, in agreement with the supervisor, who is an expert in physiology, identified the most important physiological variables suitable for the Hyperoxic training method based on the research objectives and hypotheses.

1. Partial pressure of oxygen (PaO2).
2. Oxygen saturation (SPO2).
3. Partial pressure of carbon dioxide (PaCO2).
4. Bicarbonate (HCO3).
5. Lactate (Lactit).
6. pH level.
7. Completion time of the 5000m race for men.

2-4-2. Description of Tests:

1. Description of Arterial Blood Gas (ABG) Tests:

Blood samples are drawn before running (during rest) by the medical staff assistant for all sample individuals and the samples are redrawn after completing the 5000m race for men. Each time, two players (1 control and 1 experimental) are selected, and the same procedure is followed for the rest of the sample individuals to ensure timing and delivery of arterial blood samples to the laboratory. The player is called by name, sits on the chair, extends his arm, and a cloth is placed under it. Then, the medical specialist assistant (assistant doctor) palpates the pulse in the wrist area and selects a palpable pulse site. The area is sterilized, and the needle is inserted slowly into the artery. When the needle is in the artery, arterial blood will appear in the needle chamber. About 3 ml of sufficient blood is extracted according to instructions. The needle is then removed, the area is sterilized again, and the player is asked to apply direct and strong pressure to the puncture site to prevent bleeding. The blood is then emptied from the needle into special tubes containing heparin, labeled with the player's name, and placed in a cooling container (Coolman). The samples are then sent to the laboratory equipped with an ABG device for measuring the studied variables. The blood sample is placed in the designated space of the device, and after pressing "start" and then "Ok," the results appear on a form containing all the information related to the studied research variables, including blood lactate ratio, pH, bicarbonate, partial pressure of oxygen, carbon dioxide, and oxygen saturation.

2. Description of the 5000m Running Test (Completion):

(Reference: Aamer Fakher Shakhati: p. 85)

2-5Field Research Procedures:

2-5-1 Preliminary Exploratory Trials:

The researcher conducted the preliminary exploratory trial on Friday, 20/10/2023, at the Al-Furat Sports Club stadium in Suq Al-Shuyukh district in the morning, involving the research community. The objectives of this trial were as follows:

1. To assess the suitability of the stadium's ground for the research sample individuals.
2. To ensure the validity of the tools and availability of the necessary resources for implementing the tests.
3. To identify common errors in players' performance during the tests and guide the assistants to alert the players to avoid them.
4. To evaluate the appropriateness of the tests for players in terms of ease and difficulty.
5. To determine the suitability of the test timing distribution.
6. To determine the time required for blood sample collection from the players and its transfer to the laboratory.
7. To determine the time needed to administer the test items.
8. To identify the best location for the medical staff and recorders to sit.

2-5-2 Second Exploratory Trial:

The second exploratory trial was conducted on Wednesday, 23/10/2023, at 9:00 AM in the "Al-Abtal" hall. The objective of the trial was to calibrate the speed of the treadmill machine to correspond with the training intensity levels intended for use in the training program. This calibration involved adjusting the speed of the treadmill machine to match each level of heart rate intensity specified in Table No. (4). Consequently, these speeds were recorded in a specific form and used as a guide during the training program periods. The recorded speeds in this form were utilized daily according to the designated intensity level for each day of the training program.

Table (٢) illustrates the ranges of intensity.

Number of heartbeats per minute	Percentage of the maximum level of individual's achievement capability	Intensity Ranges
140-130	%50-30	Low
150-140	%60=50	Light
160-150	%75-60	Moderate
180-165	%90-80	Submaximal
180	%100-85	Maximal

2-6Main Experiment:

2-6-1 Pre-Tests:

The research procedures commenced on October 27, 2023 (Friday and Saturday). All sample members attended the pre-tests along with the assisting team. The tests conducted on Friday included:

1. Arterial blood gas testing by drawing a blood sample before running (during rest) for all sample individuals.

[5]

2. 5000m running time trial.
3. After each player completed the 5000m run and the time was recorded by the observers, the player proceeded directly to the medical team for arterial blood sample collection (post-exertion).

These pre-tests were carried out on Friday, October 27, 2023, at 8:30 AM.

2-7 Main Experiment (Training Protocol):

The implementation of the research program began on Monday, October 30, 2023, and concluded on Monday, December 11, 2023. The program spanned 6 weeks, comprising 3 training units per week in the specific preparation phase for the 5000m performance, under the supervision of the coach. The researcher's role in conducting these units was focused on the treadmill, monitoring oxygen delivery between 50-70%, with durations of 25-30 minutes and heart rates between 140-165 to achieve the Hyperoxic training method.

The control group followed the coach's method for the purpose of comparison. The experiment was executed according to the following paragraphs:

- The total number of training units was 18.
- The experiment duration was 6 weeks, totaling 42 days.
- Training days were set for Saturday, Monday, and Wednesday.
- Training sessions started at 9:00 AM.
- The researcher solely implemented the Hyperoxic method during the primary section of the training unit.
- The researcher did not interfere with the coach's work for the control group.
- Continuous training method was adopted for the sample group with varying training intensities ranging from 50% to 70%, based on the sample's physical and physiological capabilities.
- Emphasis was placed on maintaining a fluctuating heart rate according to workload and the 1:2 execution ratio.
- Heart rate was controlled (140-165 bpm) during running using a heart rate monitor. If the maximum limits were exceeded, the alarm bell alerted the athletes to adjust their exertion level.
- Intensity was regulated based on heart rate.

The desired heart rate at a specific intensity = Resting heart rate + ((Maximal heart rate - Resting heart rate) * Desired intensity / 100)

2-8 Post-Intervention Assessments:

The post-intervention assessments were conducted on December 12, 2023, over two days, Monday and Tuesday, using the same conditions and procedures as the pre-intervention assessments, following the completion of the Hyperoxic training program prepared by the researcher.

2-9Statistical Methods:

After collecting the data, statistical analysis was performed using the statistical

[6]
package SPSS.V12 along with Excel. The key statistical analyses conducted included:

1. Mean (Arithmetic Mean)
2. Standard Deviation
3. Median
4. Sum of Ranks
5. Wilcoxon Signed-Rank Test for related samples
6. Mann-Whitney U Test for independent samples.

3-1 Presentation of pre-test and post-test (after exertion) results of arterial blood gases for the experimental group:

Table (3) displays the means, standard deviations, ranks means, sum of ranks, and the value (z) and Sig for the blood variables (APG) for pre-test and post-test (after exertion) for the experimental group

Variables	Unit of Measure	Groups	Degrees of Freedom	Mean	Standard Deviation	Rank Means	Sum of Ranks	Z	sig	Result
pao2	mm/Hg	Pre-test)After Exertion(	5	85.000	1.0954	0.00	0.00	2.333	0.020	Significant
		Post-test		89.166	1.1690	3.50	21.00			
SPO2	mm/Hg	Pre-test)After Exertion(	5	93.000	0.6324	0.00	0.00	2.207	0.02	Significant
		Post-test		99.200	0.6782	3.50	21.00			
paco2	%	Pre-test)After Exertion(	5	33.000	1.5491	0.00	0.00	2.207	0.02	Significant
		Post-test		37.600	0.9208	3.50	21.00			
Hco3	mmoI/L	Pre-test)After Exertion(	5	20.000	0.8944	0.00	0.00	2.226	0.026	Significant
		Post-test		24.300	0.7456	3.50	21.00			
LACTIC	mmoI/L	Pre-test)After Exertion(	5	8.1000	0.3794	3.50	21.00	2.214	0.028	Significant
		Post-test		6.8000	0.4289	0.00	0.00			
ph	H	Pre-test)After Exertion(	5	7.2017	0.1036	1.00	1.00	1.997	0.04	Significant
		Post-test		7.3200	0.0200	4.00	20.00			

3-2Presentation of pre-test and post-test (after exertion) results of arterial blood gases for the control group:

Table (4) displays the means, standard deviations, rank means, sum of ranks, and the value (z) and Sig for the blood variables (APG) for pre-test and post-test (after exertion) for the control group.

Variables	Unit of Measure	Groups	Degrees of Freedom	Mean	Standard Deviation	Rank Means	Sum of Ranks	Z	sig	Result
pao2	mm/Hg	Pre-test)After	5	85.500	1.0488	2.50	5.00	1.186	0.263	Insignificant

[7]

		Exertion(								
		Post-test		86.200	0.7483	4.00	16.00			
SPO2	mm/Hg	Pre-test)After Exertion(	5	92.800	0.4000	0.00	0.00	2.032	0.042	Significant
		Post-test		93.400	0.4690	3.00	15.00			
paco2	%	Pre-test)After Exertion(	5	32.700	1.1575	0.00	0.00	2.041	0.040	Significant
		Post-test		33.600	1.5349	3.00	15.00			
Hco3	mmoI/L	Pre-test)After Exertion(	5	20.300	1.0198	0.00	0.00	2.032	0.042	Significant
		Pre-test)After Exertion(		21.700	0.7848	3.00	15.00			
LACTIC	mmoI/L	Pre-test)After Exertion(	5	8.200	0.289	3.50	14.00	1.76	0.078	Insignificant
		Post-test		7.8000	0.089	1.00	1.00			
ph	H	Pre-test)After Exertion(	5	7.2200	0.0948	2.00	2.00	1.782	0.075	Insignificant
		Pre-test)After Exertion(		7.2600	0.0209	3.80	19.00			

3-3 Presentation and Discussion of Post-Exertion Arterial Blood Gas Test Results for the Control and Experimental Groups:

Table (5) illustrates the means, standard deviations, values (U), Sig, rank means, and sum of ranks for blood variables (APG) for the post-exertion test (post-test) for both the control and experimental groups.

Variables	Unit of Measure	Groups	Degrees of Freedom	Mean	Standard Deviation	Rank Means	Sum of Ranks	Z	sig	Result
pao2	mm/Hg	Experimental	10	89.166	1.1690	9.33	56.00	1.000	0.004	Significant
		Control		86.200	0.7483	3.67	22.00			
SPO2	mm/Hg	Experimental	10	99.200	0.6782	9.50	57.00	0.000	0.004	Significant
		Control		93.400	0.4690	3.50	21.00			
paco2	%	Experimental	10	37.600	0.9208	9.50	57.00	0.000	0.000	Significant
		Control		33.600	1.5349	3.50	21.00			
Hco3	mmoI/L	Experimental	10	24.300	0.7456	9.50	57.00	0.000	0.004	Significant
		Control		21.700	0.7848	3.50	21.00			

[8]

LACTIC	mmoI/L	Experimental	10	6.2500	0.9115	3.75	22.50	1.500	0.008	Significant
		Control		8.1000	0.3794	9.25	55.50			
ph	H	Experimental	10	7.3200	0.0200	9.42	56.50	0.500	0.002	Significant
		Control		7.2600	0.0209	3.58	21.50			

3-4Discussion of Results and Analysis:

Upon reviewing the results of arterial blood gas tests in the pre-intervention and post-intervention (post-exertion) assessments for both the control and experimental groups, as determined by the Wilcoxon signed-rank test, there are significant differences in favor of the post-intervention assessments. When comparing the post-intervention results between the independent groups, as analyzed through the Mann-Whitney U test, there are significant differences in favor of the experimental group. This difference is attributed to the independent variable (Hyperoxic training method), and it can be explained as follows:

First : the partial pressure of oxygen (Pao2)

The results from Table (5,3) indicate statistically significant differences in Pao2 between the post-tests for the experimental group. However, in Table (2) for the control group, there were no significant differences between the pre- and post-tests. The researcher attributes this to the coach's reliance on conventional training methods without incorporating modern supportive techniques. This is because high-intensity exercise is accompanied by increased oxygen demand from muscle tissues.

The researcher attributes the significant differences observed in the experimental group to the Hyperoxic training method, which significantly elevated the partial pressure of oxygen. This increase enhances oxygen saturation in the blood and facilitates oxygen delivery to organs and skeletal muscles. These improvements are primarily derived from increased arterial hemoglobin saturation (SaO2) and arterial oxygen content (PaO2), consequently enhancing oxygen delivery to tissues and skeletal muscles (Peltonen, 11: p.27). These factors contribute to improving the management of exercise-induced oxygen deficiency and enhancing energy metabolism (Nummela, 10: p.12).

The researcher also notes that Hyperoxic training significantly increases the dissolved oxygen percentage. In cases of hyperoxia, arterial oxygen content in the blood increases primarily due to dissolved oxygen. Arterial hemoglobin is almost fully saturated during conventional aerobic exercises. With an increase in FiO2, arterial oxygen pressure (pO2) rises, further elevating oxygen diffusion from arteries to muscle tissue (SPERLICH B, 13: p.47).

Second: blood oxygen saturation (Spo2):

The results from Tables (4,3,5) indicate statistically significant differences in Spo2 between the pre- and post-tests, with the experimental group showing superiority. The researcher attributes the slight improvement in Spo2 significance for the control group in the post-test to the coach's method and style, as high-intensity efforts require endurance and increased energy, necessitating modern techniques. This is what was provided to the experimental group through Hyperoxic training.

"Inhaling more O2 may reduce the loss of productivity and prolong endurance time. In this study, participants produced a 14% increase in performance under hyperoxic conditions compared to those tested with room air, and this enhanced performance may come from increased aerobic ATP production" (Cyr-Kirk S, 12: 2022). The researcher also believes that the increase in blood oxygen saturation due to Hyperoxic training reduces muscle fatigue due to ischemia and activates muscles. This aligns with the understanding that muscles involved in athletic performance naturally compete for oxygenated blood, and high training loads can lead to fatigue in these muscle groups due to poor blood perfusion, including respiratory muscles. Hyperoxic training in this context may reduce central fatigue in respiratory function and activate respiratory muscles (Dempsey, 7: 151). The researcher also believes that the increase in Spo2 through Hyperoxic training (hyperoxia) enhances oxygen diffusion from arteries to muscle tissues, and these physiological changes are responsible for increasing muscle efficiency in oxygen consumption and aerobic energy production, aiding muscles to work for a longer period and endure fatigue.

Third: Partial Pressure of Carbon Dioxide (Paco2)

Through the presentation and analysis of the results of the variable Paco2 in tables (5, 4, 3), it is evident that the experimental group has an advantage in differences. The researcher attributes the clear significance of the experimental group to the use of hyperoxic training, as it helps maintain acid-base balance by reducing the high acidity of the blood generated during exertion. There is an inverse relationship between the oxygen-binding capacity of hemoglobin and the level of partial pressure of CO2 (carbon dioxide). The physiological significance of this relationship lies in the process of carbon dioxide removal through respiration to acquire oxygen. As indicated in a study by Michael K, "The increased demand for VO2MAX during exercise or physical exertion is accompanied by a decrease in arterial oxygen partial pressure (PaO2), as well as a decrease in arterial carbon dioxide partial pressure (PaCO2) with each increase in VO2MAX value during exertion" (Michael K) (9:10). The researcher believes that the amount of carbon dioxide depends on the amount of oxygen consumption, which varies between rest and exertion. An increase in its proportion in body tissues above the normal range (45-35) leads to increased blood acidity, resulting in athlete fatigue. The researcher confirms that the hyperoxic training method addresses this condition by increasing oxygen pressure and saturation, making the partial pressure of carbon dioxide (Cao2) closer to the normal level by maintaining acid-base balance.

Fourth: Bicarbonate (HCO3).

From the values in tables (5, 4, 3) for the variable (HCO3), statistically significant differences were observed favoring the post-tests for the experimental group. The researcher attributes the improvement in bicarbonate levels observed in the experimental group to the hyperoxic training method. This improvement positively affects the acid-base balance in the blood by reducing acidity and lowering lactate acid levels, which have an inverse relationship with bicarbonate (HCO3). As noted by Mohammad Al-Khaldi, when lactate acid concentration increases in the blood, the concentration of blood bicarbonate (HCO3) decreases proportionally. Generally, respiratory processes act as vital regulators of lactate acid during exercise, indicating respiratory compensation for metabolic acidosis. The body preserves acid-base balance through key regulators such as bicarbonates, hemoglobin, and proteins. Some researchers provide evidence that increased blood bicarbonate concentration improves the performance of certain types of exercises (Mohammad Jasim Al-Khaldi).

Fifth: Lactic Acid"

The researcher attributes the superiority of the differences exhibited by the experimental group in the post-tests in Table (5,3) to the method of Hyperoxic training responsible for enhancing muscle efficiency in oxygen consumption and aerobic energy production. This helps the muscle to work for longer periods and endure fatigue, consistent with what Stellingwerff mentioned: it has been proven that training with hypoxia reduces central and peripheral fatigue and improves performance (i.e., higher energy production and exercise tolerance) as a result of delivering oxygen at higher levels and changes in aerobic and anaerobic metabolism. For example, hypoxia in respiration with an increased oxygen ratio (FIO2 = 0.6) during exercise, at 70% intensity of V̇O2max, decreases glycogen utilization in muscles by about 33% compared to the normal state (Stellingwerff) (14: p. 98). As for the non-significant results for the control group in Table (2), the researcher attributes them to the decreased oxygen balance due to high exertion, which is confirmed by Abu Al-Ala (2003): "The occurrence of fatigue in muscle fibers resulted from insufficient oxygen levels and inadequate blood flow" (Abu Al-Ala

Ahmed Abdul Fattah) (2: p. 211).

Six: Acid-Base Balance (pH).

The statistical results in table (5, 4, 3) demonstrate the superiority of differences in favor of the experimental group concerning the (pH) values. This indicates the success of the training program as it contains the necessary requirements for proper training, notably the Hyperoxic training. "Modern sports training should include exercises that target the same organic systems involved in the physical activity" (Mohammed Hadi) (22: p.6). The researcher attributes the superiority of differences to the Hyperoxic training method, which removes metabolic byproducts and heat from contracted muscles, and delivers nutrients and oxygen to them through circulatory activity. This leads to increased muscle recruitment due to the availability of energy that meets the body's needs during exertion, and improved oxygen consumption. It is one of the most important measures reflecting the functional status of the runner's body because oxygen plays a fundamental role in energy production processes, especially aerobic energy in physical exertion, and the adequacy of the respiratory and circulatory systems to meet these performance requirements (Ibrahim Al-Sakar et al.) (1: p.94).

The researcher believes that increasing the balance of oxygen partial pressure (Pao2) enhances control over the acid-base balance, reduces CO2 elevation, and decreases acid concentrations. As mentioned by (Mohammed Jasim), an increase in hydrogen ion concentration leads to a decline in pH, an increase in blood acidity, and the condition is called acidosis. Conversely, when hydrogen ion concentrations decrease, pH increases, and the solution becomes more alkaline, known as alkalosis.

$CO2+H2O \rightarrow H2CO3 \rightarrow H+ +HCO3$

The relationship becomes apparent when the quantity of CO2 in the blood increases, leading to an increase in H2CO3, which lowers pH by raising the acid concentration in the blood, such as the movement reaction to the right in the pH measurement indicator. Conversely, when the CO2 content in the blood is low, for example, when CO2 is reduced by the lungs, the blood pH increases due to the reduction of the acid present, causing the reaction to shift to the left. Therefore, the respiratory system provides the body with rapid means to regulate blood pH by controlling CO2 pressure in the blood (Mohammed Jasim Al-Khaldi) (6: 275).

As evidenced by Table 2 for the control group in the pre-post tests (after exertion) for the variable (PH), the researcher attributes the lack of significant differences to the method followed by the coach, the lack of modern reinforcement methods, and the decrease in blood oxygen pressure (Pao2) due to the high exertion leading to increased blood acidity.

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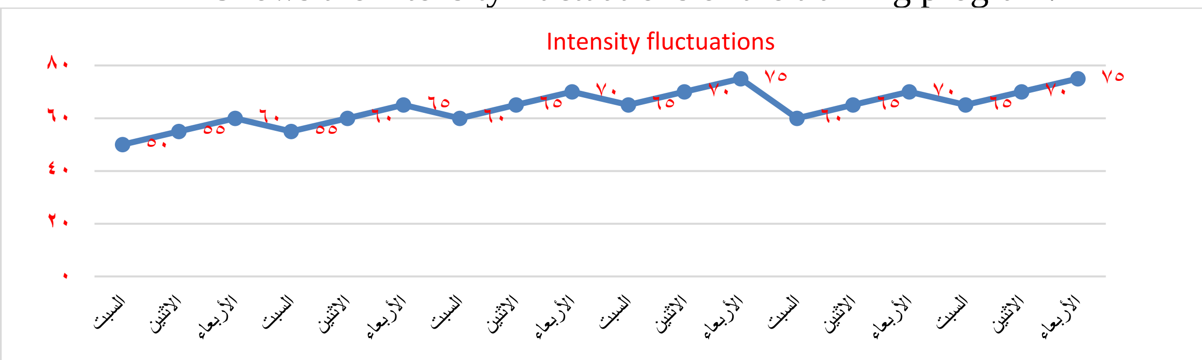
[13]

Appendix (1)

Shows the intensity fluctuations of the training program.



Appendix (2)

Illustrates the training program.

Training Unit
Educational Objectives: Integration and interaction among players
Intensity: 50-75
Educational Goals: Hyperoxic training method
Heart Rate: 140-165 bpm
Tools and Materials Used: Field, cones, whistle, flags, stopwatch
Duration of the Unit: 60-90 minutes
Conclusion

[14]

Training	**Week**	**Weekly Training Volume**	**Heart Rate (beats/min)**	**Intensity (%)**	**Training Unit**	**Day**	**Daily Training Volume**
1	1st	23 km	140 / 150	% ٥٠	1	Saturday	8000
				% 55	2	Monday	8000
				% 60	3	Wednesday	7000
2	2nd	22 km	150 / 155	% 55	4	Saturday	8000
				% 60	5	Monday	7000
				%65	6	Wednesday	7000
3	3rd	20 km	155 / 160	% 60	7	Saturday	7000
				% 65	8	Monday	7000
				% 70	9	Wednesday	6000
4	4th	19 km	160 / 165	% 65	10	Saturday	7000
				% 70	11	Monday	6000
				% 75	12	Wednesday	6000
5	5th	20 km	155 / 165	% 70	13	Saturday	6000
				% 65	14	Monday	8000
				%70	15	Wednesday	6000
6	6th	20 km	160 / 165	٪65		Saturday	8000
				% 70		Monday	6000
				% 70		Wednesday	6000