**A comparative study for functional response of the respiratory system according to the energy systems of tennis players**

**Keyword**

**Compare Energy Systems**

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**Abstract**

In the introduction the researchers touched on the progress made in the athletic level and the importance of practicing sports, due to the great role in achieving the desired goal in relation to the general health of the individual and society, or what is related to the sport of high achievement, which is a reflection of the changes and functional responses that occur in the internal organs of the body. The research aims to know the functional response of the respiratory system and compare it with the training units according to the energy systems of the tennis players, the researchers used the descriptive approach, the sample consisted of (12) players, team of the College of Physical Education and Sports Sciences - University of Diyala, they were divided into (3) groups, The researchers concluded that there is a discrepancy between the three groups in the functional response according to the energy systems.

# **1 Introducing the research**

## **1-1 Introduction and the importance of research:**

According to the great development that the world has witnessed in recently with regard to the importance of sports, due to the significant and influential role in the public health for the individual and society, as well as its role in high achievement sports, The individual’s athletic level has increased in recent decades as a result of the success of medical sciences and their harnessing to what is appropriate to raise the level of athletes in terms of physical and health, and this is confirmed by the literature that physiology science has become a basic rule For all sports training operations. The progress of the individual's athletic level is only a reflection of the functional changes and responses that occur in the internal organs, and according to these functional changes and responses, the individual's functional capabilities increase. The tennis game is one of the sports that requires high effort among its practitioners, due to the high speed and fitness need in performance, despite of the tools size and the small area of its stadium, this matter has a great impact, causes internal pressure on the functional systems, especially circulatory and respiratory systems. The importance of the research lies in conducting a comparative study of the functional response of the respiratory system for training units based on the working energy systems for tennis players.

## **1 – 2 Research problem**

Researches and scientific literature have indicated that the growth and safety of vital systems in the body related to the practice of sports activities. The physiological aspect still presents the active side for research and investigation, especially after the technological progress in the medical devices. To answer some of the questions that represent the research problem:

A comparative study of the functional response of the respiratory system to the training units according to the working energy systems of the tennis players.

## **3-1 research objective**

1. Identifying the functional response of the respiratory system to the training units according to the working energy systems of the tennis players.

2. Comparing the functional responses of the respiratory system to the training units according to the working energy systems of the tennis players.

**4-1 Assuming the search**:

There are statistically significant differences in the functional response of the respiratory system to the training units according to the energy systems.

**5-1 Research areas**:

**5 - 1 - 1** : The human field: a sample of ( 9 ) players from the students of the College of Physical Education and Sports Sciences, representing Diyala University tennis team .

**5-2** : Spatial field: Laboratory of the College of Physical Education and Sports Sciences – Diyala University.

**5 - 3** Temporal field : for the period from 9/2/2022 to 1/2/2023

## **6-1 Definition of Terms**

Energy: is the ability to produce work

- Adenosine triphosphate ( ATP ): a chemical substance found inside the body and contains high energy required for muscular work and it is fuel for cells in general and the muscle cell in particular ( Ayed Fadl 1999: p. 328).

# **2- Research methodology and field procedures :**

## **2-1 Research Methodology**

The researchers used the descriptive approach as it is the appropriate approach to address the research problem based on the survey method, "as the survey is considered one of the basic approaches in descriptive research " (Ahmed Badr 1978: p. 279) .

## **2-2 Research sample :**

The research sample consisted of ( 9 ) players representing the College of Physical Education team in the tennis game, who were chosen by the intentional method, this sample represents the entire research community.

## **2- 3 Tools and devices used in the Research :**

### **2-3-1 Research tools**

Observation

Personal interviews .

Direct measurement.

**2-3-2 Equipment used** :

Digital camera ( 1) type ( Sony ) , Japanese made.

A Chinese – made HP computer ) computer + device software .

Treadmill treadmill \_

- Fit mate pro device , made in Italy

A medical device for measuring height and weight.

A clock to measure time .

### **2 -3- 3 Fit mate pro**

The Fit mate pro device is one of the products of the Italian company Cosmed specialized in the manufacture of sports and medical laboratory devices, along with papers or the catalog attached to it, and it is one of the reliable companies on the global level that produces a lot of modern laboratory devices, this product is one of the latest devices manufactured on The global level, which is one of three production lines:

1 - Fit mateBasic : (Fitmate basic device).

2 - Fit mate Med : (Fit mate medical device).

3 - Fit mate Pro : (The professional Fitmate device), which was used in the research.



Figure (1)

( Cosmed — 2009 ) on behalf of (Fit mate pro) the device

Each of these devices has its own characteristics and mostly used in the field of physical education (Fit mate Pro ), its programming Setting based on the latest recommendations of the American College Sportmedicine ( ACSM ) ( Zina Ibrahim Mahdi 2011: p. 55) .

The device measures a set of functional indicators in the direct way during a test

Rest and stress test, the most important of which is the metabolic rate and the maximum consumption of Oxygen,it must be used under the supervision of a qualified and experienced person, the instructions for measurements must not be exceeded.

Fit mate pro device consists of the following parts, as shown in Figure (1):

1 - Color display screen ( LCD ) size 8 inches.

2 –keyboard.

3 - Data cable and air connections.

4 - An internal laser printer.

5 - Other accessories :

\* Receiver and transmitter signals (USB ) for the pulse works as a definition of Bluetooth Attached to the belt worn by the tester.

\* Masks for both the metabolic rate index and the maximum intake Oxygen.

## **2-4 Measurements used in the research:**

## **2-4-1 Measuring body length and weight**

The lengths were measured using a device (medical scale detector) type ( medical scale detector ), as the player stands on the base of the device without shoes, and the device projects rays on the player’s head from the upper end of the digital device, then two numbers appear on the digital screen, the first number represents the length of the player in centimeters, and the second number represents the weight of the player in kilograms.

### **2-4-2 Measuring breathing indicators with ( Fit mate Pro ) device :**

Measurement of breathing indicators is carried out in a direct way through the use of the Fit mate Pro device , which is as follows:

Proper warm-up for the player for time not less than ( 5 ) minutes to avoid injuries that may occur during the implementation of the test.

The assistant team links the connections of the device after entering the data of the player, then putting on the mask for the voltage on the player’s face so it covers the nose and mouth areas, after which the device is turned on, taking into account that the playe in a position that enables it to see the researchers throughout the hypothetical test period specified for each test.

|  |  |  |
| --- | --- | --- |
| **code** | **reading** | **measuring unit** |
| **T** | **time** | **m.s** |
| **VE** | **pulmonary ventilation rate** | **liters / min** |
| **RF** | **breathing rate** | **times/min** |
| **HR** | **heart rate** | **stroke / min** |
| **FeO2** | **The rate of oxygen concentration in exhaled air** | **%** |

The player stands on the ( Traed mill ) device and run it at the specified speed for each of the three tests allocated in the research.

## **2-5 Exploratory experience:**

To avoid mistakes and reach the implementation of the research steps within the scientific controls, the exploratory experiment was conducted on Monday 12/19/2016 on a sample of two students who are good at practicing tennis. The researchers helped in :

Calculating the total time of the test for each player.

Ensure the safety of the devices and tools used.

- Benefiting from some of the mistakes that the researchers faced during the exploratory experiment and trying to correct them in the main experiment.

Ensure the efficiency of the work team.

Determine the appropriate time for the player to start warming up.

## **2-6 The main experience**

The main experiment was conducted on days 2 , 4 , and 7/10/2022 in the Physiology Laboratory at the College of Physical Education and Sports Sciences . On the first day, the first research group test was conducted to obtain breathing indicators using maximum effort (90-100%) for a period of 15 seconds or what called anoxic method. On the second day, the submaximal effort (80-90%) was used by the second group for a period of 2 minutes to obtain breathing indicators. By the lactic method, on the third day, the test was conducted on the third group, using medium effort (70-80%) for a period of 5 minutes to obtain breathing indicators by the oxygen method, as the tests were conducted and indicated in the researchers' procedures.

## **2-7 Statistical means :**

The researchers used the SPSS statistical package to reach the results of the research using this

Arithmetic mean .

standard deviation .

Analysis of variance for three groups.

significant difference LSD .

# **3- Presentation and discussion of results**

## **3-1 Displaying the results:**

### **3-1-1 displaying the results of the RF test:**

|  |  |  |  |
| --- | --- | --- | --- |
| **the group** | **Sample volume** | **Arithmetic mean** | **standard deviation** |
| **not oxygenic** | **3** | **54,266** | **1,413** |
| **lactic** | **3** | **49,055** | **5,462** |
| **Oxygenic** | **3** | **55,388** | **3,352** |

Table ( 1) The sample size, mean, and standard deviations of the research sample in the RF test show the respiratory rate.

Table (1) shows in the breathing rate test, sample size, the arithmetic mean, and the standard deviations of the research sample. The arithmetic mean of the anoxic group was ( 54,266 ) and its standard deviation was ( 1,413 ), while the lactic group had a mean of ( 49,055 ) and its standard deviation ( 5,462 ). The arithmetic mean for oxygen group ( 55,388 ) and the standard deviation ( 3,352).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **source of variance** | **square groups** | **degrees of freedom** | **mean of squares** | **F value** | | **Statistical significance** |
| **calculated** | **Tabular** |
| **between groups** | **205,57** | **2** | **102,78** | **7,159** | **3,40** | **0,004** |
| **within groups** | **344,57** | **24** | **14,35** |
| **groups** | **550,15** | **26** |  |

**• Significant at the error level ( 0.05 ) if the error level is less than ( 0.05 ).**

Table ( 2) It shows the variance between groups and within groups and the F value calculated for research groups in the ( RF ) test.

Table ( 2 ) shows the statistical features of the variance analysis for the three groups in the tennis game. The value of squares summation between the groups was (205.57) , which is greater than the tabular (q) value of ( 3.40 ), and this indicates the existence of significant differences among the three groups in the tennis game, and to know which groups are better, the Least Significant Difference ( LSD ) method was used.

|  |  |  |  |
| --- | --- | --- | --- |
| **Significance of differences** | **significance level** | **medial difference** | **variants** |
| **non-moral** | **0,536** | **-1,122** | **m2 x m3** |
| **moral** | **0,002** | **-6,333** | **m 1 x m 3** |
| **moral** | **0,002** | **6,333** | **m2 x m1** |

* **Significant at the error level (0,0 5( if the error level less than(0,0 5(**

Table ( 3) It shows the difference of the means, the levels of significance, and the significance differences for the research groups in the R test. ( RF )

It can be seen from Table ( 3 ) regarding the estimation of the least significant difference for the RF variable that:

- The differences between m 2 and m 3 are not significant , as the difference of the two arithmetic means was ( -1,122 ) , while the calculated ( LSD ) value was ( 0.214 ). Since the difference of the two means was greater than the calculated ( LSD ) value, this indicates that the differences are not significant at the level of The error is ( 0.05 ) , knowing that the error level is (0.536 ) .

- Significant differences between M1 and M2 in favor of group 1, as the difference of the two arithmetic means reached

(-6333 ) , while the calculated ( LSD ) value was ( 0.221) , and since the difference of the two means was greater than the calculated ( LSD ) value, this indicated the significance of the differences at the error level (0.05 ) , noting that the error level is high ( 0,002 ).

- Significant differences between m2 and m1 in favor of the second group, as the difference of the two arithmetic means was ( 6,333 ), while the calculated ( LSD ) value was ( 0.063 ), and since the difference of the two means was greater than the calculated ( LSD ) value, this indicated the significant differences at the error level ( 0.005 ). Note that the error level is ( 0.002 ) .

### **3-1-2 Presentation of the results of the pulmonary ventilation ( VE ) test :**

|  |  |  |  |
| --- | --- | --- | --- |
| **the group** | **Sample volume** | **Arithmetic median** | **standard deviation** |
| **Non oxygenic** | **3** | **65,088** | **2,957** |
| **lactic** | **3** | **64,700** | **3,330** |
| **Oxygenic** | **3** | **72,844** | **25,120** |

Table (4) The sample size, mean, and standard deviations of the research sample in the VE test show the rate of pulmonary ventilation.

Table ( 4 ) shows the sample size, the arithmetic mean, and the standard deviations of the research sample in the pulmonary ventilation rate test. The arithmetic mean for the anoxic group was ( 65,088 ) and the standard deviation for it was ( 2.9 5 7 ) . As for the lactic group, the arithmetic mean for it was ( 64,700 ) and the standard deviation for it. It has ( 3,330 ) , as for the oxygen group, the arithmetic mean was ( 72,844 ) and the standard deviation was ( 25,120 ).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **source of contrast** | **square groups** | **degrees of freedom** | **mean of squares** | **F value** | | **Statistical significance** |
| **calculated** | **Tabular** |
| **between groups** | **379,89** | **2** | **189,94** | **7,159** | **3,40** | **0,004** |
| **within groups** | **5206,89** | **24** | **216,95** |
| **groups** | **5586,78** | **26** |  |

**\* Significant at the error level ( 0.05) if the error level is less than ( 0.05 ).**

Table (5) It shows the variance between groups and within groups and the F value calculated for the research groups in the pulmonary ventilation rate ( VE ) test.

Table (5) shows the statistical parameters of variance analysis for the three groups in the tennis game In a test, the value of the sum of squares between groups was (379.89), with a degree of freedom (2), and the mean of squares (189.94), and the calculated (q) value was (0.876), which is greater than the tabular (q) value of (3.40). This indicates that there are significant differences between the three aggregates in the tennis game, and to determine which aggregates are better, the least significant difference (LSD) method was used.

|  |  |  |  |
| --- | --- | --- | --- |
| **Significance of differences** | **significance level** | **medial difference** | **variants** |
| **moral** | **-7,755** | **0,275** | **m2 x m3** |
| **moral** | **-8,144** | **0,252** | **m 1 x m 3** |
| **moral** | **8,144** | **0,252** | **m2 x m1** |

**\* Significant at the error level ( 0.05) if the error level is less than ( 0.05 ).**

Table (6) It shows the mean difference, variance levels, and differences for the pulmonary ventilation variable rate ( VE ) .

It can be seen from Table (1) regarding the estimation of the least significant difference for the ( VE ) variable that:

- Significant differences between m2 and m3 for the second group, as the difference of the two arithmetic means was ( -7,755 ) , while the calculated ( LSD ) value amounted to (0.214 ) , and since the difference of the two means was greater than the calculated ( LSD ) value, this indicates significant differences at the error level ( 0.05 ) , noting that the error level is ( 0.27 5 ).

- Significant differences between M 1 and M 3 for the first group, as the difference of the two arithmetic means reached ( -8,144) , while the calculated ( LSD ) value was ( 0.221 ), and since the difference between the two means was greater than the calculated ( LSD ) value, this indicated significant differences at the error level (0.05 ) , noting that the error level was ( 0.252 ) .

- Significant differences between m2 and m1 for the second group, as the difference of the two arithmetic means reached ( 8,144 ), while the calculated (LSD) value was ( 0.063 ), and since the difference of the two means was greater than the calculated ( LSD ) value, this indicated the significant differences at the error level ( 0,0 5 ) , noting that the error level is ( 2 5 2 ).

### **3 - 1 - 3 Presentation of the results of the average concentration of**

Oxygen in exhaled air ( FEO2 )

|  |  |  |  |
| --- | --- | --- | --- |
| **the group** | **Sample volume** | **Arithmetic mean** | **standard deviation** |
| **Non oxygenic** | **3** | **15,277** | **0,373** |
| **lactic** | **3** | **15,496** | **0,911** |
| **Oxygenic** | **3** | **16,566** | **1,186** |

Table ( 7) The sample size, the arithmetic mean, and the standard deviations of the research sample in the ( FEO2 ), show the rate of oxygen concentration in the exhaled air.

Table ( 7 ) shows the rate of oxygen concentration in exhaled air ( FEO2 ), the size of the sample, the arithmetic median, and the standard deviations of the research sample. The arithmetic mean for the anoxic group was (15,277) and its standard deviation was (0.373), while the lactic group had a mean of (15,496) and its standard deviation. ( 911 ). As for the oxygen group, the arithmetic mean was ( 1.6.566 ) , and the standard deviation was ( 1.18.6 ) .

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **source of variance** | **square groups** | **degrees of freedom** | **mean of squares** | **F value** | | **Statistical significance** |
| **calculated** | **Tabular** |
| **between groups** | **8,562** | **2** | **4,281** | **5,402** | **3,40** | **0,012** |
| **within groups** | **19,018** | **24** | **0,792** |
| **groups** | **27,580** | **26** |  |

**\* Significant at the error level ( 0.05 ) if the error level is less than ( 0.05 ) .**

Table ( 8) shows the variance between groups within groups and the F calculated value for research groups in the ( FEO2 ) test.

Table ( 8 ) shows the statistical features of variance analysis for the three groups in the tennis game . the value of squares between groups (8,562) with freedom degree (2) and median squares(281,4). F value is (402,5) which is greater than the tabular (F) value ( 3.40 ), and this indicates the presence of significant differences between the three totals in the tennis game, to determine which aggregates are better, the least significant difference ( LSD ) method was used.

|  |  |  |  |
| --- | --- | --- | --- |
| **Indication of differences** | **significance level** | **medial difference** | **variants** |
| **moral** | **0,005** | **-1,288** | **m2 x m3** |
| **moral** | **0,018** | **-1,070** | **m 1 x m 3** |
| **moral** | **0,018** | **1,070** | **m2 x m1** |

**\* Significant at the error level ( 0.05 ) if the error level is less than ( 0.05 ).**

Table No. ( 9) Shows the difference of the means, the significance levels and the significance differences for the variable ( FEO2 ).

It can be seen from Table ( 9 ) regarding the estimation of the least significant difference for the ( FEO2 ) variable that:

Significant differences between m 2 and m 3 of the second group , as the difference between the two arithmetic means was ( -1,288 ) , while the calculated ( LSD ) value was ( 0.214 ),since the difference between the two means was greater than the calculated ( LSD ) value, this indicated the significant differences at the error level. ( 0.05 ) , noting that the error level was ( 0.005 ) .

Significant differences between m 1 and m 3 of the first group , as the difference of the two arithmetic means was ( -1,070 ) , while the calculated ( LSD ) value was ( 0.221 ) . The error is ( 0.05 ) , noting that the error level was ( 0.018 ).

- Significant differences between m2 and m1 of the second group, as the difference of the two arithmetic means was (1,070) , while the calculated ( LSD ) value was (0.063) , since the difference of the two means was greater than the calculated ( LSD ) value, this indicated the significant differences at the error level. ( 0.0 e) , knowing that the error level is ( 0.018 ).

## **3-2 Discuss the results**

### **3-2-1 Discussing the results of the respiratory rate ( RF ) test :**

It can be seen from Table ( 3 ) refers the estimation of the least significant difference for the RF variable that:

2 and m 3 are not significant, as the difference between the two arithmetic means was ( 122 , -1) while the calculated ( LSD ) value was ( 0.214 ). Since the difference between the two means was greater than the calculated ( LSD ) value, this indicated that there is no significant differences at The error level is ( 0.05) , noting that the error level was (0.536) , and the researchers mentioned the reason for the lack of differences between the two groups to the fact that the performance period of two groups was close, as the performance of the second group was about ( 90 seconds) with an effort below The maximal, which led to a high rate of pulmonary ventilation for the second group, while the third group performed moderate physical effort in performance period of ( 240 seconds), which caused a high rate of pulmonary ventilation. Thus, the mean difference between the two groups was small, which led to the absence of significant differences between the two groups , " the rate of ventilation increases with increasing physical effort, as lactic acid accumulates and then passes into the blood, thus increases the hydrogen ions in the blood leads to alerting the nerve centers of breathing so speed the pulmonary ventilation." ( Ma Ardle 2000: p 22 ).

- Significant differences between M1 and M3 of the first group, as the difference of the two arithmetic means reached ( -6,333 ), while the calculated ( LSD ) value was ( 0.221 ), and since the difference of the two means was greater than the calculated ( LSD ) value , this indicated the significant differences at the error level. ( 0.05 ) , noting that the error level reached ( 0.002 ) , and the researchers noted the reason behind this, the first group needs a large pulmonary ventilation more than the third group, the oxygen group, because the first group depends on obtaining oxygen through oxygen debt, especially directly after the end of the effort, the depth of breathing and the number of breaths increase his times to compensate for the lack of oxygen, while the third group suffices with the oxygen taken by breathing during the effort.

- Significant differences between m2 and m1 in favor of the second group, as the difference between the two arithmetic means was ( 6,333 ) , while the calculated ( LSD ) value was (0.063), and since the difference between the two means was greater than the calculated ( LSD ) value, this indicated the significant differences at the error level ( 0 ). 0.5 ) , noting that the error level reached ( 0.002 ) , and the researchers attribute the reason for this to the fact that the second group needs a large pulmonary ventilation more than the first group the oxygen group, because the first group depends on obtaining oxygen through the oxygen debt, directly after the end of the effort, as the depth breathing numbers increases to compensate the lack of the oxygen, while the third group is satisfied with the oxygen taken by breathing during the effort . “Pulmonary ventilation depends on the accumulation amount of lactic acid in the muscles.” ( Ma Ardle 2000: p 21

### **3-2-2 : Discussing the results of the pulmonary ventilation ( VE ) test:**

By presenting the results in Table ( 6 ), we notice that there are significant differences between all groups The researchers explained the reason of that is the body's need for oxygen varies based on the effort performed by the research sample, as each system of energy production has a corresponding actual need for the body. When a person performs muscular effort, the amount of carbon dioxide that added to the blood increases from Muscles, so partial pressure in the blood rises, which leads to alert the nerve centers related to breathing, especially the nerve center for inhalation so it sends nerve impulses to the breathing muscles that increases the speed of respiratory movements. As a result of this increase, the body quickly gets rid of carbon dioxide with exhaled air, so the partial pressure in the blood decreases, and respiratory movements gradually return to their normal speed. An increase in the amount of carbon dioxide in the blood is the important factor in normal conditions. The reason for the superiority of the second group is that this group performs a high-intensity effort for a relatively long period, causing an increasing in breathing rates so it can compensates the body for its increased need for oxygen , as it is mentioned ( Fox, EL 1993: p127 ) “ As the arrangements and activities that operate with the second system energy causes a rise and accumulation of lactic acid in the blood, and to get rid of it, the lack of oxygen must be compensated through high rates of pulmonary ventilation . And agrees with him ( Bompa, TT . 1981: p44 ) “ During rest time, the amount of lactic acid in the blood ranges from ( 15-20 ) mg per 100 cm3 of blood . As a result of the exercises, especially the hypoxic exercises (the anoxic exercises with the lactic acid system, up to more than 160 mm per 1 00 cm 3 of blood and in games in which the deoxygenated energy system (lactic acid system) is the main system in the game as in middle distance running ( 800 m, 1 500 m , 3000 m) lactic acid reaches K to more than ( 200 mg) per 100 cc in blood .

### **3-2-3 : Discussing the results of the oxygen concentration rate test in exhaled air ( FEO2 ): -**

By presenting the results in Table ( 9 ), we notice that there are significant differences between all the groups, and the researchers attribute the reason behind this the body's need for oxygen varies according to the effort performed by the research sample, as each energy production system has a corresponding actual need for the body And this is what seemed clear through the results, the results showed the prevalence of the anoxic systems over the oxygenic system, as the decrease in the percentage of oxygen in the exhaled air means the utilization of oxygen during energy production processes, and since the respiratory processes and energy production in the first and second systems took place in the absence of oxygen, this means an increase in the demand for oxygen during the period followed by the effort to compensate for the oxygen debt required by energy production processes. Therefore, the performance of exercise, especially intense ones, leads to an increase in the rate, depth of respiratory movements and an increase in pulmonary ventilation, as well as an increase in chemical stimulations to the respiratory centers as a result of the increase in metabolism came out of muscle effort . , and this is what Delecluse, C.1997: p147-156 mentioned , that the oxygen concentration or its partial pressure is not considered an important factor in normal conditions. Helps in regulating the breathing process. even if the partial pressure of oxygen in the air of the alveoli decreases to (60) mm Hg, large amounts of oxygen remain bound to hemoglobin in the form of oxyhemoglobin. During physical exertion, especially in carrying out the physical tasks of the first and second systems, incomplete oxidation processes occur that result in certain substances, the most important of them is lactic acid, which increases in the blood, and there are chemical receptors in the walls of the aorta and the carotid artery that are affected by a decrease in the amount of oxygen or an increase in the amount of lactic acid . These receptors send nerve impulses to the nerve center related to breathing, working to alert them, thus increasing respiratory movements, and raise the amount of ventilation, which then reaches eight or nine liters per minute, and this increase is not compared to the increase that occurs in the carbon dioxide.

# **4- Conclusions and recommendations**

## **4-1 Conclusions:**

Through the results of the research, the researchers reached the following conclusions:

- There is a contrast in the results of respiratory rate ( RF ) between the research groups It showed high breathing rates in the anoxic groups , and there was a contrast in the results of pulmonary ventilation ( VE ) between the research groups . ) Among the research groups, it showed high rates of respiration in the anoxic groups and a clear superiority in the second group (Lactic system). There is a variation in the results of oxygen concentration in the exhaled air FEO2 , among the research groups, it showed higher respiratory rates in the anoxic groups and clear superiority in the first group, i.e. that works with the ATP-PC system.

## **4-2 Recommendations: -**

The researchers recommend the following:

The necessity of diversity in training when preparing sports teams and emphasize on training with the oxygen energy system to build a solid physiological base during the general preparation stage, then moving to special training based on the energy system of the game. Repeat the experiment on different samples, each one use its own system, and compare them. Maximum benefit of the Fitmate device in conducting research experiments and prepare sports teams obtained results.

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