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The effect of moderate-intensity exercises on the level of Hemoglobin and Iron in the blood and the incidence of sports Anemia among long-distance runners

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Abstract

The study aimed to identify the effect of moderate-intensity exercises on the level of hemoglobin and iron in the blood and the incidence of sports anemia among long-distance runners.The exercises wereapplied on (6) long-distance runners from the Anbar Governorate team. The pre-tests were obtained after the study parameters were chosen by the researcher, which included measuring the level of hemoglobin and iron in the blood. Then, the research sample performed physical exertion on a treadmill with medium intensity for 10 days, at a rate of (60) minutes per day. Post-tests were carried out and variants had been measured in the same way that was used in the pre-test measurements. The results were analyzed and discussed based on previous studies that are similar in content to the current study, and it was concluded that moderate-intensity physical efforts led to a decrease in hemoglobin and iron levels in the blood. The researcher recommended the need for trainers to monitor the level of hemoglobin and iron in the blood of athletes because of their important role in transferring oxygen to tissues and cells and getting rid of carbon dioxide quickly so that the athlete can perform his physical and skilled duties in an integrated manner.

training plan, especially if this plan works to develop the athlete's physical elements and capabilities.The science of physiology associated with sports training has developed so that it studies the smallest details that work on adapting the functional organs of the body according to the components of the external load of training, which includes intensity,

1 – Definition of research:

1.1Introduction and The Importance of Research:

Training and physiology scientists are currently pursuing to study the responses that occur to the athlete's body after performing the physical exercises related to the training units and included in the

natural level will inevitably affect the runner in terms of health and physical, and thus will affect his achievement and reaching a high level in the performance.

1.2Research Problem

The lack of hemoglobin and iron in the body is one of the major problems that athletes suffer from, especially long-distance runners.However, understanding such problems helps to get rid of one of the important obstacles facing the runner in maintaining the normal ratio of hemoglobin and iron in the blood due to their importance in transporting the appropriate amount of oxygen to the cells responsible to produce the energy needed to perform the exercises and movements required for their sporting activity, whether during training or competition.

The problem of the research is the lack of trainers and runners with sufficient information about the role of hemoglobin and iron in the blood and following up their levels before and after training or competition to get rid of their deficiency, which may lead athletes to anemia and thus have a negative impact on their physical performance in general. So the researcher decided to study this problem to identify the effects of hemoglobin and iron deficiency in the blood to reach the results that may be useful to raise long-distance runners to their best levels.

size and density. Moreover, this science has improved further by studying everything related to those changes that occur in the athlete's body, such as blood components, hormones, enzymes and mineral elements, especially iron.

Hemoglobin and iron are among the main components of the blood, as their importance lies in their major and basic role in transporting oxygen from the lungs to tissues and cells to carry out their tasks in metabolic processes to produce the energy that the athlete needs when performing the exercises included in the training unit optimally.As well as getting rid of the wastes of energy production, especially carbon dioxide, and delivering it to the lungs to excrete it out through exhalation. Therefore,iron is one of the important components of hemoglobin, which is part of red blood cells, and its deficiency leads to a decrease in the body's production of hemoglobin and red blood cells, so it is a vital element of the nutrients that the human body needs.

The importance of the research lies in the study of hemoglobin and the iron element and knowing their effects on the functional organs of the runner's body and the effect of physical effort on their natural levels, especially since a decrease in their

consists of two parts: heme and globin, Hemoglobin in general consists of four protein molecules called globulin chains connected to each other, and the natural hemoglobin molecule (HGB) or (Hb) contains two alpha globulin chains and two beta globulin chains, each chain of globulin contains an important compound called porphyrin that contains iron, which is called Heme. It is a vital iron atom that works to transport oxygen and carbon dioxide as a link between the cells of the body and the lungs **[1]**.

Hemoglobin is measured by a CBC test after a blood sample is drawn, as the normal range for hemoglobin for men ranges between (14-18 g/dl), and thus the World Health Organization confirms that a man whose hemoglobin level is less than (13) grams for each liter is a sign that a man has anemia**[2]**.

Exercises affect the level of hemoglobin in the blood, leading to a decrease in its percentage and weakening the ability to carry out its vital functions by transferring oxygen and carbon dioxide between the lungs and cells working in the performance of physical exertion, but hemoglobin levels are not expended until iron supplements are drained, meaning that hemoglobin levels do not change during the latent stages for iron deficiency.

1.3Research Aims

1. Identifying the effect of continuous physical exertion of moderate-intensity on the level of hemoglobin and iron in the blood of the research sample.
2. Identifying the effect of continuous physical exertion of moderate-intensity on the percentage of the research sample suffering from sports anemia.

1.4Research Assumptions

1. There are statistically significant differences between the pre and post-tests in the level of hemoglobin and iron in the blood of the research sample.
2. There are statistically significant differences between the pre and post-tests in the percentage of the research sample suffering from sports anemia.

1.5Research Fields:

1.5.1 The Human Field: a sample oflong-distance runners of the Anbar Governorate team.

1.5.2 Time Domain: for the period from 07/12/2019 to 12/19/2019.

1.5.3 Spatial Domain: The closed hall of Al-Ramadi Club in Anbar Governorate.

2. Theoretical Studies:

2.1Hemoglobin and Iron:

Hemoglobin is one of the important proteins in the body and it

for the availability of oxygen to cells to produce the energy required to perform their continuous exercises, which are characterized by the absence of rest times between them.

Although iron is one of the trace elements found in the body, it enters the composition of all cells of the body and plays an important role in growth and secretions.In addition, the iron in hemoglobin is what gives blood its red color, and the importance of iron for the human body lies in its main role in transporting oxygen from the lungs to all tissues and cells of the body in order to use it in the production of energy needed to perform its vital functions, as well as the transfer of carbon dioxide resulting from the remnants of energy production from cells to the lungs to be excreted away.

The body obtains iron from food, especially those rich suppliesof this mineral. Dietary iron is classified into heme iron and non-heme iron. Heme iron is abundant in red meat, poultry and fish, as red meat is one of the richest sources of dietary iron because it contains three times more iron than what is found in other types of meat,The sources of non-heme iron are fruits and vegetables, and the ability of the body to absorb heme iron from the digestive system is double its ability to absorb non-heme iron because non-heme iron needs vitamin (C)

Iron is considered to be one of the important elements for the human body, because "(75%) of the weight of iron in the body is included in the composition of hemoglobin, especially in red blood cells and the oxide found in the mitochondria, and the remaining (25) part of the iron weight is stored in the body in the form of ferritin (Ferritin)"**[3]**.Iron is the central iron atom in hemoglobin that combines with oxygen, as four atoms of oxygen combine with a hemoglobin molecule. There are (280) million hemoglobin molecules in red blood cells, and each red blood cell carries more than a billion oxygen molecules, and the body contains more red blood cells than any other type of cell that consists of (97%) hemoglobin and the life of these cells is approximately (120) days, after which they are constantly replaced by new cells, as iron plays a major role in the renewal of these cells **[4]**.Iron is about (3) grams of the weight of a human body who weighs (70) kg, and the body needs (18) milligrams per day, and its normal value in the human body is (41-132) mcg/100 milliliters of blood serum, and the natural human body losesabout (1) milligrams per day excreted with feces or skin cells **[5]**.

Athletes need iron more than other people, and long-distance runners need iron more than other athletes due to their continuous need

because this metallic element is directly responsible for delivering oxygen to all cells of the body, especially the brain cells. The basic importance of the iron absorption mechanism is to maintain its level in the body if the body experiences a limited physiological loss of iron, especially for long-distance runners, whose bodies are more exposed than others to the loss of iron as a result of its consumption when transporting oxygen to cells that are responsible for the physical performance, so, the iron absorption mechanism must be compatible with the requirements of the runner's body, which needs to compensate for the loss of iron during its continuous physical exercises. On this basis, "the amount of iron that crosses the small intestine, in which most of the iron is absorbed, is related to the state and level of iron in the blood.", the rate of iron entry into the blood depends on the amount of ferritin present in the intestinal mucosal cells, which in turn depends on the amount of transferrin. When iron is deficient, the level of ferritin in the mucosal cells decreases, allowing more iron to pass into the plasma, most of the iron passes through the mucosal cells by binding to the protein apoferritin, forming ferritin molecules. Moreover, Intense training leads to an increase in the saturation of plasma transferrin and this delays the release of iron from the mucosal cells of the small intestine even during times of that helps in its absorption.So eating foods rich in vitamin (C) with Iron-containing foods increase the amount and balance of iron for both types **[6]**.

Iron absorption depends on the amount of iron and its vital activity. Heme iron has a high biological activity, and this activity helps it to be easily absorbed, as (10% - 37%) of heme iron is absorbed that is found in red meat in the form of divalent ferrous (Fe^{+2}). Meat stimulates the stomach to produce its acids that promote and facilitate the absorption of heme iron in the tissues of the digestive system,especially the upper part of the small intestine. As for the non-heme iron found in vegetarian foods, which represents the largest amount of dietary iron, its vital activity is somehow weak, therefore, less than (10%) of its intake is absorbed into the body. While Non-vegetarian heme iron shown in the form of trivalent Ferric (Fe^{+3}) is bound to insoluble compounds, its absorption varies widely depending on other components of the diet system. However, trivalent ferric must be reduced to divalent ferrous with the help of vitamin C to be easily absorbed**[7]**.

The lack of iron in the body makes a person more exposed to many health problems such as anemia, blood pressure imbalance, and the possibility of heart disease;

The natural iron deficiency is formed as a result of the successive decrease in the level of iron in the body, and this decrease works to deplete the iron stores continuously, which leads to the person suffering from iron deficiency anemia. We find this type of anemia in some athletes, especially long-distance runners, who often lose some iron from their bodies due to the requirements of their sporting activities,which exercises are ongoing for a long time and continuously, which requires the continuous availability of the recompense of iron to transfer oxygen to muscle cells that are responsible for the physical performance to carry out the metabolism process and provide the energy needed to complete the physical effort throughout the training or competition period, therefore, some long-distance runners develop this type of iron deficiency anemia (sports anemia), which is directly related to iron deficiency. Among the reasons that a runner may develop sports anemia are poor iron absorption from the gastrointestinal tract, low iron concentration in the blood plasma, poor red blood cell formation, or all of them together, these reasons are carried out in stages that depend on the intensity and volume of training and the structural rest times between groups or between one training unit and another, and It often occurs through the performance of physical intermittent rest, this reduces the saturation of transferrin, which in turn allows iron absorption, an increase in the number of red blood cells, as well as an increase in hemoglobin concentration**[8]**.

2.2Sports Anemia

Anemia occurs as a result of a lower level of iron and hemoglobin in the blood than the normal range, and low hemoglobin is often associated with a low number of red blood cells. In addition, anemia leads all the organs and tissues of the body to be negatively affected, as the patient suffers from fatigue, weakness and lack of energy to carry out his normal activities.

There are types of anemia that are divided according to their causes and level of severity, one of them includes iron deficiency anemia due to malnutrition and\or the one that affects some athletes as a result of their performance of various sports activities. Another type is anemia related to the work of the bone marrow, which is responsible for the production of red blood cells, such as aplastic anemia or myelodysplastic syndrome, or diseases related to the bone marrow directly, such as marrow cancer, lymphoma, and solid tumors, plus some other like Hemolytic anemia which is caused by the loss or breakdown of red blood cells before the end of their normal life cycle**[9]**.

as the loss of some iron when the body loses water through urine or sweating that accompanies physical exercise throughout training.

Another reason for a runner to suffer from sports anemia is "some of his digestive system tissues have small cracks in the intestinal walls as a result of the pressure they are exposed to when the runner engages in violent exercises, which causes the loss of a lot of iron without the runner feeling it, but sports doctors can determine this through the symptoms that It appears in the runner in the form of shortness of breath, a feeling of fatigue, and a delay in understanding speech, so urgent measures must be taken and appropriate nutritional supplements should be prescribed to compensate for the iron lost by the runner, otherwise he will be in danger of losing health" **[10]**.

3. Research Methodology and Field Procedures:

3.1Research Methodology:

The researcher used the experimental method by designing one group with two tests, pre and post-tests, for its suitability to the nature of the research problem.

3.2Research Sample:

The research sample was tested in a purposive method and consisted of (6) long-distance runners from the Anbar Governorate team. Table (1) shows the exercises, especially those that depend on the method of continuous training, which is characterized by medium intensity and large training volume as a result of the long period of performance of the exercises of this training method. If the causes are diagnosed separately and well-treated, the iron balance will be restored in the body in any of these stages.

Sports anemia is characterized by a short duration of infection, as we can detect it by measuring the level of hemoglobin, which is below the normal level when practicing sports activities that reduce the concentration of hemoglobin and red blood cells and the volume of working cells in athletes, especially at the beginning of the training season, Sports anemia rarely leads to clinical anemia because it often disappears after completing the training unit if it is diagnosed and iron-rich nutritional supplements are taken to get rid of the exacerbation of its effects if the iron lost by the body during physical exertion is not compensated because endurance exercises work.Completion of the training module if it is diagnosed and iron-rich dietary supplements are taken to eliminate worseningeffects if the iron lost by the body during physical effort is not compensated because endurance exercises weaken the iron ion's ability to perform its role in continuous oxygen transport, as well

the research sample. homogeneity of age, training age and biochemical variables understudy for

Table (1)
Shows the homogeneity of the sample members

Variables	Measuring Unit	Mean	Standard deviation	Median	Kurtosis*
Age	**year**	**24.50**	**1.788**	**25**	**0.839**
Training Age	**year**	**5.00**	**2.168**	**5.5**	**0.692**
Iron Serum	**Mcg / dl**	**113.82**	**1.138**	**114.04**	**0.580**
Hemoglobin Serum	**g / dl**	**15.89**	**0.569**	**15.79**	**- 0.527**

* The distribution is moderated if the values of the Kurtosisare less than (± 3).

treatment according to the equation:
C = A x 36.8

A standard curve and a standard table are prepared, running under successive dilutions of Standard solution, whose concentration is as follows (1:5. 1:4. 1:3. 1:2). These capacitors are read after setting the device with a Drabkin solution, and then a graph curve is drawn to estimate hemoglobin with a (grams/liter) unit per reading, from which we make a standard table for all readings.

The final output of this equation is recorded in the form of measurements to be used as a basis for blood hemoglobin level, measured by unit (microgram/100 ml) .

3.3.2 Test the Level of Iron in the Blood [12]:

Measurement objective: To know the iron concentration in the

3.3Pre-Tests:

Measurements were made on the research sample on 07/12/2019 at four o'clock in the evening in the Ramadi Sports Club Hall, as the following were taken:

3.3.1 Test the level of Hemoglobin in the Blood [11]:

Measurement objective: To know the level of hemoglobin in the blood.Measurement method: (Drabkin).Measurement procedure;

1. Add (20 microns of EDTA + blood) to (5) milligrams of Drabkin solution and mix well.
2. The sample is placed at room temperature for (15) minutes to ensure that hemoglobin turns brown.
3. The sample is measured in the Spector Photo Meter at a wavelength of (540) nanometers.

Recording: The result of the device is taken to enter a statistical

less than the normal level as a result of consuming some of them when they transfer oxygen to tissues and cells when carrying out the research sample for the required physical effort, or losing some of them when urinating or continuous sweating that is accompanied by the exit of some mineral elements from the body when the research sample performed exercises that last for a full hour without giving the sample intermittent rest times. The researcher used pulse measurement to extract the required intensity according to the following equation:

Pulse value = degree of load % x (maximum heart rate - pulse at rest) + resting pulse rate **[13]**.

3.5Post-Test:

The post-tests were carried out in the same way as the Pre-tests, as the researcher took the required measurements on12/19/2019

3.6Statistical Means: [14]

Arithmetic means, median, standard deviation, torsion modulus, t-test for symmetric samples.

blood. Measurement method: (0.5) ml of blood serum is treated on two samples (standard solution and control solution) separately, i.e., we need (1.0) ml of serum, the treatment is done with iron chemicals (lactate), and after waiting for (20) minutes, we read the absorbance at a wavelength of (595) nanometers with a spectrophotometer (Spector Photo Meter).

3.4The Main Experience:

The research sample is constantly walking on a moving treadmill according to the method of continuous trainingwith intensity ranging between (70% - 60%) of the maximum capacity of the research sample over a period of ten days at a rate of (60) minutes per day, as the sample continues to perform this effort without stopping.The purpose of using this training method is to know its effects on the percentage of hemoglobin and the level of iron in the blood after executing jogging exercises according to the required intensity, whose quantities may be

4. Presentation, analysis and discussion of the results:

4.1Presentation and analysis of the results:

Table (2)

Statistical treatments for the pre and posttests of the research variables

Variables	Pre-test		Post-test		X Variance	S Variance	T-test Cal.	Results
	X	S	X	S				
Iron serum	114.04	1.138	110.19	1.201	3.848	0.300	12.827	Significant
Hemoglobin serum	15.79	0.569	14.81	0.703	0.982	0.077	12.753	Significant

in an integrated manner.Although the decreases recorded for hemoglobin and blood iron were within the normal level of their amounts in the body, they are not without negative effects on the performance of the runners to ensure that they perform their functions appropriately because the runner needs to maintain their full natural rates in order to deliver adequate quantities From oxygen to working cells so that they, in turn, produce the energy needed to complete the physical effort in an integrated manner, depending on the specifics of the game and its physical and skill requirements, whether during training or competition.

The researcher sees that the specific effectiveness of training of long-distance runningwhich requires the performance of sports exercises characterized by continuity and continuous running, makes the runner sweat a lot as a result of the continuous physical effort, as well as the continuous work of tissues and cells working in the metabolic processes to produce energy for the continuation of the physical effort. In training or competition,the body loses a small amount of iron in the sweat, but with profuse sweating, especially that which accompanies long-distance runners, the runner's body loses iron excessively, as "the amount of iron in the sweat reaches (400 mcg) / liter and when the effort is executed. Physically, the runner's

The results of Table (2) related to the Pre and Post-tests of the research variables (Iron serum, Hemoglobin serum) recorded positive differences between the two measurements, before and after, amounting to (3.848, 0.982), while the deviations of those variance were (0.300, 0.077), thus the value of "calculated T-test" for the variables of research was (12.827, 12.753) respectively, and when it comparedwith the tabular degree which was (3.365) at the significance level (0.01) and the degree of free (6-1=5), to obtain the significance of the differences between the two tests, it was found that the value of "calculated T-test"was greater than its tabular value, so the significant differences were in the side of the post-tests of all the variables understudy.

4.2Discuss the Results:

The researcher attributes the low level of hemoglobin and iron in the blood, which was confirmed by the significant differences between The pre and post-tests of the research sample showed continuous physical effort on the treadmill with a training intensity that ranged between (60% - 70%) of the maximum capacity of the runners for a period of (90) minutes without rest times, and this led to a decrease in the percentage of iron in the blood that affected the establishment of hemoglobin to perform its functions

noticing them even during rest because the runner's body adapts temporarily to withstand the deficiency in iron stores despite the low blood viscosity and the lack of oxygen delivery to the muscles working in performance"**[17]**.But this type of adaptation accompanies a long-distance runner's injury to sports anemia without feeling unsuitable for the runner's body due to the capabilities andrequirements of this athletic activity to produce the energy needed to perform its exercises continuously and for a long period of time without stopping, so with a decrease in the iron level and an increase in physical performance, the heart becomesunable to pump larger amounts than it pumps at the normal level, and this "leads to weak oxidation in the tissues so that the blood circulation cannot meet the oxygen requirements, which leads to acute failure of the heart muscle"**[18]**.Thus, the weak ability to perform the requirements of physical performance in an integrated manner, in addition to the increase in the heart rate and the increase in the level of lactate with continuous training has a significant impact on the level of physical performance of the runner, as his ability to perform exercises at the same level decreases with the passage of time.

The researcher believes that physical exercises according to the method of continuous training led to loss through sweat may reach three liters of body water accompanied by minerals, including iron, and this leads to an increase in the body's iron loss from (0.4 mg) to (1 mg per day)"**[15]**.

This large amount of iron lost by the body leads to an increase in the volume of blood plasma, the breakdown of red blood cells and a decrease in the level of hemoglobin, these reasons make the runner suffers from sports anemia that results in a low pH in muscle cells. Which reduces the metabolic processes of skeletal muscles, as "continuous exercise leads to poor performance of hemoglobin below the optimal level due to a decrease in the amount of iron"**[16]**.

Continuous training leads to a decrease in blood viscosity and a weak ability of hemoglobin to deliver oxygen and remove carbon dioxide from the muscles working in motor performance. This affects the mechanism of the circulatory system and thus increases the workload of the heart significantly.As the low blood viscosity leads to a weakening of the surrounding resistance in the veins and arteries so that more blood is returned to the heart than usual, which leads to an increase in cardiac output two or more times than its normal value.However, "this increase in cardiac production prevents the athlete from showing symptoms of anemia without

hemoglobin in the blood of the research sample.

- Continuous exercise of moderate-intensity led to a decrease in the level of iron in the blood of the research sample.
- Sports anemia is a temporary condition in most cases resulting from a low percentage of hemoglobin and iron in the blood of the runner as a result of his continuous exercise that does not include rest-times.
- A runner can get rid of the sports anemia that accompanies physical activity by taking nutritional supplements rich in iron.

5.2Recommendations:

- Emphasis on long-distance runners taking nutritional supplements rich in iron to compensate for the loss of hemoglobin and iron when they perform the continuous physical effort that characterizes their sports activities.
- Athletes eat all meat, especially red meat, because it is rich in heme iron, which compensates for iron ions and its lost storage as a result of sports activities.
- Athletes eat more fruits and vegetables because they are rich in non-heme iron, while taking vitamin C, which helps in its absorption easily.

a decrease in the level of iron in the blood as a result of its consumption or loss through sweat or its exit with the blood when cracks occur in the intestines or other reasons. Therefore, the body resorts to withdrawing more iron stored in the form of ferritin. As "when measured, it was found that the ferritin storage of long-distance runners was less than normal because of its consumption compared to their implementation of exercises that last for a relatively long period of time" **[19]**.If the level of this storage decreases, the hostility will develop sports anemia caused by iron deficiency, and its symptoms will appear in the feeling of hostilityfatigue and lethargy because it reduces the ability of the runner to perform the appropriate performance to the fullest extent due to the lack of adequate oxygen access to the working muscle cells, which weakens the metabolism in the muscles to produce energy, and often the symptoms of sports anemia disappear after rest times between training units, especially when the runner takes nutritional supplements Rich in iron to restore blood iron and its stores of ferritin to their normal level.

5. Conclusions and Recommendations:

5.1Conclusions:

- Continuous exercise of moderate-intensity led to a decrease in the proportion of

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- The need for athletes to take vitamins and substances that help absorb both heme and non-heme iron from the body in order to increase the amount and balance of iron for both types.
- Conducting periodic examinations for long-distance runners to identify the percentage of hemoglobin, the level of iron ion, and the iron storage of ferritin in the blood.
- Examination of long-distance runners constantly through stool analysis to identify that they have had bleeding in the tissues of their digestive system resulting from their continuousexercise because of its negative effects on iron loss directly.

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