

# **THE EFFECT OF FARTLEK TRAINING ON SOME HORMONES AND SPEED ENDURANCE IN (400) METERS RUNNERS**

**Asst. Prof .Dr. Abdullah Bahr Fayyad / Open Educational College - Anbar Studies Center**

**Email : [d.a.bahar1961@gmail.com](mailto:d.a.bahar1961@gmail.com)**

## **Research abstract**

The study aimed to identify the effect of fartlek training on some hormones and speed endurance in 400-meter runners. The study was performed on the Anbar province team for applicants with a running activity of (400) meters, and their number is (5) runners. The researcher hypothesized that the fartlek training would lead to changes in the level of the cortisol and thyroxine hormones and the level of speed endurance in the research sample. The researcher used the experimental method for its suitability to solve the problem of his research. And the researcher concluded that the fartlek training led to increase in the level of the cortisol hormone and developed the ability of speed endurance, while the thyroxine hormone maintained its level in the research sample. The researcher recommended the adoption of this training method in developing the speed endurance of (400) meter runners, as well as emphasizing that the trainers have to track the differences in the amount of hormone secretion under study, and the level of their concentration in the blood because of their important and basic role in the metabolic processes of energy production to make athlete reaches the best levels.

## **1 – Definition of research**

### **1 – 1 Introduction and importance of research:**

Coaches have recently increased their interest in identifying the changes caused by the external load of sports training according to the training methods and techniques they use on the internal load represented by physiological changes of the functional organs of the athlete's body, especially the changes and adaptations that occur to the muscular, nervous and glandular systems, and acknowledge the effect of physical exercises on the ability of the glands to secrete hormones necessary for the metabolism process, which leads to the production of sufficient energy to perform the required exercises according to the method or technique of training that are followed, especially the fartlek training method which is different from other training methods because it depends on manipulating the speed and intensity of the exercises, and for this, it is considered one of the best methods that develop the ability of the body's functional systems to adapt to the performance of sports activities that fall within the non-oxygenic energy production systems, both phosphate and lactic, as well as the adaptation of those functions for exercises that fall within the framework of the aerobic energy production system. The importance of the research lies in studying the effect of fartlek training on the hormones secreted by some glands, as well as its effect on the endurance of the working muscles in the (400) meter running activity as quickly as possible.

### **1 – 2 Research problem:**

Through the researcher's experience in athletics activities as a former runner and running coach, he noticed that the trainers do not rely on modern scientific methods when training runners, especially their lack of interest in knowing the physiological changes that occur to

the runner's body organs and their responses to physical exercises that ultimately lead to adapting those organs to the stresses and training loads that the runner needs to reach the best achievements. Therefore, the researcher decided to study this problem by putting physical exercises according to the Fartlek training method to know the extent of the glands' response to this training method, which may help in knowing the appropriate quantities secreted by the glands of hormones necessary to increase the speed of metabolism in the production of energy that commensurate with the level of intensity of this training method, as well as knowing its effect on the development of the runner's physical ability to withstand the speed needed to cover a distance of (400) meter at the same level.

**1 – 3 Research Objectives:**

- Preparing exercises according to the method of Fartlek exercises for the research sample.
- Identifying the effect of fartlek training on the levels of the cortisol and thyroxine hormones and the endurance of speed in the research sample.

**1 – 4 Imposing search:**

- There are statistically significant differences between the pre and post tests in the levels of the cortisol and thyroxine hormones and the endurance of speed in the research sample.

**1 - 5 Research Areas:**

1 - 5 - 1 The human domain: Anbar province team runners of (400) meter running activity.

1 - 5 - 2 Temporal domain: the period from 2/10/2020 to 4/1/2021.

1 - 5 - 3 Spatial domain: Al-Ramadi Club Stadium / Al-Anbar province Center.

**2 - Theoretical studies:****2 – 1 Fartlek method:**

Fartlek training is one of the uncomplicated training methods, as its exercises consist of the player performing the skills of running, walking and jogging continuously for different distances, this training method is based on the principle of speed manipulation, as it makes the player perform short, medium and long distances with varying intensity between maximum or less than maximum or medium, interspersed with some rest times determined by the trainer according to the physical level of each player so that the player does not reach abnormal fatigue, and this training method aims to provide the player with general and speed endurance as a result of changes in pulse, breathing and the exchange of anaerobic and aerobic effort by performing exercises with varying intensity, therefore, it works to develop endurance and speed at the same time, because performance for a long period of time with moderate or less than maximum intensity develops in the athlete the ability to endurance, however, running with a maximum or high intensity develops the element of speed and thus the athlete's ability to withstand speed will increase for the longest period of time, depending on the type of specialized sport practiced by the player.

**2 – 2 Hormones:**

The physiological changes that occur to the body's organs, especially the glandular and muscular systems, when acting the physical effort depend on the response of those organs and their adaptation according to the size and intensity of the exercises performed by the player according to the method of training. As in "high-intensity physical loads lead to a change in the secretions of hormones and enzymes and an imbalance in the internal environment of the

body"[1]. Hormones are highly specialized chemical compounds secreted by the endocrine glands, and the changes that occur in the body as a result of sports activities play an important role in increasing the secretion of hormones by the glands and regulating their levels in the blood, and hormones are divided according to their function into two parts: "The first is made of cholesterol and is easily soluble in fats. It is called steroid hormones, such as cortisol, aldosterone, testicular and ovarian hormones"[2]. As for the second part "proteins overcome their chemical composition and do not dissolve in fats, such as amino hormones, peptides and proteins, and glycoproteins"[3].

### **2 – 2 – 1 Cortisol Hormone:**

This hormone is a steroid hormone that has an anabolic effect in increasing the formed amount of protein, as well as its main role in the metabolism of nutrients, and this hormone "is secreted from the adrenal cortex and regulates the metabolism of protein, starch, fats, and the formation of glycogen and its conversion into glucose. It is a strong anti-inflammatory and helps activate enzymes that convert amino acids into glucose in the liver, also the cortisol hormone regulates the amounts of water and salts inside the body, and its rate in the blood ranges between (6.4 - 21.0) microgram/deciliter"[4]. During the physical effort, "cortisol increases blood glucose indirectly by converting fats into glycogen in the liver"[5].

### **2 – 2 – 2 Thyroxine Hormone:**

Thyroxine (TSH) consists of a carbohydrate protein in the form of glycoprotein secreted from the anterior lobe of the pituitary gland and contains two subunits known as alpha ( $\alpha$ ) and  $\beta$  ( $\beta$ ) molecules. This hormone regulates the thyroid gland and stimulates it in the secretion of two completely similar hormones, the first is called thyroxine, a derivative of the amino acid tyrosine with iodine added and it is called iodothyronine and contains four iodine atoms (T4), and the second hormone is called triiodothyronine, which is derived from the amino acid thyronine added to it (T3), and thyroxine (T4) is the main form of thyroid hormone in the blood and has a half-life longer than (T3) in humans, and the ratio of (T4) to (T3) in the blood is about (1:14)[6]. Thyroxine is an amino hormone that is secreted by the thyroid gland and is transported through the blood to all parts of the body. This hormone increases metabolic rates, increases heart rate, and grows tissues and organs in the body[7]. The work of the thyroxine hormone is linked to the iodine element and is not formed without it, as the need for thyroxine depends on the presence of iodine that the body needs daily at a ratio of (100 - 150) micrograms, The concentration of free thyroxine (T4), which is the most active and used in tissues, ranges between (0.82 - 1.60) ng/dL, and this percentage increases to reach (35%) of most of the total thyroxine when engaging in sports activity, which works to speed up the secretion of this hormone, which is used quickly in increasing fat metabolism, which helps to face the requirements of physical efforts, especially those that need long periods [8]. Thyroxine helps in the metabolism of fats and the speed of their metabolism as well, which is the main source of supplying the body with energy during training that lasts for long times, as the rate of fat stores in cells reduces or raises the rate of free fatty acids in the plasma, which increases its consumption in cells to produce energy, so these hormones work to reduce the level of cholesterol in the plasma.

### **2 – 3 Speed Endurance:**

Speed endurance is a compound physical ability that combines the characteristics of endurance and speed, as it is "the ability to maintain a high rate of movement at a maximum and less than maximum speed during short distances and for a long period"[9]. Athletes need in their various sports activities, whether their training or competitions fall within the scope of the anaerobic energy production system, in its two types, phosphate or lactic, or the aerobic

energy production system. Therefore, a 400-meter runner needs to develop this physical ability mainly so that he can cross the entire race distance at the same level, especially in the last meters of the race.

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

#### **3 – 1 Research 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 – 2 Research Sample:**

The research sample was tested in a deliberate way, and it consisted of (5) runners representing the Anbar Province team of (400) meter running activity for the applicants. Table (1) shows the homogeneity of age, training age and speed endurance of the research sample.

Table (1)  
shows the homogeneity of the research sample

| <b>Variants</b>        | <b>Measuring unit</b> | <b>Mean</b> | <b>Standard deviation</b> | <b>Median</b> | <b>Kurtosis*</b> |
|------------------------|-----------------------|-------------|---------------------------|---------------|------------------|
| <b>Age</b>             | <b>Year</b>           | <b>22.6</b> | <b>3.049</b>              | <b>23</b>     | <b>- 0.393</b>   |
| <b>Training age</b>    | <b>Year</b>           | <b>3.8</b>  | <b>2.167</b>              | <b>3</b>      | <b>1.107</b>     |
| <b>Endurance speed</b> | <b>Second</b>         | <b>70.6</b> | <b>2.701</b>              | <b>71</b>     | <b>- 0.444</b>   |

\* The distribution is moderated if the values of the Kurtosis are less than ( $\pm 3$ ).

#### **3 – 3 Pre-tests:**

Pre-tests were conducted on the research sample on (5/10/2020) in the Ramadi Sports Club stadium, as the researcher made the following measurements and tests:

##### **3 – 3 – 1 Hormone Measurement:**

The cortisol and thyroxine hormones were measured by means of the (TOSOH AIA - 360) device, which depends on the immunofluorescence process. This device was manufactured by (TOSOH), a Japanese company, a leader in electronic industries, which means high accuracy in performance and lower cost of maintenance, and this device contains the sample tubes to place the sample in, and the sensor tubes containing the test substance and the photosensitive reactant, the bottle of washing water that is diluted with distilled water by (1000/4) milliliters, and the bottle of the diluent that is diluted with distilled water by (500/10) milliliters and waste bottle. The measurement process is carried out after the preparation is completed within (5-10) minutes by taking blood samples from the research sample in the amount of (3) ml and placing them in a special tube for each runner from the research sample, and placing the blood samples in a special refrigerated container for the purpose of transporting them to the analysis laboratory, as the specialist places the blood tubes in the centrifuge for a period of (6) minutes to separate the blood and obtain the serum that will be used to extract the level of hormones in the blood. Then (300-500)  $\mu\text{mol}$  of the serum is withdrawn and placed in the sample tubes of the device. Then they are placed in the lowest plate of the (TOSOH) device that is designated for placing samples, then the thyroxine or cortisol reagent tube is placed on the upper plate of the (TOSOH) device for test tubes, then we close the door of the device and write the name of the research sample on the display screen and press start, then we wait for (20-30) minutes until the results appear

**3 – 3 – 2 Speed Endurance Test, Run (500) Meter[10]:**

The aim of the test: To measure the endurance of speed.

Tools used: track and field stadium, stopwatches, whistle, registration forms, timers.

Performance description: The runners take their place in a standing position behind the starting line, then when the whistle is heard as a signal to start the race, the runners run over the area roundabout (400) meters to cover a distance of (500) meters after allocating a timer for each runner, as the clock starts at the start signal and stops time when the runner's chest reaches the finish line.

Recording: The runner's time is recorded in the registration form in seconds, rounded to the nearest tenth of a second.

**3 – 4 The main experience:**

The researcher prepared exercises according to the method of Fartlek exercises, based on his experience, field and training experience, and access to Arab and foreign sources. The duration of the exercises was (8) weeks, with three training units per week, and the number of units is (24) training units. While putting the sample up with the exercises, the researcher used training loads of varying intensity according to the running distance for each exercise, as the intensity of those exercises ranged between (70 - 100%) of the maximum sample capacity and size commensurate with the physical level of the research sample. The sample began by applying the exercises of the training curriculum on (9/10/2020) and the aim was to increase the endurance of speed and to know the effect of fartlek exercises on the level of concentration of the cortisol and thyroxine hormones in the blood, as these exercises included speed manipulation, especially the exercises that lead to the improvement of the anaerobic energy system in its two forms, phosphate and lactic, as well as exercises to increase aerobic capacity because the aim is to develop endurance, especially speed endurance, therefore, most of the exercises for developing anaerobic phosphorous ability included exercises of no more than (40) seconds in duration, with maximum intensity and with many repetitions. Examples include {running at maximum intensity for (5) seconds, followed by jogging for (10) seconds, then walking for (20) seconds, repeating the exercise (5) times}, Or (running at maximum intensity for (15) seconds, followed by jogging for (25) seconds, then walking for (40) seconds, repeating the exercise (4) times}, as for the exercises for developing anaerobic lactic ability, they included exercises of a duration not exceeding (180) seconds for one repetition with relatively high intensity, such as (running with maximum intensity for (30) seconds, followed by slow jogging for (90) seconds, then fast walking for (60) seconds), or running at maximum intensity for (45) seconds, followed by slow running for (60) seconds, then running at maximum intensity for (45) then fast walking for (30) seconds, while in developing aerobic capacity the duration of one repetition exceeded three minutes, and the intensity ranged between less than maximum and medium with fewer repetitions such as {running at an intensity below the maximum for (150) seconds, followed by slow jogging for (120) seconds, then running at an intensity below the maximum for (90), then walking for (180) seconds}, or {running at medium intensity for (210) seconds, followed by jogging for (90), then walking for (90) seconds, then at medium intensity for a distance of (500) meters}. The purpose of these exercises was to stimulate the functional systems of the runner's body and increase their susceptibility by changing stimuli and putting the body in front of constantly renewed challenges because putting the athlete's body under pressure and stimulating it with unusual stimuli affect the working cells and tissues of the body positively, as well as its role in keeping runners away from monotony and boredom during running and thus will achieve the purpose of training in gaining general endurance and speed endurance as a result of changes in pulse and breathing and the exchange of anaerobic and aerobic work when manipulating

the speed of performance and Intensities of training load, which ranged between maximum and medium.

**3 – 5 Post- Tests:**

The post-tests were carried out in the same way as the pre-tests, as the researcher took the required measurements on (6/12/2020)

**3 – 6 Statistical means[11]:**

Mean, median, standard deviation, Kurtosis, t-test.

**4 - Presentation, analysis and discussion of the results:**

**4 – 1 Presentation 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     |            |            |             |                 |
| Cortisol hormone  | 13.88    | 0.920 | 14.50     | 0.914 | 0.58       | 0.067      | 8.656       | Significant     |
| thyroxine hormone | 1.064    | 0.063 | 1.050     | 0.061 | 0.014      | 0.0015     | 2.745       | Not Significant |
| speed endurance   | 70.6     | 2.701 | 63.4      | 2.881 | 7.2        | 0.583      | 12.349      | Significant     |

The results of Table (2) of the pre and post-measurements of the research variables (cortisol, thyroxine, speed endurance) indicated differences were recorded between the pre and post-measurements, which amounted to (0.58, 0.014, and 7.2), respectively, while the deviations of those differences were (0.067, 0.0015, 0.583) respectively, and thus the calculated (T-test) value for the search variables was (8.656, 2.745, 12.349), respectively, and when it's compared with the tabular score of (3.747) at the significance level (0.01) and the Degree of Freedom ( $5 - 1 = 4$ ) to find the significance of the differences between the two tests. It was found that the calculated (T) value is greater than its tabular value in relation to cortisol and the speed carrying capacity, whose differences were significant in favor of the post-test, while the difference was not significant for thyroxine, whose calculated score was less than the tabular score.

**4 – 2 Discussion of the results:**

The researcher attributes the Significant differences obtained by the research sample between the pre and post-measurements to the fartlek exercises, which are characterized by manipulating the speed of performing its exercises to increase the ability of the adrenal gland to secrete the hormone cortisol, which "The concentration of cortisol in the blood plasma increases in response to high-intensity sports activity, and its secretion begins during the first minutes of physical exertion and is directly proportional to the intensity of the physical load"[12]. And this is what happened to the research sample, which confirmed the results of the post-measurement that there is a significant difference in its favor, after the research sample applied physical efforts, especially exercises that depend on the anaerobic energy production system, which is included in this training method, which desperately needs such a

hormone to help in metabolic processes to produce energy, especially its main role in the decomposition of proteins to produce more quantities of blood glucose, as "Cortisol is called a stress hormone, because the stress of all kinds causes an increase in this steroid hormone in the blood to perform several functions, including increasing blood glucose and increasing protein breakdown within the muscle"[13]. Also, "the level of cortisol hormone in the blood that is secreted by the adrenal gland increases with high-intensity physical exertion, especially when using exercises that are part of the anaerobic phosphate energy production system"[14]. Therefore, the researcher believes that fartlek exercises, which are characterized by different intensities ranging from maximum to less than maximum, led to an increase in the secretion of the hormone cortisol, which performs important functions for the working muscles.

In addition, "Fartlek exercises also increased the ability of the thyroid gland to rapidly secrete thyroxine, Sports activities, especially those characterized by the long duration of their exercise, lead to an increase in the speed of thyroxine secretion, so that the concentration of free thyroxine reaches 25%, but its level decreases in the blood because the speed of its consumption exceeds the speed of its excretion due to its important and main role in the metabolism of fats when performing physical exertion"[15]. The researcher believes that fartlek exercises, which range between maximum and medium intensity, need their exercises to produce high and continuous energy, which makes the working muscles need this hormone in the metabolism process, which has an important role in fat metabolism to produce the energy needed to perform those exercises appropriately, so the researcher attributes randomness the differences between the pre and post measurements of this hormone and maintaining its level in the blood leads to the speed of consuming the largest amount of it in order to release the energy necessary to perform the exercises, especially those that need a long time to be performed. In general, cortisol helps to produce the energy needed to perform high-intensity exercises that are interspersed with negative or positive rest times, so its concentration remains high in the blood. While the role of thyroxine continues to produce energy, whether it is anaerobic or aerobic, so it has an important role in fat metabolism when performing exercises that fall within the aerobic energy production system, such as jogging and walking that runners perform when they perform Fartlek exercises, which is characterized by manipulating the speed and intensity of those exercises. Thyroxine is constantly consumed, and this confirms the need for this hormone to be constantly available in order to provide energy to perform all exercises continuously.

Thus, the researcher attributes the development that the research sample obtained in the endurance of speed to the quality of physical exercises of different intensities, including incomplete rest times that were included in the Fartlek method, as "the training that aims to develop speed endurance must take into account the use of incomplete rest"[16]. So this is what was related to the exercises adopted in this study from the fartlek exercises, as the rest period most of the time was a positive rest of low intensity, such as simple jogging and walking, taking into account that the runner did not reach abnormal fatigue, and the researcher took into account the diversity of its objectives between increasing anaerobic and aerobic susceptibility to the runners. The aim of these exercises was to develop the elements of endurance and speed, as well as develop the capabilities of the sample to withstand a distance of (400) meters at the same speed from its beginning to its end because carrying speed is one of the most important requirements for training this sporting activity, as "the endurance of speed is one of the most important elements required in training running (400) meters in order to maintain the quality of intensity required in the race"[17].

**5 - Conclusions and Recommendations:****5 – 1 Conclusions:**

1. Fartlek exercises led to an increase in the speed of cortisol secretion and an increase in its concentration in the blood of the research sample.
2. Fartlek exercises led to an increase in the rate of thyroxine secretion and maintained its concentration in the blood of the research sample.
3. Fartlek exercises led to the development of speed endurance in the research sample.

**5 – 2 Recommendations:**

1. Using the fartlek training method to develop the special speed endurance of a runner (400) meters.
2. Emphasis on short and medium running trainers by including their training curricula on exercises that develop the ability to endurance special speed according to the specificity of the sporting activity.
3. The trainers should keep track of the differences in the amount of hormone secretion and the level of their concentration in the blood because of their important and basic role in the metabolic processes of energy production.
4. Conducting researches dealing with the effect of other types of training methods and techniques on biochemical variables and physical ability under study and for other age groups.
5. Conducting researches to study the effect of fartlek training on biochemical variables and physical abilities other than the variables under study.

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