



## The effect of lactic acid concentration on the performance of men's middle-distance runners

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### Abstract

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The importance of the research lies in knowing the effect of lactic acid concentration on the achievement of middle-distance runners by investing it in training units in order to develop some physiological variables and the achievement of middle-distance runners. The research problem is summarized in the researchers' failure to address the effect of lactic acid concentration in the blood of middle-distance runners 0, as the latter is a realistic problem that must be solved appropriately because it directly affects the runner's digital achievement. The study aimed to (identify the effect of lactic acid concentration on the achievement of men's middle-distance runners), and the research sample represented men's middle-distance runners. The most important conclusions were as follows:

1. There were statistical differences between the pre-measurement (before the warm-up process) and the post-measurement (after the first test) in the percentage of lactic acid concentration, in favor of the post-measurement.
2. There were statistical differences in the concentration of lactic acid at the end of the first test and the end of the second test in favour of the end of the second test.

## 1-1 Introduction and importance of the research

In recent years, the world has witnessed remarkable progress in all areas of life, and physical education is one of these areas that has witnessed great development at various levels and most sports as a result of what various sciences have provided in the impact of sports movement to reach the highest levels.

There is no doubt that running activities require extreme intensity to generate maximum emotional speed to cover its distance at the highest possible speed (Hussein, 2000) This requires exerting all the runner's latent capabilities and exploiting them to reach maximum speed. "Sprinting requires complete preparation not only from the physical and physiological aspect, but also from the mental and psychological aspect (others, 2023), as the runner has muscle fibers that enable him to benefit from them during training periods and racing in short distances.

The runners' muscles must be characterized by rapid contractions, as their percentage is (70-90%) of the number of muscle fibers.

Short-distance running activities generally depend on anaerobic energy, the energy expended during running is performed in the absence of oxygen. and energy expended during is between (10-20 seconds) is equal to 98% of the energy and 2% of the aerobic energy (Khuraibet, 2017), while activities that exceed this time enter into the rest of the energy production systems as is the case in middle-distance activities, as these activities enter into two systems: the anaerobic system and then move to the lactic acid system, as lactic acid is considered one of the physiological variables that directly affect physical activity, as the method of measuring it is indirect, and it is also mentioned that most of the body's cells and tissues participate in the secretion of this acid. The appearance of lactic acid in the blood is the body's production of energy from the method of sugar analysis of oxygen, and this is considered the waste of non-oxygen reactions that occur inside muscle fibers in order to provide them with basic energy without the need for oxygen during athletic performance, especially at high intensity. Measuring lactic acid in the athlete's body is of great importance as it shows athletes and coaches the level of non-oxygen physical abilities that the athlete has, and it also shows the intensity and impact of training intensity for players, i.e. the higher the concentration of lactic acid, the higher the intensity and vice versa. Here the importance of this research

under study crystallizes, as it identifies the effect of lactic acid concentration on the achievement of the effectiveness of middle-distance runners.

## 1-2 Research problem

Middle-distance running activities play an effective and essential role in providing its practitioners with physical and motor fitness and have a direct impact on all physiological variables of the runners' bodies such as heart rate and cardiac output as well as improving the respiratory system. Many studies have addressed this topic in detail, but through the researcher's follow-up of many studies, he found that researchers did not address the effect of lactic acid concentration in the blood of middle-distance runners.

## 1-3 Research aims

- To identify the effect of lactic acid concentration on the performance of men's middle-distance runners.

## 1-4 Research hypotheses

There is a significant difference in the concentration of lactic acid in the blood between the pre- and post-measurement of the research sample, in favor of the post-measurement.

## 1-5 Research areas

1-5-1 Human field: Middle distance runners from Iraqi clubs.

1-5-2 Time frame: Middle distance runners' tests before the clubs' championship for the last season, which will be held in the city of Erbil on (6-10/11/2024 AD)

1-5-3 Spatial area: College of Physical Education and Sports Sciences Stadium at the University of Baghdad/and Al-Najaf Sports Club Stadium.

## 2- Theoretical studies and previous studies

### 2-1 Theoretical studies

Lactic acid system: Lactic acid can be defined as a chemical compound symbolized by the chemical symbol  $C_3H_6O_3$ , and its quantity in human blood under normal conditions ranges from (1-2) millimoles per liter of blood (Khuraibet, Selected group in training and sports physiology, 2014), it is a colorless chemical substance, containing in its chemical composition three carbon

atoms, three oxygen atoms, and six hydrogen atoms (C<sub>3</sub>H<sub>6</sub>O<sub>3</sub>). The percentage of this acid in the blood and during rest ranges from (4.5-19.8) mg/dL (0.5-2.2) mmol/L.

It is known that when the intensity of physical effort increases and the rate of energy requirement becomes high, the body resorts to anaerobic energy, including the short-term energy system, represented by the anaerobic system for both muscle glycogen and blood glucose, where muscle glycogen (as well as blood glucose after entering the muscle) is broken down through chemical steps to end up with a chemical compound called pyruvic acid, which quickly turns into lactic acid, and these chemical processes result in recharging the compound. It is clear to us that lactic acid is a natural product of the anaerobic decomposition process. ATP for glycogen or glucose, when the need for energy is greater than the body's ability to provide it through the aerobic system (aerobic by using oxygen). The lactic acid system is considered an important element for providing the energy needed to benefit from (ATP) for activities performed at maximum speed and which take a period of time ranging between (1-3 minutes) such as running in the (400 meters or 800 meters or 1500 meters) middle distances (Khuraibet, Applications in Physiology and Sports Training, 1995).

The lactic acid system is the system responsible for producing energy for physical activities that last longer than 30 seconds. This system becomes responsible for producing energy if the activity lasts longer than 30 seconds. The body needs an energy release system through the lactic acid compound. The body resorts to releasing glycogen stored in the liver and muscles as a source for rebuilding the energy compound (ATP) trihydrogen phosphate. This occurs in the absence of oxygen, which leads to the accumulation of lactic acid in the muscles, which leads to muscle fatigue when its concentration increases (Al-lami, 2010).

### 3- Research methodology and field procedures

#### 3-1 Research Methodology:

The researcher decided to use the descriptive approach to suit the nature of the research under study (Al-Azzawi, 2008)

#### 3-2 Research community and sample:

The research community was deliberately selected (Al-Asadi, 2008), consisting of middle-distance runners from Iraqi clubs for track and field events that

participated in the Iraqi Clubs Athletics Championship. The research sample consisted of seven players who were randomly selected from the total number of participating runners.

### 3-3 Information collection methods

- 1- Special puncture device and withdrawal of 25 microliters of blood.
- 2- Capillary tubes from the device accessories.
- 3- Preservative tubes containing a blood diluting solution.
- 4- Lactic acid measuring device (electronic) in order to obtain the blood acid concentration percentage.

### 3-4 Sample homogeneity:

Under the sample homogenization process to control the following variables: -

- 1- Chronological age.
- 2- Weight.
- 3- Height.
- 4- Fat percentage.

Table (1) shows the mean, standard deviation and range of the sample.

Variables	Arithmetic mean	Standard deviation	Range
height	178 cm	0.7	174-184
Age	20 years	7.000	19-30
weight	70 kg	4.88	69-80
Fat percentage	6.5	2.898	4-10

### 3-4 Research procedures

At first, the researcher clarified the mechanism of work for the research sample under study, by explaining it, where he showed that by withdrawing blood from each runner during different periods, after which the specialists withdraw a sufficient sample of blood from the fingertips after sterilizing it and piercing it using the piercing device prepared for this purpose, where an amount of (25) microliters of blood is withdrawn, which is a sufficient amount to obtain the required data that serves the main research objective. As for the withdrawal times, they were before the runners warmed up in order to know the concentration of lactic acid in the blood during rest periods, and the second blood withdrawal process was immediately after the warm-up and running test, while the third process was after the runners performed the second running test. All of this was done in order to determine the percentage of acid concentration in the blood. The samples were placed in special preservative molds prepared for this purpose, and then mixed with a blood diluent in order to facilitate the analysis process, where an electronic lactic acid device was used to display the results.

### 3-5 Support Team

- Mr. Hussein Shaker Salim / Senior Analyst (Biological Sciences)
- Prof. Dr. Nawar Abdullah Hussein / Professor of Sports Training
- Asst. Prof. Dr. Hassan Abdel Hadi Lahims / Assistant Professor, Physiology

### 3-6 Statistical methods used

The researcher decided to use the statistical package (SPSS) to obtain the research results.

### 4-1 Presentation, analysis and discussion of the results

After statistical processing of the available data given from the blood withdrawal process before warming up and testing, the researcher presented, analyzed and discussed the results that clarified the indicators and interpretations that serve the objectives of the research under study.

Table (2) shows the values of the arithmetic mean, standard deviation and range for the pre-warming variables for lactic acid accumulation in the research sample.

Range	Standard	Arithmetic	Variable
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	deviation	mean	
0.5-1.88	0.88	0.69	Lactic acid

Table (2) shows the arithmetic mean and standard deviation of the lactic acid concentration in the research sample before the race (before the warm-up process). The arithmetic mean of the lactic acid concentration in the research sample was (0.69) mmol/L , While its standard deviation was (0.88) and the measurements indicated that the range was (0.5 - 1.88).

Table (3) shows the values of the arithmetic mean, standard deviation and range of the dimensional variables of lactic acid accumulation after the first test.

Range	Standard deviation	Arithmetic mean	Variable
6.22-6.98	2.5	8.1	Lactic acid

We note from Table (2) that the arithmetic mean, standard deviation and range of lactic acid after the end of the first test were as follows, respectively: the arithmetic mean was (7.1) mmol/L, the standard deviation was (2.5) and the range was (6.22-6.98).

Table (4) shows the values of the arithmetic mean, standard deviation and range of lactic acid concentrations after the end of the second test.

Range	Standard deviation	Arithmetic mean	Variable
6.62-7.29	2.88	9.9	Lactic acid

Table (4) shows that the values of the arithmetic mean, standard deviation and range of lactic acid accumulation in the blood of the research sample are as follows: (9.9) mmol/L (2.88) (6.62-7.29).

The above tables explain that the average concentration of lactic acid in the blood in the pre-measurement was (0.69) mmol/L. This concentration of lactic acid in the blood of the research sample increased if the arithmetic mean of this concentration was (8.1) mmol/L at the end of the first half. The lactic acid ratio increased at the end of the match to an arithmetic mean of (9.9) mmol/L. By studying the significance of the differences between the pre-measurement (before the warm-up process) and the two post-measurements (end of the first test and end of the second test), it is clear that there are statistically significant differences at a significance level of (0.5), as the calculated value of (F) reached (78.8), which is greater than the tabular value, which is (2.99) at degrees of freedom (15).

Table (5) shows the arithmetic mean values for the pre-test (before the warm-up process) and the post-test for the first and second tests.

Measurement after the second test	Measurement after the first test	Pre-measurement	
9.9	8.1	0.69	Pre-test measurement
-	-	-	Post-test measurement
+	-	+	Post-test measurement
-	-	+	

It is clear from the results in Table No. (5) that there are significant differences between the pre- and post-test measurements of the two tests.

#### 4-2 Discussion and analysis of results

By analyzing the results using special statistical methods, the researcher reached several data, as it became clear that the load of the race in running for middle-distance events had a direct effect on the concentrations of lactic acid in the blood of runners, thus achieving the goal of the research under study, which indicates the effect of the concentration of lactic acid on the achievement of men's middle-distance runners, as the physical effort exerted



by the runner with high intensity causes the accumulation of lactic acid quantities in the blood, as the rate of its accumulation reached (90%) at the end of the tests.

The data of this research illustrate the picture of the metabolic state of middle-distance runners during the test. The researcher also noted significant differences between the percentage of lactic acid accumulation at the end of the first test (8.1) mmol/L and the end of the second test (9.9) mmol/L. The researcher believes that these differences are logical differences, as it was shown that the increase in the concentration of lactic acid in the blood at the end of the first test led to an increase in the accumulation of hydrogen ions and thus reduced the pH in the muscles and blood so that it became acidic, which led to the appearance of fatigue and exhaustion in the runner, which led to a decrease in the digital achievement in the second test.

#### 5- Conclusions and recommendations

The researcher reached the following conclusions:

1. There were statistical differences between the pre-measurement (before the warm-up process) and the post-measurement (after the first test) in the percentage of lactic acid concentration, in favor of the post-measurement.
2. There were statistical differences in the concentration of lactic acid at the end of the first test and the end of the second test in favour of the end of the second test.

#### 5-2 Recommendations

The researcher recommends:

- 1- The intensity of the load during training units for runners should be increased to the maximum.
- 2- Conducting other studies on different activities.

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