# The Effect of a Training Program designed for the Improvement of Speed Endurance in Light of Genetic Diversity (ACE) on Some Signs of Muscle fatigue and on the Quantitative Level of the Runners of 1500m Run

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**Summary**:

This research aimed at establishing a training program for the improvement of speed endurance in light of genetic diversity (ACE) for juniors in (1500m) run at the National Project for Talents at the governorate of Sharqia and identifying its effect on the signs of muscle fatigue (Lactic acid – Dehydrogenase – Beta-endorphin) and the quantitative level of the runners of (1500m) run. The researcher has applied the empirical method on a sample of (16) juniors in middle distance track events at the National Project for Talents at the governorate of Sharqia. The research tools included: measurements of the functional activities – a training program for the improvement of speed endurance.

**Key results:**

1- The training program using genetic diversity (ACE-ID/DD) has a positive impact on the signs of muscle fatigue (Lactic acid – Dehydrogenase – Beta-endorphin) and the quantitative level of the runners of (1500m) run.

2- Juniors at (1500m) runs who have ACE ID gene show an improvement in the signs of muscle fatigue (Lactic acid – Dehydrogenase – Beta-endorphin) and the quantitative level compared to the other group with ACE DD gene.

**Introduction and problematic:**

The peak of the athlete's performance in a specialized sports activity depends on the appropriate gene. It was discovered that one of the most important genes is ACE gene which was called so because it was associated with Angiotensin Converting Enzyme, an active enzyme in the tissues of muscles which it regulates the flow of blood, and consequently, it can have an effective impact on physical performance.

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Hopekins (2004) and Shnaider et., al. (2007) agree on the importance of genes, especially ACE gene, in physical performance, and this with the aim of achieving the highest levels in sports. Their studies show that, depending on the two types of energy producing systems among runners of long, middle and short distances races, which systems depend on the aerobic and anaerobic energy producing styles, the ACE D gene which is common among the runners of short distance races is a contributing factor in the improvement of muscle strength and that such genotype also bears the primary responsibility for muscle hypertrophy as a result of cell growth factor: Ang. II. While the importance of ACE gene demonstrates in its effective impact on physical performance given that this gene exists in two forms: the first form is "I", derived from the word Insertion, the second is "D", derived from the word Deletion. The difference between the two forms "I" and "D" consists in the length of the base pair.

Tsianos, et, al. (2004) indicate that genetic diversity ACE/I is associated with the performance of endurance athletes, while genetic diversity ACE/D is associated with the performance of speed and muscle strength athletes.

Lactic acid is one of the basic indicators that cause muscle fatigue associated with fatigue phenomena. Therefore, blood lactate measurements represent a very important sign of muscle fatigue seen that the level of blood lactate is a good indicator of performance endurance. Given that blood lactate's response to trainings is very sensible, training programs require a more specialized planning and relevance with blood lactate responses.

Dehydrogenase (LDH) helps in getting rid of lactate. The increase in this enzyme concentration is associated with an increase in the level of elimination of lactate acid seen that it removes hydrogen. By consequence, it transforms lactate acid into pyrovic acid. Also, beta-endorphin (blood morphine) serves as a chemical transmitter, takes part in many physiological processes and helps in stimulating the production of some hormones such as Glucagon and Insulin.

Middle distance races are the link between running events and long distance running races. Middle distance races include 800m and 1500m races. In fact, we can't establish a boundary between running events and middle distance run. For example, the runners of 800m race may participate in a 400m race provided that they were fast. The same thing applies to the runners of middle distance races, especially 1500m races, who may participate in long distance races provided that they have high endurance, or the runners of long distances race who may participate in a 400m race provided that they were fast.

Through the researcher's follow-up of juniors in a (155m) race in the National Project for Talents at the governorate of Sharqia, he has noticed that some juniors are superior in terms of physical and aerobic capacities, others are superior in terms of other physical abilities and the anaerobic capacity, although minors have all been introduced to the same training program under the supervision of the same technical staff. The researcher attributes this variation among the juniors' response to the training to the disparity of their physical and physiological structure given that their genes are diversified. Some scientific studies have proven the importance of genes, especially ACE gene with its two types "I" and "D',' in the promotion of physical and physiological performance. While other studies have not drown up any relation between the diversity of this gene "I","D" and the improvement of physical and physiological performance.

The researcher has also noticed that juniors in (1500m) races in the National Project for Talents at the governorate of Sharqia were unable to continue to maintain a high level of speed endurance during the (1500m) run, and signs of muscle fatigue appeared rapidly causing a decrease in the quantitative level of juniors in the (1500m) race, which indicates that there's a problem in need of more scientific studies in order to link sports training with athletes' genetic diversity and benefit from this biological field. This drove the researcher to establish a training program in order to improve speed

endurance in light of genetic diversity (ACE) and identify its effect on some signs of muscle fatigue (Lactic acid – Dehydrogenase – Beta-endorphins) and on the quantitative level of the runners of (1500m) races in the National Project for Talents at the governorate of Sharqia.

**Research goals:**

The research aimed at designing a training program with the aim of improving speed endurance in light of generic diversity (ACE) for juniors in (1500m) race in the National Project for Talents at the governorate of Sharqia and identifying its impact on:

1- The signs of muscle fatigue (Lactic acid – Dehydrogenase – Beta-endorphin) for the runners of 1500m races.

2- The quantitative level of the runners of (1500m) races.

**Research hypotheses:**

1- There are statistically significant differences between the averages of both pre and post tests of the first experimental group (ACE – ID Genes) and the second experimental group (ACE – DD Genes) in terms of the signs of muscle fatigue (Lactic acid – Dehydrogenase – Beta-endorphin) and the quantitative level of the runners of (1500m) race in favors of the post test.

2- There are statistically significant differences between the averages of both post tests of the first and second experimental groups in terms of the signs of muscle fatigue (Lactic acid – Dehydrogenase – Beta-endorphin) and the quantitative level of the runners of (1500m) race in favor of the first experimental group that has ACE – ID gene.

**Research procedures:**

**Methodology:**

The researcher has applied the empirical method using the experimental design of two experimental groups by conducting the pre and post tests, given that it suits the nature of this research.

**Population and sample:**

By means of the purposive sampling, the researcher chose a sample of junior runners in (1500m) race in the National Project for Talents at the governorate of Sharqia for the training season 2015/2016. They were at the number of (21) juniors born in 2001. (5) Juniors were chosen from the research population and from outside the basic research sample for the

exploratory study. So, the basic research sample consisted of (16) juniors, the researcher classified them according to genetic diversity into two experimental groups. The first experimental group of (9) juniors had ACE/ ID gene, while the second experimental group at the number of (7) juniors in 1500m race had ACE / DD gene.

The researcher established equivalence between the first and the second experimental groups in terms of the pretests under consideration, as shown in tables (1) and (2).

**Table (1)**

**Indication of the differences between the first and second experimental groups in terms of growth rates (age – height – weight – training age)**

| Variables | Unit of measurement | First experimental group ACE/ID N=9 | | Second experimental group ACE/ DD N=7 | | T Value |
|---|---|---|---|---|---|---|
| | | Ind. | Dep. | Ind. | Dep. | |
| Age | Years old | ١٥.٦٠ | ٠.٣٨ | ١٥.٤٥ | ٠.٣٥ | ٠.٧٦ |
| Total body height | cm | ١٦٧.٥٥ | ٤.٦٢ | ١٦٦.٢٧ | ٤.١٨ | ٠.٥٤ |
| Weight | Kg | ٦٤.٤٧ | ٤.٣٣ | ٦٣.٠٠ | ٤.١٢ | ٠.٦٤ |
| Training age | Years old | ٢.١٥ | ٠.٣٢ | ٢.١٠ | ٠.٢٩ | ٠.٣١ |

T value is at 0.05 = 2.145 significance level

As table (1) shows, there are no statistically significant differences at level 0.05 between the first and the second experimental groups in terms of growth rates (age – height – weight – training age) which indicates that both research groups are equivalent in terms of these variables.

**Table (2)**
**Indication of the differences between both the first and the second experimental groups in terms of physiological variables and the quantitative level in 1500m race**

| Variables | Unit of measurement | First experimental group ACE/ID N=9 | | Second experimental group ACE/ DD N=7 | | T Value |
|---|---|---|---|---|---|---|
| | | Ind. | Dep. | Ind. | Dep. | |
| Age | Mmol/ l | ٥.٤٣ | ٠.١٢ | ٥.٤٨ | ٠.١٤ | ٠.٧٢ |
| Total body height | Unit / l | ٥٧٩.١٥ | ١٧.٩٦ | ٥٨١.٢٨ | ١٩.٢٧ | ٠.٢١ |
| Weight | Pico-mol /l | ٩.٧٢ | ٠.١٨ | ٩.٧٩ | ٠.٢٣ | ٠.٦٤ |
| Training age | Minutes | ٤.٥٣ | ٠.٠٩ | ٤.٥٨ | ٠.١١ | ٠.٩٤ |

T value is at 0.05 = 2.145 significance level

As table (2) shows, there are no statistically significant differences at level 0.05 between the first and the second experimental groups in terms of physiological variables under consideration and the quantitative level in (1500m) race, which indicates that both research groups are equivalent in terms of these variables.

**Data collection tools:**

**First: Biochemical measurements under consideration**

A blood sample of (3) $cm^3$ was drawn from each racer of the research sample after the completion of a 1500m race (pre and post tests) by a specialized doctor in medical analysis from the antecubital area using sterile plastic single-use tourniquets. The total size of the collected blood from each junior reached (6) $cm^3$ during the implementation of pre and post tests.

The samples were emptied in clean sterile tubes which were numbered using a marker pen and they were ordered and sequenced in an analysis box so that each plastic tube would have a specific number.

The blood samples were transported to the laboratory in order to isolate the serum (blood serum) from cells using laboratory centrifuge with a centrifugal force of 3000 cycle / m for (5) minutes. The tubes were placed in the centrifuge in

a balanced way in order to prepare them for the measurements of Lactic acid, Beta-endorphin and Dehydrogenase.

**Second: Measurements of the quantitative level of 1500m race**

The researcher used 1500m running test in order to measure the quantitative level of the subjects of the basic research sample. He recorded the nearest time to 1/100 seconds.

**Third: the suggested training program:**

**Objective of the training program:**

1- Improving speed endurance and reducing signs of muscle fatigue (Beta-endorphin – Lactic acid – Dehydrogenase).

2- Improving the quantitative level of the runners of 1500m race.

**Basis for the suggested training program:**

- Taking into consideration genetic diversity among the subjects of the basic research sample.
- The adequacy of the program content to the level and abilities of the subjects of the basic research sample.
- Using the wavy method (2:1), i.e. two days of high intensity exercises followed by a day of low intensity exercises or a rest.
- The intensity of the suggested training program varied between 60%: 90% of the junior runner's maximum speed.
- The researcher used the interval method in its two forms (low intensity – high intensity).
- Performance of distance races varying between 50m – 150m with a higher intensity compared to the actual race in order to train the runner to gain speed.
- Performance of distances varying between 200m – 1500, at the speed of the actual race in order to improve speed endurance among the runners of 1500m race (the research's basic sample).
- Repetitions varying between (2:3) repetitions.
- Groups varying between (3:4) groups.
- Rests between repetitions 2 min. – 7 min.
- Rests between groups 5min. – 10 min.

− Rests should be sufficient so that the subjects of the research sample could recover.

**Schedule of the training program:**

- The duration of the training program should be (8) weeks.
- The duration of each daily module should be (120) minutes.
- Number of weekly trainings should be (3) modules.
- Number of training modules (24) modules.
- Program's total duration (48) hours.

**Exploratory study:**

The researcher has applied a weekly training module, (3 modules) per week, on the subjects of the exploratory sample in the period from 2/8/2015 till 9/8/2015. The modules aimed at determining the maximum endurance of each junior runner in the established trainings (distances) and rests between the repetitions and groups. In light of this, the content of the suggested training program for the improvement of speed endurance was set. Before its implementation, the program was presented to a group of experts in track and field and sports physiology. They've (100%) agreed on it.

**Pretests:**

The researcher conducted the pretests of the variables of both experimental groups in terms of the physiological variances under consideration and the quantitative level of 1500m racers during the period from 12/8/2015 till 14/8/2015.

**Implementation of the suggested training program:**

The content of the suggested training program was applied on the subjects of both research groups in the period from 17/8/2015 till 11/10/2015 for (8) weeks; (3) training modules per week.

**Posttests:**

The posttests of both research groups were conducted in terms of the physiological variables under consideration and the quantitative level at 1500m race in the same order and manner by which the pretests were conducted, for the period from 13/10/2015 till 15/10/2015.

**Presentation and discussion of the results:**

**First: presentation and discussion of the results of the first hypothesis:**

**Table (3)**
**Indication of the differences in the pre and post tests of the first experimental sample ACE/ID in terms of physiological variances and quantitative level in 1500m race N=9**

| Variables | Unit of measurement | First experimental group ACE/ID N=9 | | Second experimental group ACE/ DD N=7 | | T Value |
|---|---|---|---|---|---|---|
| | | Ind. | Dep. | Ind. | Dep. | |
| Lactic acid | Mmol/ l | ٥.٤٣ | ٠.١٢ | ٥.١١ | ٠.٠٩ | *٥.٨٢ |
| Dehydrogenase | Unit / l | ٥٧٩.١٥ | ١٧.٩٦ | ٥٤١.٣٧ | ١٥.٢٤ | *٤.١٦ |
| Beta-endorphin | Pico-mol /l | ٩.٧٢ | ٠.١٨ | ٩.٣١ | ٠.١٤ | *٤.٧٣ |
| Quantitative level of 1500m run | Minutes | ٤.٥٣ | ٠.٠٩ | ٤.٣٨ | ٠.٠٧ | *٣.٤١ |

T value is at 0.05 = 2.306 significance level
* Statistically significant at level 0.05

As table (3) shows, there are statistically significant differences at level 0.05 between the pre and post tests of the first experimental group ACE/ID in terms of physiological variables and quantitative level in 1500m race in favor of the post test.

**Table (4)**
**Indication of the differences in the pre and post tests of the second experimental sample ACE/DD in terms of physiological variances and quantitative level in 1500m race N=7**

| Variables | Unit of measurement | Pretest | | Posttest | | T Value |
|---|---|---|---|---|---|---|
| | | Ind. | Dep. | Ind. | Dep. | |
| Lactic acid | Mmol/ l | ٥.٤٨ | ٠.١٤ | ٥.٣٢ | ٠.١١ | *٢.٩٢ |
| Dehydrogenase | Unit / l | ٥٨١.٢٨ | ١٩.٢٧ | ٥٦٦.١٩ | ١٦.٣٨ | *٢.٦٤ |
| Beta-endorphin | Pico-mol /l | ٩.٧٩ | ٠.٢٣ | ٩.٥٨ | ٠.١٩ | *٢.٧١ |
| Quantitative level of 1500m run | Minutes | ٤.٥٨ | ٠.١١ | ٤.٤٩ | ٠.٠٩ | *٢.٤٨ |

T value is at 0.05 = 2.447 significance level * Statistically significant at 0.05

As table (4) shows, there are statistically significant differences at level 0.05 between the pre and post tests

of the second experimental group ACE/DD in terms of the physiological variables and the quantitative level in 1500m race in favor of the post test.

The researcher attributes the improvement in the physiological variables (Lactic acid – Dehydrogenase – Beta-endorphin) and the quantitative level in 1500m race among the subjects of the first experimental group which has ACE ID gene and the second experimental group which has ACE DD gene to the effective content of the suggested training program which took into account, while selecting the used trainings, that all such trainings should include aerobic, anaerobic and mixed energy producing systems, which had a positive impact on the improvement of speed endurance and the reduction of the signs of muscle fatigue (Lactic acid – Dehydrogenase – Beta-endorphin) given that endurance trainings lead to the improvement of the process of delivery of oxygen to the tissues as well as the muscles' ability to consume it. Bahaa Eddin Salama (1994) indicates that endurance trainings lead to the increase of blood volume and, consequently, the increase of red blood cells which carries hemoglobin which becomes combined with oxygen in order to carry it to muscles. Therefore, the bigger the size of red blood cells, the more amount of hemoglobin which holds a bigger quantity of red blood cells in order to transmit it from the lungs to the muscles.

The researcher also attributes the decrease in the percentage of concentration of lactic acid in the blood to the improvement of the state of the respiratory system given the impact of the suggested training program which includes a set of trainings in accordance with the aerobic energy producing system. Hussein Heshmat and Nader Shalaby (2003) indicate that lactic acid is a good indicator of the performance of aerobic endurance through which the state of the respiratory system could be recognized and it's an important indicator of progress in the training.

Sawka, et., al (2004) add that the decrease in the concentration of lactic acid in the blood indicates an improvement in the functional state of athletes and their ability to continue the physical performance.

The researcher attributes the decrease in the percentage of concentration of dehydrogenase in the blood to the improvement of the junior runner's endurance and ability to get rid of lactic acid, and, consequently, the production of LDH decreases due to adaptation of the physical effort and improvement of speed endurance.

The researcher attributes the improvement in the quantitative level of junior runners in 1500m race to the effectiveness of the suggested training program on the improvement of speed endurance which gave the junior runners the ability to endure fatigue and get rid of metabolism waste (lactic acid) rapidly, this in turn leads to the improvement of the quantitative level of the runners of 1500m race.

Thus, the validity of the first hypothesis has been established

**Second: presentation and discussion of the second hypothesis**

**Table (5)**

**Indication of the differences between both posttests of the first experimental group ACE/ID and the second experimental group ACE/DD in terms of the physiological variables and the quantitative level in 1500m race**

| Variables | Unit of measurement | First experimental group ACE/DD N=9 | | Second experimental group ACE/ID N=7 | | T Value |
|---|---|---|---|---|---|---|
| | | Ind. | Dep. | Ind. | Dep. | |
| Lactic acid | Mmol/ l | ٥.١١ | ٠.٠٩ | ٥.٣٢ | ٠.١١ | *٣.٩٣ |
| Dehydrogenase | Unit / l | ٥٤١.٣٧ | ١٥.٢٤ | ٥٦٦.١٩ | ١٦.٣٨ | *٢.٩٢ |
| Beta-endorphin | Pico-mol /l | ٩.٣١ | ٠.١٤ | ٩.٥٨ | ٠.١٩ | *٢.٧٨ |
| Quantitative level of 1500m run | Minutes | ٤.٣٨ | ٠.٠٩ | ٤.٤٩ | ٠.٠٩ | *٢.٥٦ |

T value is at 0.05 = 2.145 significance level

* Statistically significant at 0.05

As table (5) shows, there are statistically significant differences at level 0.05 between both post tests of the two experimental groups in terms of the physiological variances in 1500m race in favor of the first experimental group which has ACE/ID gene.

The researcher attributes this result to the nature of the genetic diversity among the individuals of the first experimental group which has

ACE ID gene and the second experimental group which has ACE/DD gene. In this respect, Nabila Abdurrahman and Salwa Fekry (2004) indicate that the variation in the players' response to the same training may be attributed to many reasons, the most important of which is the variation in heredity factors.

This result is consistent with the following studies: Tsianos, et., al (2004), Mohammed Mohammed Ali (2006), Schneider, et.,al (2007), Amr Mohammed Roshdy (2007), Nada Hamed Rommah (2008), Tarek Mahdy Attia (2012), Fatma Allam Hussein (2012), Abdurrahman Bassiouny Abdurrazzak (2015) which indicate that disparity between athletes in terms of the physical and functional variables under consideration can be attributed to genetic diversity. Athletes with ACE ID gene have shows better improvement in their speed endurance, maximal oxygen uptake and vital capacity, while athletes with ACE DD gene, have shown improvement in their speed and muscle strength.

In this respect, Hopkins (2004) indicates that genetic diversity ACE ID gives a high response to endurance trainings.

Nazarov, et., al (2001) add that genetic diversity ACE DD increases among athletes given that they have fast white muscles fibers with big muscles and high energy production using glucose during performance.

**Table (6)**

**Percentages of improvement in the post tests of both the first experimental group (ACE ID) and the second experimental group (ACE DD) in terms of physiological variables and quantitative level in 1500m race**

| Variables | First experimental group N=9 | | | First experimental group N=7 | | |
|---|---|---|---|---|---|---|
| | Pretests | Posttests | Percentage of improvement | Pretests | Posttests | Percentage of improvement |
| Lactic acid | ٥.٤٣ | ٥.١١ | %٦.٢٦ | ٥.٤٨ | ٥.٣٢ | %٣.٠١ |
| Dehydrogenase | ٥٧٩.١٥ | ٥٤١.٣٧ | %٦.٩٨ | ٥٨١.٢٨ | ٥٦٦.١٩ | %٢.٦٧ |
| Beta-endorphin | ٩.٧٢ | ٩.٣١ | %٤.٤٠ | ٩.٧٩ | ٩.٥٨ | %٢.١٩ |
| Quantitative level of 1500m run | ٤.٥٣ | ٤.٣٨ | %٣.٤٢ | ٤.٥٨ | ٤.٤٩ | %٢.٠٠٤ |

As tables (6) shows, the subjects of the first experimental group (ACE/ID) are superior to those of the second experimental group (ACE/DD) in terms of the

improvement of posttests compared to pretests regarding the physiological variances under consideration in 1500m run.

This result is consistent with: Tsianos, et., al (2004) who indicates that there is a relation between genetic diversity ACE/I and the performance of endurance athletes, and genetic diversity ACE/D and the performance of speed and muscles strength athletes.

**Thus the validity of the second hypothesis has been established Findings:**

1- Training using genetic diversity (ACE-ID/DD) has a positive impact on the signs of muscle fatigue (Lactic acid – Dehydrogenase - Beta-endorphin) for the runners of (1500m) race.

2- Training using genetic diversity (ACE-ID/DD) had a positive impact on the runners of quantitative level of (1500m) race.

3- Junior runners with ACE ID gene have shown an improvement in the signs of muscle fatigue (Lactic acid – Dehydrogenase- Beta-endorphin) and the quantitative level of (1500m) race, compared to the group who have ACE DD gene.

**Recommendations:**

Based on the obtained results and the concluded finings, the researcher recommends the following:

1- The training should be implemented using ACE genetic diversity given its effective impact on the signs of muscle fatigue (Lactic acid – Dehydrogenase – Beta-endorphin) and the quantitative level of the runners of (1500m) race.

2- The necessity of classifying and selecting long distance junior runners in accordance with genetic diversity ACE ID/DD

3- Juniors in the National Project for Talents at the governorate of Sharqia who have ACE ID gene should be guided to medium distance races.

4- Juniors in the National Project for Talents at the governorate of Sharqia who have ACE DD gene should be guided to short distance races.

5- Conducting more scientific studies on various types of genes. Studies shall not be limited to an only gene.

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