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ACE gene diversity and its relationship to some anthropometric and physiological measurements and the digital level of the anaerobic endurance athlete as a function of selection

Dr. Galal Abdullah Saad Al-Alawi [1], Prof. Dr. Hussein Ahmed Heshmat[2], Prof. Dr. Emad Al-Deen Shaban Ali[3]

[1]Ph.D. Department of Sports Health Sciences, College of Physical Education, Hodeidah University, Yemen.
[2]Professor of Physiology, Faculty of Medicine Zagazig University Egypt.
[3] Professor of Sports Physiology and Head of the Department of Sports Health Sciences, Faculty of Physical Education - Assiut University, Egypt.

Abstract: Research aim: We are identifying the relationship between the variation of the angiotensin gene ACE II/ID/DD and some anthropometric and physiological measurements and the digital level in anaerobic endurance athletes as a function of selection. **Research question:** What is the relationship between the variation of the angiotensin gene ACE II/ID/DD and some anthropometric and physiological measurements and the digital level in an anaerobic endurance athlete as a function of selection? **Research methodology**: The researchers used the descriptive method (for survey studies) as it suits the nature of this research. **The research sample:** The sample was chosen deliberately, represented by short-distance anaerobic endurance athletes who excelled in the speed component, the number of which was (9) players registered in sports clubs affiliated with the Egyptian Athletics Federation - Assiut branch. **Results**: There is a strong direct correlation between anthropometric measurements and some physiological measurements (systolic blood pressure) with the ACE gene, where the calculated “t” value ranged between (0.56 and 0.90), It is also clear that there is an inverse correlation between fat percentage and body mass index with the ACE gene, as the calculated “t” value reached (0. -61 and 0. -52), There is a strong direct correlation between the digital level and the ACE gene, where the calculated “t” value ranged between (0.85), There is also no correlation between the rest of the other measurements under study with the ACE gene, as the calculated “t” value ranged between (0.12 and 0.25). **Conclusions**: The results showed that the percentage of occurrence of the sub gene (ID) was (0.44), the sub gene (DD) appeared at a percentage of (0.56), and the gene (II) did not appear in the anaerobic tolerance group, that there is a strong direct correlation between the digital level and the ACE gene, where the calculated “t” value ranged between (0.85), that there is a strong direct correlation between anthropometric measurements and some physiological measurements (systolic blood pressure) with the ACE gene, where the calculated “t” value ranged between (0.56 : 0.90). It is also clear from the previous table that there is an inverse correlation between the fat percentage and the body mass index with the ACE gene, where the calculated “t” value reached (0.61-) (0.52-), and there is no correlation between the other measurements under study with the ACE gene, as the calculated “t” value ranged between (0.12 : 0.25). **Recommendations**: Selection of players for activities that require anaerobic endurance based on the ACE DD/ID genotype, Using molecular biology technology by conducting tests to analyze deoxyribonucleic acid (DNA) to determine the Genotypes of players and their use in the modern sports selection process.

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Introduction:

Genetic and environmental factors also play a major role in athletic performance and related phenotypes; in fact, 66% of the variance in athletes is explained by genetic factors, with the remaining percentage coming from environmental factors, Sports genomics is a scientific field that studies how elite athletes' genomes are organized and operate, Its goal is to provide molecular techniques for identifying talent and creating individualized training regimens. (Ahmetov et al., 2022)

It is well known that every athlete has an innate talent that contributes to their success in sports; these traits are largely determined by genetic factors or genomics. "Sports". Some people are born athletes who perform exceptionally well in certain sports even with the same training and physical condition as others. (Semenova et al., 2019; Youn et al., 2021).

Today, a crucial component in spotting potential athletes is genetic testing. This is because a variety of genetic, physiological, behavioral, and environmental factors interact to determine athletic achievement to ascertain an athlete's unique condition in reaction to training, nutrition, and physical stress, the genetic profile must be considered by combining medical and genetic data. (La Montagna et al., 2020; Meckel et al., 2014)

The ability of humans to succeed in athletic performance varies, and this variation is mostly influenced by hereditary variables. Approximately 155 genetic markers, including 93 markers linked to endurance and 62 markers related to speed and force, have been discovered recently inside all chromosomes and Deoxyribonucleic acid (DNA) strands associated with the status of top athletes. (Ahmetov et al., 2022)

Genes are important in the subject of physical education since half of the traits affecting an individual's physical performance are inherited. They also control 50% of the variables that alter in response to exercise. Genes may be more important than training in explaining the differences in performance across players. The process of identification and selection is taken into account. Talent is one of the most important components in creating a spectacular athlete. (Bouchard et al., 2011)

Angiotensin-converting enzyme known (ACE) is present in blood capillary epithelial cells. As one of the circulatory system-related components of the Renin-Angiotensin System (RAS), ACE influences the circulatory system by inducing the elimination of two amino acids (Ang/I) that are to be transformed into (Ang/II). Renin is released by the kidney in response to low blood volume and sodium levels, and this results in the conversion of (Ang/I) to (Ang/II) in the blood, There is a difference in ACE density between the genetic diversity (II/ID/DD). It might cause varying Ang/II production, which would change the size of the left ventricle. (Khurana & Goswami, 2022)

Research problem:

Researchers have noticed that some players in athletics competitions excel in anaerobic abilities and others excel in aerobic abilities, Researchers attribute this difference between players and their responses to training to their differences in physical and functional structure due to the diversity of their genes. The results of some scientific studies, such as the study of (Dionísio et al., 2017; Grenda et al., 2014; Orysiak et al., 2018; Pereira et al., 2013) on the importance of genes, especially the ACE gene, in the I/D type in developing The level of performance, and through scientific observation by researchers, they found the inability of track and field athletes in many races to maintain a high level of endurance during the races and not to finish them with a high level of achievement, and the rapid appearance of fatigue and a decline in their technical and digital level. Survey studies of multiple databases, including paper, electronic and available ones, indicate On the Internet, which attempts to study the genetic diversity of the angiotensin ACE gene and its relationship to some anthropometric and physiological measurements among anaerobic endurance athletes in the Arab community, it is limited, which sparked the desire of researchers to try to identify the reality of this phenomenon and the urgent need to conduct intensive studies that aim to raise the technical and digital level of sports players, The strengths through studying the genetic genes responsible for developing anaerobic capabilities as a basic requirement for reaching championship rank, in addition to the scarcity of studies in the sports field that linked sports training and molecular biology, represented by the study of genetic diversity (ACE I/D) and its relationship to anthropometric and physiological variables and the level of performance among athletes, which Researchers were prompted to conduct an extensive scientific study on the genetic diversity of the angiotensin I/D ACE gene and its relationship to some anthropometric and physiological measurements in anaerobic endurance athletes as a function of selection.

Research aim:

We are identifying the relationship between the variation of the angiotensin gene ACE II/ID/DD and some anthropometric and physiological measurements and the digital level in anaerobic endurance athletes as a function of selection.

Research question:

What is the relationship between the variation of the angiotensin gene ACE II/ID/DD and some anthropometric and physiological measurements and the digital level in an anaerobic endurance athlete as a function of selection?

Research plan and procedures:

Research methodology:

The researchers used the descriptive method (for survey studies) as it suits the nature of this research.

The research community:

The research community represents high-level athletics athletes registered with the Egyptian Athletics Federation, numbering (9) players.

Research sample:

The sample was chosen deliberately, represented by short-distance anaerobic endurance athletes who excelled in the endurance component, and the number of which was (9) players registered in sports clubs affiliated with the Egyptian Athletics Federation - Assiut branch.

Moderation of the data of the research sample members in the basic variables:

The researchers normalized the data of the basic sample members under study with the aim of using the appropriate statistical method using the Kolmogorov-Smirnov test in the following research variables:

Table (1): Arithmetic mean, standard deviation, and Kolmogorov-Smirnov test (age, height, weight, pulse, blood pressure) for the sample under study (n=9)

variables		Measuring Unit	Average	Standard Deviation	Kolmogorov-Smirnov Test	Significance
					Significance level	
Descriptive variables	Age	yr	19.50	1.51	0.01	Significance
	Weight	kg	67.04	8.15	0.85	No Significance
	Height	cm	175.13	5.26	0.55	No Significance
Basic variables	Arm length	cm	78.69	1.92	0.15	No Significance
	Leg length	cm	95.63	11.30	0.00	Significance
	Foot length	cm	25.19	1.28	0.11	No Significance
	Digital level 200 m	M/S	27.07	1.72	0.01	Significance
	BMI	kg	21.72	1.73	0.48	No Significance
	FAT%	%	11.22	2.39	0.21	No Significance
	HR	bpm	87	16	0.03	Significance
	SYS	mm Hg	124	16	0.42	No Significance
	DIA	mm Hg	80	9	0.53	No Significance

It is clear from the results of Table (1) that the Kolmogorov-Smirnov test indicates that the sample follows a normal distribution in some variables (age, leg height, Digital level, pulse) under study, as the values of the Kolmogorov-Smirnov test ranged at levels of significance between (0.0: 0.85), which It indicates that the rest of the variables do not follow a normal distribution.

Research fields:

1- The human field:

The research was applied to high-level athletics athletes registered with the Egyptian Athletics Federation, who numbered (9) players and whose ages ranged between (18-24) years.

Spatial field:

Biological measurements of the ACE gene were performed at the Molecular Biology Center - Assiut University, Anthropometric and physiological measurements were conducted in the Physiology Laboratory at the Faculty of Physical Education - Assiut University, Measurements were made Anaerobic endurance Digital level measurement and blood withdrawal were performed at the Sports Stadium - Olympic Village - Assiut University.

The temporal field:

Blood samples were drawn from 8:00 am until 1:00 pm on the morning of Monday, 28/10/2021, until Monday, 13/12/2021, at the Sports Stadium - Assiut University, and sent to the Molecular Biology Laboratory - Assiut University. To perform a polymerase chain reaction (PCR) test.

The research measurements were applied in the period from (28/10/2021) to (11/4/2022).

Data collection tools:

Physiological measurements:

Measuring heart rate (at rest, after physical exertion): The measurement was done using a POLAR watch device, measuring systolic and diastolic blood pressure (at rest, after physical exertion): The measurement was done using a sphygmomanometer, Measuring the maximum oxygen consumption VO_{2max} : using the Cooper test (12 s).

Anthropometric measurements:

Measurement of fat percentage FAT% and body mass index (BMI): done using the TANITA device, Lengths of some parts of the body (cm), including (total body length - arm length - leg length - foot length). It was done using a graded tape (50 m).

Digital level measurements:

Measure the time of running 200 meters.

Measurement of anaerobic endurance:

Measuring the (200m) running time using a stopwatch, athletics track legal (400m) lap.

Table (2): Devices used in the research

TANITA	Tanita TBF 300A
Rhystrameter Seca	Germany Seca gmbh ser
polar watch	FT4M:90036750
Sphygmomanometer	MD140280b04
Stopwatch	RS-013
ASUS	TP500L
VORTEX GENIE	MD(G560)
Veriti Thermal Cycler	MD: 9901
laminar flow cabinet	MADE Latvia 040104
biometra thermocycler	050- TPersonal
Gel documentation system	MD 6721
Microwave	LG MC2886BRUM
Gel Electrophoresis	1704489 EDU
GeneQuant-Spectrophotometer	MD:111292
centrifuge Centurion Scientific	K241R

Research measurement:

The research was applied in the period from (28/10/2021) to (11/4/2022) and was as follows:

Physiological measurements before performance (Rest time and after Physical exercises):

Measure the pulse rate using a POLAR watch, Measuring blood pressure at rest (systolic and diastolic), and the measurement was done by a specialist doctor using a Sphygmomanometer.

Anthropometric measurements:

Measuring the body mass index (BMI), Measuring body fat percentage (FAT%), Measurement (weight, total body length, arm length, leg length, foot length) was done using a Seca electronic Restameter, and a graduated tape (50 m).

Digital level measurements:

Measure the time of running 200 meters.

Anaerobic endurance test:

(200 m) time run using stopwatch, athletics track legal (400 m) lap.

Molecular biology measurements of genetic diversity:

Angiotensin converting gene ACE I/D.

Conduct preliminary preparations:

Draw a blood sample:

The researchers conducted the process of drawing blood samples from each individual in the research sample (5 ml of blood) by a specialist doctor at the Sports Stadium - Olympic Village - Assiut University. The blood for the research sample was placed in tubes containing EDTA, an anticoagulant.

The blood sample was placed in a container of ice and transported to the Molecular Biology Center - Assiut University.

The two primers for the angiotensin converting gene (ACE) were designed through published international books and research:

ACE - forward: 5,CTGGAGACCACTCCCATCCTTTCT3,

ACE -Reverse: 5,GATGTGGCCATCACTTCGTCAGAT3,

Procedures for DNA extraction from blood:

Add (150 microliters) of blood to a collection tube (1.5 ml), Add (300 µl) of lysis solution, Mix using the Vortex rotary device for 15 seconds, Incubate the samples at room temperature (15-25°C) for 10 minutes, Add 300 microliters of binding buffer and mix gently with a Vortex rotator, Place a spin column in a 2 ml collection tube, Transfer the decomposed portion of blood onto a spin column and rotate it on a centrifuge at a speed of (13,000/min) for one minute, Dispose of the solution in the collection tube, then add a spin column into a new collection tube, Add (500 microliters) of washing solution (A) to Spin Colm and then rotate it on the centrifuge for (1) minute at a speed of (13000/min), Dispose of the solution in the collection tube, then put a spin column in a new collection tube, Add (500 microliters) of washing solution (B) to a spin column, then place them and rotate them on the centrifuge for (1) minute at a speed of (13,000/min), Dispose of the solution in the collection tube, then put a Spin Column in the same first collection tube again, then rotate it on the centrifuge for (1) minute at a speed of (13,000/min),Transfer the spin column to a 1.5 ml tube, then add 200 microliters of Elution Buffer to the spin column, Incubate the tube at room temperature for (1) minute, then rotate it for (1) minute at a speed of (13,000/min).

Agarose gel electrophoresis:

Add (1.5 grams) of agarose, then add (50 ml) of Tris/Borate/EDTA (TBE) solution, and place it in the microwave for (2) minutes, Add (1.5 microliter) of ethidium bromide, Dump the dissolved agarose containing TBE into the gel mold until it is immersed in the product containing TBE, Injection (samples) for each sample (5 microliters) of the same sample, Connect the gel mold to two electrodes at a voltage of (100 volts) for one (1) hour, Photographing the gel under a UV lamp.

Statistical methods:

Arithmetic average, Standard deviation, Pearson correlation coefficient, Kolmogorov-Smironov test, Mann Whitney.

Results:

The relationship between the variation of the angiotensin gene ACE I/D and some anthropometric and physiological measurements in an anaerobic endurance athlete as a function of selection:

Table (3): Genetic diversity (ACE) of the anaerobic tolerance group (n=9)

Concentration of genetic diversity of a gene ACE					
Alleles	**II**	**ID**	**DD**	**I**	**D**
Anaerobic endurance	0.0	4 (0.44)	5 (0.56)	0.33	0.67

It is clear from Table (3) that the percentage of occurrence of the sub gene (ID) was (0.44), the sub gene (DD) appeared at a percentage of (0.56), and the gene (II) did not appear in the anaerobic tolerance group.

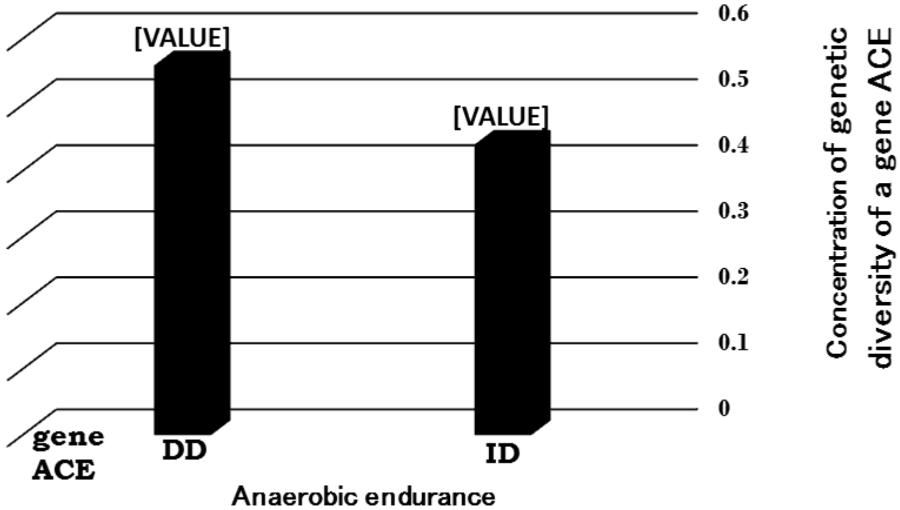

Figure (1): Genetic diversity (ACE) of the anaerobic tolerance group

Table (4): Pearson correlation coefficient between ACE gene and digital level (n=9)

Measurements	Average time	Unit of measurement	ACE gene concentration	Significance level
digital level 200m	26.78	Seconds	0.85	Significance

The tabular value of "R" at the level of "0.05" = 0.46

It is clear from Table (4) that there is a strong direct correlation between the digital level and the ACE gene, where the calculated “t” value ranged between (0.85).

Table (5): Pearson correlation coefficient between the ACE gene and anthropometric measurements and physiological measurements (n=9)

Measurements		**measruing unit**	**Concentration of genetic diversity of a gene ACE**	**Significance**
Anthropometric variables	Total body length	cm	0.90	Significance
	Arm length	cm	0.84	Significance
	Leg length	cm	0.84	Significance
	Foot length	cm	0.84	Significance
Basic variables	BMI	kg	0.52-	Significance
	FAT%	%	0.61-	NO Significance
	HR	bpm	0.12	NO Significance
	SYS	mm Hg	0.56	Significance
	DIA	mm Hg	0.25	NO Significance

The tabular value of "t" at the level of "0.05" = 0.46

It is clear from Table (5) that there is a strong direct correlation between anthropometric measurements and some physiological measurements (systolic blood pressure) with the ACE gene, where the calculated "t" value ranged between (0.56 : 0.90). It is also clear from the previous table that there is an inverse correlation between the fat percentage and the body mass index with the ACE gene, where the calculated "t" value reached (0.61-) (0.52-), and there is no correlation between the other measurements under study with the ACE gene, as the calculated "t" value ranged between (0.12 : 0.25).

Discussion:

The relationship between the variation of the angiotensin gene ACE I/D and some anthropometric and physiological measurements and digital level in an anaerobic endurance athlete as a function of selection:

It is clear from Table (3) that the percentage of occurrence of the sub gene (ID) was (0.44), the sub gene (DD) appeared at a percentage of (0.56), and the gene (II) did not appear in the anaerobic tolerance group, It is clear from Table (4) that there is a strong direct correlation between the digital level and the ACE gene, where the calculated "t" value ranged between (0.85), It is clear from Table (5) that there is a strong direct correlation between anthropometric measurements and some physiological measurements (systolic blood pressure) with the ACE gene, where the calculated "t" value ranged between (0.56 : 0.90). It is also clear from the previous table that there is an inverse correlation between the fat percentage and the body mass index with the ACE gene, where the calculated "t" value reached (0.61-) (0.52-), and there is no correlation between the other measurements under study with the ACE gene, as the calculated "t" value ranged between (0.12 : 0.25).

The results reached are consistent with the results of the study of:(Cam et al., 2005; Papadimitriou et al., 2016; Papadimitriou et al., 2009; Puthucheary et al., 2011; Thompson et al., 2006), who all confirmed that there is a correlation between the (ACE/II/ID) gene and anaerobic tolerance.

The researchers attribute that there is genetic diversity in ACE II/ID, where the appearance of the II gene counterpart prevailed, followed by the ID genetic counterpart, and this indicates that players possess red fibers for endurance, which include a high content of myoglobin, a greater number of mitochondria and capillaries, and are characterized by greater efficiency in producing triglycerides. Adenosine phosphate (ATP) aerobically and anaerobically.

The ACE I/D polymorphism was the first to be linked to human performance fifteen years ago. The angiotensin-1 gene, which is a component of the angiotensin renin system that regulates bodily fluid levels to control blood pressure, includes the ACE gene. The ACE/II genotype is consistently linked to endurance performance and increased operational efficiency, while the DD genotype is linked to power and energy performance. The ACE gene allele (I) represents insertion 287 and is associated with low blood and tissue ACE activity, while the D allele is associated with high blood and tissue ACE activity. (Guth & Roth, 2013)

In the 400-meter running event, Caucasian runners with the ACE/DD genotype on average outperformed those with the ACE/II genotype in terms of speed. (Papadimitriou et al., 2016)

The first genetic variation to be found to substantially affect human performance was a polymorphism in the angiotensin I converting enzyme (ACE) gene. The RAS system functions as an endocrine regulator and is also present in local tissues and cells, where the I/D allele has been linked to enhanced performance. and the length of the workout the (I) gene has consistently been linked to endurance-focused events in a range of populations, while the (D) allele is linked to power and speed and has been found to be significantly overexpressed in elite swimmers. (Puthucheary et al., 2011)

Athletes with the ACE II genotype may benefit from endurance sports, whereas those with the ACE/DD genotype excel in strength and speed-related activities. (Dionísio et al., 2017)

Polymorphism for the ACE/ID gene is one of these genetic factors. Genetic variation and environmental stimuli combine to produce athletic talents in athletes. The I allele is typically linked to endurance sports, and the D allele is typically linked to sprint performance. Investigations into the mechanisms underlying these observations are ongoing. Insufficient. (Papadimitriou et al., 2009; Puthucheary et al., 2011)

The ACE/II genotype works to increase red fibers and blood capillaries, which is important for long distance running. The ACE/ID genotype is for middle-distance athletes. The ACE/DD genotype affects muscle fiber size by increasing white fibers. The distribution of the ACE/DD gene is primarily associated with short-term physical performance, while the ACE II allele is more associated with long distances, including the endurance component. (Cam et al., 2005)

Two gene types, ACE/II and ACTN3/RR, are consistently associated with athletic performance. The endurance component is associated with the ACE/II gene, while the strength and speed component are associated with the ACTN3/RR gene. Athletic performance depends on having the right genetic makeup in conjunction with the best possible training environment. Genetic testing can Little is known about the relationship between genetic diversity and young athletes' physical ability, despite the possibility that they can prevent them from major injuries. Nevertheless, genetic testing has gained popularity as a talent identification tool over more conventional approaches. (Guth & Roth, 2013)

Through the previous presentation, the researchers concluded that genes determine for us the various traits and characteristics that differentiate between individuals, that the genetic differences that distinguish one individual from another are what later affect his performance in general, and that genes are an important and essential factor in the emergence of sports talent. Genetic diversity was found in ACE I/D, where DD was dominant, followed by ID, while ACE II did not appear.

Conclusions:

The results showed that the percentage of occurrence of the sub gene (ID) was (0.44), the sub gene (DD) appeared at a percentage of (0.56), and the gene (II) did not appear in the anaerobic tolerance group, that there is a strong direct correlation between the digital level and the ACE gene, where the calculated "t" value ranged between (0.85), that there is a strong direct correlation between anthropometric measurements and some physiological measurements (systolic blood pressure) with the ACE gene, where the calculated "t" value ranged between (0.56 : 0.90). It is also clear from the previous table that there is an inverse correlation between the fat percentage and the body mass index with the ACE gene, where the calculated "t" value reached (0.61-) (0.52-), and there is no correlation between the other measurements under study with the ACE gene, as the calculated "t" value ranged between (0.12 : 0.25).

Recommendations:

Researchers recommend that the selection of players for anaerobic endurance activities be based on the ACE DD/ID genotype. Molecular biology technology is also used by conducting tests for DNA analysis to determine the genotypes of players and using them in the modern sports selection process.

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