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EFFECT OF GENOTYPE (ACTN3) ON THE LEVEL OF ACHIEVEMENT AS A DETERMINANT FOR SELECTING PHYSICAL STRENGTH PLAYERS

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Abstract:
The process of selecting sports talents is still based on basic determinants and the best practitioners of the event at the levels of various sports, which will rely on the training curricula later hoping to achieve in the championships and win medals, without focusing and taking into account the type of gene and genetic traits supporting this, so this process is random and incomplete lacks the elements of the foundations of success that are built on it, with the numbers of doses of training loads that will have the greatest impact and bear fruit to achieve the goals of the Olympic champion industry, and for this the determination of The pattern of gene expression that distinguishes emerging physical strength, which accelerates the ways to reach the required higher levels, and here the results of training emerge by saving a lot of effort, time and money, and this is what prompted the researchers to study the phenomenon of research and ask the question, what is the impact of gene patterns (ACTN3) on the level of achievement as a determinant for the selection of sports talents for physical strength players. The research aimed to find the effect of the patterns of the gene (ACTN3) and its association with the level of achievement of physical strength players. The researchers used the descriptive approach with correlation and identified the research community as players of the Iraq team for physical strength sports, junior group under the age of (15 years). The study came out with the following conclusions: (ACTN3) gene types, specifically the allele (RR), affect the strength and speed of muscle fiber contraction, unlike the endurance allele (XX).

Keywords: genotype (ACTN3), level achievement

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1. Definition of the Research

1.1 Introduction and Importance of the Research

Genetics and genetics and their multiplicity of patterns are among the modern trends that have broken into the sports field and have become one of important scientific topics, as research and studies in molecular biology sciences, through partial structures of biological processes, focused on the digital level of the cell, which specializes in analyzing the structure and work of (DNA) and (RNA) and seeking to identify the characteristics of genes to identify and approximate the appropriate type of gene associated with special physical activity and its reflection to develop skill performance to reach the highest levels. Scientific research in the past few decades has focused on trying to understand the relationships of associations between multiple genotypes and the functional response to physical performance in various sports activities. In this regard, it has identified many genes associated with sports performance and one of the genes that have received scientific attention is the (ACTN3) gene, which plays the role of protein-encoding, which is one of the components of the contraction mechanism in skeletal muscle fibers, and has a key role in producing muscle strength with strong and rapid contractions explosive movements.

The project of making a talented hero is determined by what he inherited from the genes of the parents, and no matter how many training curricula and mastering the ideal performance in sports practice, you will not make a talented hero unless he carries a certain genetic pattern that helps to excel in achieving achievement, so the selection process depends on fixed basic determinants, and it is time to start researching the determinant of human genes and taking an in-depth scientific look at molecular biology, and its link to the level of athletic achievement to discover sports talents, which is one of the basics of the industry hero.

Understanding the correct relationship of the (ACTN3) gene pattern determinant will allow clarifying the criteria for selecting junior strength athletes, and this knowledge can contribute to the objective numbers of promising sports talents in the future, hence the importance of research.

1.2 Research Problem

The process of selecting sports talents is still based on basic determinants and the best practitioners of the event at the levels of various sports, which will rely on the training curricula later hoping to achieve in the championships and win medals, without focusing and taking into account the type of gene and genetic traits supporting this, so this process is random and incomplete lacks the elements of the foundations of success that are built on it, with the numbers of doses of training loads that will have the greatest impact and bear fruit to achieve the goals of the Olympic champion industry, and for this, the determination of the pattern of gene expression that distinguishes emerging physical strength, which accelerates the ways to reach the required higher levels, and here the results of training emerge by saving a lot of effort, time and money, and this is what

prompted the researchers to study the phenomenon of research and put it in a question as follows:

- What is the impact of Gen (ACTN3) patterns on the level of achievement as a determinant of the selection of athletic talents for physical strength players?

1.3 Research Objective

1) Identify the patterns of the (ACTN3) gene and the level of achievement of young physical strength players.
2) Finding the effect of (ACTN3) gene patterns and its association with the level of achievement of emerging physical strength players.

1.4 Imposition of the Research

- There is a correlation between the types of the (ACTN3) gene and the level of achievement in young physical strength players.

2. Research Methodology and Field Procedures

2.1 Research Methodology

The researchers adopted the descriptive approach with correlation relations for its suitability and the nature of the research phenomenon to be studied.

2.2 Research Community

The researchers identified their research community, which are the players of the Iraq team for physical strength sports, junior category under the age of (18 years) for weights (59-74) and registered with the lists of the Iraqi National Federation for Physical Strength (suits, classics) for the season (2023-2024), and by (9) players and their percentage was (100%), where clinical and laboratory tests were conducted by a specialized medical staff to ensure their safety and freedom from diseases that may affect the results of the research, and homogeneity has been done in (height, body mass, chronological age, training age), and it was found that there is homogeneity among members of society.

2.3 Field Research Procedures

2.3.1 Laboratory Procedures for the Analysis of ACTN3 Gene Types

For the research procedures, (3 ml) of venous blood was withdrawn for members of the research community at rest, by a specialized medical staff in the Middle East laboratory with medical syringes size (5 ml), and the blood was placed in a special tube prepared for the purpose of preserving it to prevent coagulation after numbering it according to the sequence of community members, and then the tubes were placed in a cooled box, and transferred to the National Investment Statement Laboratory so that the patterns of the (ACTN3) gene can be analyzed and its percentage determined through Polymerase chain reaction (PCR) as instructed by the manufacturer.

2.3.2 Main Experience

After obtaining all the fundamental approvals for the ethics of scientific research by the Sub-Federation of Physical Strength Sports and members of the research community, who are the emerging players, and their acquaintance with the importance of the study and the extent of its benefit to select players whose genetic genes match the requirements of that effectiveness, which expressed their consent to cooperate with the researchers and implement their research procedures, and after completing all preliminary procedures, starting with the results of clinical examination and laboratory analysis, which resulted in the safety of community members And their full health, we started the aforementioned blood draw procedures for the purpose of analyzing the patterns of the (ACTN3) gene on Monday, 27/1/2024, and on Tuesday, 28/1/2024, community members participated in the Iraq Club Championship, where the players conducted the required lifting techniques (Bing Press, Squat, Deadlift), and after the competition, the results of the performance of the regular lifts were collected for each player, to extract their levels of achievement that were adopted in our research.

2.4 Statistical Treatments

The researchers used the statistical bag (SPSS) version (23).

3. Presentation and Discussion of Results

3.1 Presentation of (ACTN3) Gene Typing Results and Level of Achievement

Table 1: The arithmetic mean, standard deviation and torsion coefficient to measure the patterns of the (ACTN3) gene of the research population

Statistical Treatments Variables	Unit of measurement	Going to	±	Torsion coefficient
(ACTN3)	Dp	0.47	0.088	0.773

Table 2: The arithmetic means, standard deviations and torsion coefficient to test the level of achievement of the research community

Statistical Treatments Variables	Unit of measurement	Going to	±	Torsion coefficient	Average achievement
Squat	Kg	169.83	7.08	0.105	505.16
Bing Press		116.50	8.31	0.113	
Deadlift		217.16	9.28	0.156	

Table 3: The frequencies, percentages of genetic formation and allele for the (ACTN3) gene

ACTN3	Morphology			Allele	
	XX	RR	RX	R	X
Iteration	3	5	1	12	6
Percentage	33.3	55.5	11.1	66.6	33.3

Table 4: The arithmetic means, standard deviations, correlation coefficient value, significance level for measuring (ACTN3) gene patterns and achievement level test for research community members

Statistical Treatments Variables	Going to	±	Correlation coefficient	Sig
(ACTN3)	0.47	0.088	*0.875	0.022
achievement	505.16	25.49		

3.2 Discuss the Results of Measuring the Patterns of the (ACTN3) Gene and Its Association with the Level of Athletic Achievement

The expression of (ACTN3), which encodes the alpha-actinin-3 protein, "*genes that encode factors associated with muscle fiber structure, connective tissue, regulation of muscle growth and muscle formation, such as the (ACTN3) gene*" (Ahmetov & Fedotovskaya, 2012) & Barbara Norman, 2014, is associated with fiber structure, muscle tissue, and muscle mass regulation, and "*an important function of the (ACTN3) genotype is involved in the regulation of muscle mass on performance*", (Hampton CM, 2007) & (Hornberger TA. 2001) & (Broos S, 2012) & (Seto JT, 2011), where "*the (ACTN3) gene is expressed and encodes the sarcomier protein a-actinin-3, in rapid skeletal muscle fibers*", (Agnieszka Maciejewska-Skrendo, 2019) & (Del Coso, 2019), which plays an important role in the rapid glycolysis of the production of rapid muscle contraction type II responsible for the generation of explosive rapid force, and this explanation was consistent with all previous studies that confirmed "*the protein (a-actinin-3) plays an important role in the generation of explosive muscle contractions and is characterized by rapid strength*" (Myosotis Massidda, 2009) & (MacArthur DG, 2008) & (Vincent B, 2010) & (Lucia A, 2006) & (Eynon N, 2009) & (Yang N, 2003) The (ACTN3) gene also "*has two types Allele (R) that produces protein (A-Atn-3) in muscles provides a positive effect on strength and speed athletes while the allele (X) does not produce this protein. a-ATN3) athletes have the advantage of speed and power*." (Paparini A, 2007) & (Niemi AK, 2005) & (Alfred T, 2011) & (Ma F, 2013) Here's another view, which says "*R allele-bearing individuals are those with a higher amount of actinine-3 within the muscle to produce speed and strength when compared to the X allele*." (Hogarth, 2016) & (Houweling, p. 2018)

The results of statistical treatments of digital values showed a strong correlation between gene expression and the level of achievement of physical strength players, and the researchers see the objective link of genetic formation and the nature of gene expression of the allele pattern (R) in proportion to the actual need that requires showing a certain amount of physical strength and the percentages of its contribution are related to achievement, and if we analyze the link to interpret the results according to statistical data, the technical performance in physical strength sports requires muscular strength, which is the dominant and dominant characteristic of the character of This effectiveness, where it plays a distinctive and effective role in very large percentages of performance, which requires the juniors to show the maximum possible strength they have and mainly to overcome external resistance with large weights by performing the levers required in the competition, and this is of course imperative to express the patterns of the gene (ACTN3) to encode the protein (a-actinin-3), and to show the maximum contractions of

muscle fibers with speed and explosive power to implement performance and achieve achievement, "*the existence of a relationship between the ratios of (ACTN3) and the type of muscle fiber and the type of the allele gene (R) has an effect on the production of maximum muscle strength and speed*." (MacArthur DG, 2008) & (Lucia, A, 2006) & (MacArthur, 2008) & (Hogarth, M. 2016) and also "*that ACTN3 gene patterns affect the player's ability to produce force, and show a better correlation between allele (R) carriers and strength than allele (X) endurance*". (Eduardo M. 2013) & (Jan Weyerstraß, 2018) & (Eynon, N. 2009) & (Vincent, B, 2010)

While the statistical results of the correlation of the numerical values between the genetic formation and the nature of gene expression (ACTN3) and the level of achievement are weak for young physical strength, the researchers see weak correlation due to the expression of the gene (ACTN3) to replace the pattern of the gene (ACTN2) with the allele (X), which is characterized by not showing strength and speed in the contractions of muscle fibers, so this allele tends to the characteristic of endurance, "*the genotype (XX) It was associated with increased response to low-intensity resistance training tending to endure*." (Jones, N. 2016) In studies, evidence found confirmed that "*individuals with allelic type (RR) provide greater strength and higher muscle volume in response to muscle strength training*" (Broos, S. 2015) & Gentil, P. 2011 & Walsh, S. 2008, compared to individuals with allelic type (XX) because "*muscle fiber formation appears to be affected by ACTN3 deficiency to replace the ACTN2 gene*." (Del Coso, J. 2019) & (Norman, B. 2014)

Therefore, juniors should be oriented and rounded according to the genotype that suits the sports effectiveness "*genetic approximation and certain innate factors play a key role in determining appropriate athletic performance according to phenotypes related to effectiveness*" (Naureen et al. 2020) and also "*It is necessary to take into account the multiple environmental and genetic variables that give the final phenotype to athletes*" (Tanisawa K, 2020) because people with the same genotype respond similarly to exercise compared to those individuals with different genotypes, suggesting (Naureen Z, 2020) & (AgataLeo ńska-Duniec, 2013) that "*certain genes play a key role in determining individual differences and responding to physical activities*." So "*the benefit of determining genotyping to discover athletic talent and enhance future sports training*." (David VarillasDelgado, 2022)

Understanding the genetic determinants will allow clarifying the standards of physical activities for individual athletes in the future, because understanding that knowledge will contribute to the training of the most genetically competent athlete in order to ensure the adaptation process resulting from the training process, and the appropriate selection according to sports specialization will be reflected in the industry of the Olympic champion, and it is known that the selection process depends on multiple physical, skill, functional and psychological determinants, but now with the development of science and the entry of the era of genes to the sports arena and knowing its importance and its link to the development of physical and skill performance of players We must link the genetic aspect with the applied mathematical aspect.

4. Conclusions and Recommendations

4.1 Conclusions

1) The types of the (ACTN3) gene, specifically the allele (RR), affect the strength and speed of muscle fiber contraction, unlike the allele (XX), which is characterized by endurance.
2) There is a noticeable difference in the values of digital gene patterns among physical strength players.

4.2 Recommendations

1) Adopting the types of the gene (ACTN3) according to the allele (RR) in strength and speed and the allele (XX) endurance as a determinant for the selection of juniors.
2) Conducting similar studies using molecular biology techniques to analyze other genotypes as a determinant for the selection of juniors in different sports events and for both sexes.

Conflict of Interest Statement

The authors declare that this research had been conducted without any financial or commercial relationship, which may be considered as a potential conflict of interest.

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References

Agata Leońska-Duniec: Genetic Research in Modern Sport, Central European Journal of Sport Sciences and Medicine, 3(3), 2013, 19–26.

Agnieszka Maciejewska-Skrendo, Marek Sawczuk, Pawel Cięszczyk, Ildus I. Ahmetov, Genes and power athlete status, Sports, Exercise, and Nutritional Genomics, 2019, 47.

Ahmetov I. I., Fedotovskaya O.N. Sports genomics: Current state of knowledge and future directions. Cell. Mol. Exerc. Physiol. 1(1), 2012, 1–25.

Alfred T, Ben-Shlomo Y, Cooper R, Hardy R, Cooper C, et al, Day IN. ACTN3 genotype, athletic status, and life course physical capability: meta-analysis of the published literature and findings from nine studies. Hum Mutat 32, 2011, 1008–1018.

Barbara Norman, Mona Esbjörnsson, Håkan Rundqvist, Ted Österlund, Birgitta Glenmark, and Eva Jansson, ACTN3 genotype and modulation of skeletal muscle response to exercise in human subjects, J Appl Physiol 116, 2014, 1197–1203.

Broos S, Malisoux L, Theisen D, Francaux M, Deldicque L, Thomis MA. Role of alpha-actinin-3 in contractile properties of human single muscle fibers: a case series study in paraplegics. PloS One 7, 2012, e49281.

Broos, S. Van Leemputte, M. Deldicque, L. Thomis, M.A. History-dependent force, angular velocity and muscular endurance in ACTN3 genotypes. Eur. J. Appl. Physiol, 115, 2015, 1637–1643.

David Varillas Delgado, Juan del Coso, Jorge Gutiérrez-Hellín, et al. Genetics and sports performance, the present and future in the identification of talent for sports based on DNA testing, European Journal of Applied Physiology, 122, 2022, 1811–1830

Del Coso, J. Moreno, V. Gutiérrez-Hellín, J. Baltazar-Martins, G. Ruíz-Moreno, C. et al. ACTN3 R577X genotype and exercise phenotypes in recreational marathon runners. Genes, 10, 2019, 413.

Del Coso, J., Hiam, D., Houweling, P.J., Pérez, L.M., Eynon, N., Lucía, A. More than a 'speed gene': ACTN3 R577X genotype, trainability, muscle damage, and the risk for injuries. Eur. J. Apple. Physiol, 119, 2019, 49–60.

Eduardo M. Pimenta, Daniel B. Coelho, Christiano E. Veneroso, Ering J. Barros Coelho, et al., Effect of ACTN3 Gene On Strength and Endurance in Soccer Players, Journal of Strength and Conditioning Research, 27(12), 2013, 3286–3292.

Eynon N, Duarte JA, Oliveira J, Sagiv M, Yamin C, Meckel Y, Goldhammer E. ACTN3 R577X polymorphism and Israeli top-level athletes. Int J Sport Med 30, 2009, 695–698.

Eynon, N. Duarte, J.A. Oliveira, J. Sagiv, M. Yamin, C. Meckel, Y. Sagiv, M. Goldhammer, E. ACTN3 R577X polymorphism and Israeli top-level athletes. Int. J. Sports Med. 30, 2009, 695–698.

Foster, C. ACTN3 genotype in professional endurance cyclists. Int J Sports Med 27, 2006, 880–884.MacArthur, DG, Seto, J, Chan, S, Quinlan, KG, Raftery, JM, Turner, N, Nicholson, MD, Kee, AJ, Hardeman, EC, et al. An ACTN3 knockout mouse provides mechanistic insights into the association between alpha-actinin-3 deficiency and human athletic performance. Hum Mol Genet 17, 2008, 1076–1086.

Gentil, P. Pereira, R.W. Leite, T.K.M. Bottaro, M. ACTN3 R577X polymorphism and neuromuscular response to resistance training. J. Sport. Sci. Med, 10, 2011, 393–399.

Hampton CM, Taylor DW, Taylor KA. Novel structures for alphaactinin: F-actin interactions and their implications for actin-membrane attachment and tension sensing in the cytoskeleton. J Mol Biol 368, 2007, 92–104.

Hogarth, M.W. Garton, F.C. Houweling, P.J. Tukiainen, T. Lek, M. Macarthur, D.G. et al. Analysis of the ACTN3 heterozygous genotype suggests that α-actinin-3 controls

sarcomeric composition and muscle function in a dose-dependent fashion. Hum. Mol. Genet, 25, 2016, 866–877.

Hornberger TA. Mechanotransduction and the regulation of mTORC1 signaling in skeletal muscle. Int j biochem cell biol 43, 2011, 1267–1276.

Houweling, P.J., Papadimitriou, I.D., Seto, J.T., Pérez, L.M., Coso, J.D., North, K.N., Lucia, A., Eynon, N. Is evolutionary loss our gain? The role of ACTN3 p. Arg577Ter (R577X) genotype in athletic performance, ageing, and disease. Hum. Mutat, 39, 2018, 1774–1787.

Jan Weyerstraß, Kelly Stewart, Anke Wesselius, Maurice Zeegers. Nine genetic polymorphisms associated with power athlete status—A Meta-Analysis. Journal of Science and Medicine in Sport, 21, 2018, 213–220.

Jones, N. Kiely, J. Suraci, B. Collins, D.J. Lorenzo, D.D. Pickering, C. Grimaldi, K.A. A genetic-based algorithm for personalized resistance training. Biol. Sport, 33, 2016, 117–126.

Lucia A, Gómez-Gallego F, Santiago C et al, ACTN3 genotype in professional endurance cyclists. Int J Sport Med 27, 2006, 880–884.

Lucia, A, Go´mez-Gallego, F, Santiago, C, Bandre´s, F, Earnest, C, Rabada´n, M, Alonso, JM, et al. The association of sport performance with ACE and ACTN3 genetic polymorphisms: a systematic review and meta-analysis. PloS One 8, 2013, e54685.

MacArthur DG et al, An Actn3 knockout mouse provides mecha-nistic insights into the association between alpha-actinin-3 deWciency and human athletic performance. Hum Mol Genet 17, 2008, 1076–1086.

MacArthur DG, Seto JT, Chan S, Quinlan KG, Raftery JM, Turner N, Nicholson MD, et al. An Actn3 knockout mouse provides mechanistic insights into the association between alpha-actinin-3 deficiency and human athletic performance. Hum Mol Genet 17, 2008, 1076 –1086,

Myosotis Massidda, Giuseppe Vona, and Carla M. Calo, Association between the ACTN3 R577X Polymorphism and Artistic Gymnastic Performance in Italy, Genetic Testing and Molecular Biomarkers, 3(3), 2009, 377-380.

Naureen Z, Perrone M, Paolacci S, Maltese PE, Dhuli K, Kurti D, Dautaj A, Miotto R, Casadei A, Fioretti B, Beccari T, Romeo F, Bertelli M Genetic test for the personalization of sport training. Acta Biomed 91(13-s), 2020, e2020012.

Niemi AK, Majamaa K. Mitochondrial DNA and ACTN3 genotypes in Finnish elite endurance and sprint athletes. Eur J Hum Genet 13, 2005, 965–969.

Norman, B. Esbjörnsson, M. Rundqvist, H. Österlund, T. Glenmark, B. Jansson, E. ACTN3 genotype and modulation of skeletal muscle response to exercise in human subjects. J. Appl. Physiol, 116, 2014, 1197–1203.

Paparini A, Ripani AM, Giordano GD, et al. ACTN3 genotyping by real-time PCR in the Italian population and athletes. Med Sci Sports Exerc 39, 20007, 810–815.

Seto JT, Lek M, Quinlan KG, Houweling PJ, Zheng XF, Garton F, MacArthur DG, Raftery JM, Garvey SM, Hauser MA, Yang N, Head SI, North KN. Deficiency of alpha-

actinin-3 is associated with increased susceptibility to contraction-induced damage and skeletal muscle remodeling. Hum Mol Genet 20, 2011. 2914 –2927.

Tanisawa K, Wang G, Seto J, Verdouka I, Twycross-Lewis R, Karanikolou A, Tanaka M, et al, Sport and exercise genomics: the FIMS 2019 consensus statement update. Br J Sport Med 54(16), 2020, 969–975.

Vincent B, Windelinckx A, Nielens H et al, Protective role of al-pha-actinin-3 in the response to an acute eccentric exercise bout. J Appl Physiol, 109(2), 2010, 564–573.

Walsh, S. Liu, D. Metter, E.J. Ferrucci, L. Roth, S.M. ACTN3 genotype is associated with muscle phenotypes in women across the adult age span. J. Appl. Physiol, 105, 2008, 1486–1491.

Yang N, MacArthur DG, Gulbin JP, Hahn AG, Beggs AH, Easteal S, North K. ACTN3 genotype is associated with human elite athletic performance. Um J Hum Genet 73, 2003, 627–631.