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**THE ROLE OF ADRB2 AND NOS3 GENE POLYMORPHISMS  
IN SPORTS ACTIVITIES**

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**Abstract.** It became possible to develop methods for identifying sports talents due to the isolation of specific genes that are closely related to the demonstration of significant indicators of physical qualities. Many studies highlight the important role of genetic predictors precisely by DNA polymorphisms, which, in turn, is the basis of the individual's tendency to develop physical qualities with better results and success.

Sports genetics is developing more and more and in the near future may become the main process of finding potential champions even in childhood. It is a relatively new scientific discipline aimed at studying the functioning of the genome of elite athletes.

The study of the human genome and the identification of genetic factors remain difficult tasks, even despite the confirmation of the existent fruitful work of scientists. Experts have already determined countless genetic markers involved in sports. However, they have obtained conflicting results, which require further research and analysis of existing literature data.

**Key words:** gene polymorphism, sports, genetics, endurance, strength.

Genetic factors have a high influence on the following components of sports activities: endurance, strength, flexibility, neuromuscular coordination, and psychological traits. Athlete status is a hereditary characteristic, as on average 66% of the variability in this status is due to the additional influence of genetic factors, the rest is provided by the environment [1].

A large body of evidence suggests that genetic markers may explain mutational variability in individuals associated with changes in physical performance in response to endurance or strength training [2]. Such biodiversity, presented in the form of loss, insertion or replacement of nucleotides in relatively small areas of DNA is called polymorphism.

The ADRB2 and NOS3 genes and their polymorphisms are closely related to the results of sports achievements as they affect the functioning of the cardiovascular and respiratory systems because they are involved during sports activities, providing the body's functional capacity during exercise [3].

It is known that the ADRB2 gene is located on the long arm of chromosome 5 at locus 32 (5q32), consists of a single exon from 2015 nucleotides and does not contain introns, has a length of 3.4 kb [4]. The single nucleotide polymorphism rs1042713, also known as Gly16Arg, is located in the beta-2-adrenergic surface receptor of the gene and is associated with the replacement of the 16th amino acid of the protein chain from arginine (A) to glycine (G) at 46 nucleotide position of gene [5]. The G allele encodes the form of glycine that is most common in the population, while the A allele encodes the arginine residue [6].

Scientists Wolfarth B. et al. confirmed the association between endurance and Gly16Arg polymorphism of the ADRB2 gene. Comparing the genotypes of elite athletes and non-athletes, they concluded that the G allele has an adverse effect on the state of productivity, as it is observed in excess among non-athletes [7].

The Gly16Arg polymorphism of the ADRB2 gene with a variant of the AA genotype was found in people with low mean resting blood pressure at rest, during and after exercise. In a study Tsianos G. I. et al. found that the A allele of the ADRB2

gene of the Gly16Arg polymorphism was much more common among athletes in endurance sports than in the control group [8].

On the contrary, Santiago C. et al. did not note a difference in the prevalence of the G allele of the ADRB2 gene polymorphism among elite athletes involved in endurance sports and the control group [9]. Also, Russian scientists Kolomeychuk S. N. et al. in their work consider the G allele as a genetic marker of endurance [10]. But the difference in the results may depend on the ethnicity of the subjects.

Another gene that has a significant effect on physical performance is NOS3. It is located on the long arm of chromosome 7 at position 36.1 (7q36.1), consists of 25 introns and 26 exons and has a length of 21 kb [11]. The single nucleotide polymorphism rs2070744, also known as T-786C, is located in the gene promoter. It involves the replacement of thymidine (T) by cytosine (C) at the locus of 786 base pairs toward the 5'-end of the molecule. In the presence of this polymorphism there is a decrease in the activity of the gene promoter, which, in turn, leads to a decrease in the production of nitric oxide, which is a leading biological mediator and plays an important role in physical qualities [12].

As noted by Buxens A. et al. the rs2070744 polymorphism of the NOS3 gene provides the potential for success in both strength and endurance exercise. This conclusion was made by scientists comparing the genetic profiles of athletes focused on strength and endurance sports [13].

Examining the genomes of football players Eynon N. et al. noted that the CC genotype of the T-786C polymorphism of the NOS3 gene was observed in most athletes compared to the control group. Also, the results of this study indicate the following: T allele can serve as a marker for better indicators of such physical quality as strength, and the C allele for endurance [3].

Comparing the frequencies of alleles or genotypes between athletes is also a way to determine endurance/strength markers as endurance and strength are located at opposite poles of muscular activity [14]. Therefore, Drozdovska S. B. et al. determined that the T-786C polymorphism of the NOS3 gene affects the efficiency of athletes' cardiorespiratory system during exercise, and also emphasized that the T

allele is more common in the genotype of athletes focused on power and speed sports, compared with the control group [15, 16]. The results were confirmed in an independent study of Italian strength-oriented athletes [17].

The researchers Gomez-Gallego F. et al. in their study did not find any difference between the frequency of the T allele of the T-786C polymorphism of the NOS3 gene among Spanish elite endurance-oriented athletes and the control group. These data can also confirm already present information that the T allele is primarily an indicator of such physical quality as strength [18].

In conclusion, we can say that there is a connection between the analyzed polymorphisms of the ADRB2 and NOS3 genes. However, it is not unequivocal, so it needs further research to explain the association between genetic background and potential success in sports performance. It should also be remembered that in addition to the genetic component and the interaction of genes with each other and the environment, many other factors contribute to the formation of sports characteristics, which are difficult to quantify, such as motivation, technique, social and economic factors and even the usual possibility.

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