Allelic Variants of the Adrb3 Gene and Their Interrelation with Indicators of the Morphenotype of Junior and Cadet Athletes

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ABSTRACT

Today, it is especially important to timely identify the factors that determine the physical activity of athletes and help eliminate these factors. This, in turn, will help athletes achieve significant performance in sports and help preserve the health of junior and cadet athletes. Studies of the distribution of the ADRB3 gene polymorphism in those involved in such sports as athletics, cycling and swimming will allow us to carry out in the early stages a specialized selection of athletes predisposed to greater psychological stability and success.

Keywords: Choice of sport, predisposition, genetic polymorphism, ADRB3 gene, sports cycling, athletics, swimming, junior and cadet athletes

Relevance. In the modern world, sports activities will enable healthy children to develop the adaptive abilities of their body in extreme circumstances under high physical and psycho-emotional stress. And that factor, which can be corrected in a timely manner, which limited the ability to work, endurance of an athlete and remained unnoticed, may in the future be the key mechanism for ending the career of a young athlete much earlier than the noted genetic period. Today's professional sport will give a real opportunity to a healthy young athlete to develop the adaptive capacity of the body in circumstances of extreme conditions of activity, mainly under significant physical and psycho-emotional stress [3,5,9,12,14,15]. Precise identification of those factors that limit the physical activity of a junior and cadet athlete and timely elimination of certain factors, as well as adequate use of corrective means for these factors, will help achieve significant results in sports activities and, in turn, help maintain the health of junior and cadet athletes.

The use of physical influences will increase working capacity and endurance and will enable the athlete to recover very quickly after extreme loads. When a young athlete is assigned different volumes and types of loads during training, it is always necessary to take into account the individuality of each organism, the level of fitness and stamina, which limits the range of physiologically acceptable adaptive capacity when mobilizing endogenous mechanisms to ensure the final sports performance. The most important factors limiting sports activity are: bioenergetic (anaerobic and aerobic) potentials of junior and cadet athletes; psychological (stimulus and ability to conduct sports competitions - tactics); neuromuscular (muscle strength and technical ability to perform various exercises).

At the current level of sports medicine education, genetic factors require a special important role [1,2,4,7.]. In accordance with the current judgments of sports science, it is believed that sports success is 60% genetically determined. Pedagogical, psychological, physiological and anthropometric methods of evaluating sports gifted young athletes do not allow revealing hereditary predisposition to motor performance at an early stage of children's development. By improving the methods of molecular biology, it became possible to find sports inclinations using genetic markers already at the birth of a child.

The latest data confirm that personal differences in the levels of formation of one or another physical and mental property of an individual are mainly due to DNA polymorphisms, which number more than 50 million. To date, we know about 50 genetic markers (DNA polymorphisms) associated with predisposition to various sports. Therefore, the introduction of molecular genetic methods into the practice of sports science can significantly increase the predictive capabilities of sports selection and professional orientation in the system of youth sports [18,19.]. It is known that an inadequate choice of the type of sports activity can be accompanied by the formation of an irrational functional system of adaptation with a significant number of redundant, ineffective, and inappropriate functional interactions, tension of compensatory mechanisms, difficulty in recovery processes, slow formation of fitness, poor performance in competitions, and achievement of a significant degree of sportsmanship. , a disappointing outlook and, finally, a stop in the growth of sportsmanship due to the exhaustion of the genetic reserves of the athlete's body [8,10,11,13]. Sports activities that are inappropriate for the genetic inclination of the athlete's body can lead to a limitation of sports capacity and a decrease in sports performance. If we prefer the choice of sports specialization, taking into account the genetic propensity of the athlete's body to perform all kinds of loads and the likelihood of the body to maintain homeostasis, to avoid violations of adaptive properties and the formation of various pathological conditions. The principle of selection of children in sports should be able to predict the use of health-preserving technologies in sports activities, taking into account the early detection of genetic polymorphisms of the tendency of young athletes to previous significant physical activity, as well as timely prediction of the risk of developing pathological disorders in the child's body that interfere with the implementation of intense physical activity [16, 17.].

To develop recommendations for an adequate preference for the type and volume of loads based on genetic predisposition to various sports in the early period of a career, as well as correction of the training process at later stages, taking into account the individual and psychophysiological characteristics of the body, is one of the topical issues of today's science.

ADRB3 gene The B3-adrenergic receptor (β3-AR, ADRB3) is one of the most studied genes, an important component of the sympathetic nervous system, which primarily mediates lipolysis (destruction of fat cells, adipocytes) and thermoregulation. The ADRB3 gene encodes beta-3 adrenergic receptors. Adrenoreceptors - receptors for adrenergic substances. They respond to adrenaline and norepinephrine. ADRB3 receptors are located predominantly in adipocytes, but also in blood vessels, gastrointestinal smooth muscle, gallbladder, prostate, and skeletal muscle. Their action is based on the activation of receptors, which, through Gs-proteins, leads to the activation of adenylate cyclase. The latter leads to the formation of the second messenger cAMP, which stimulates lipolysis. The ADRB3 gene in humans is located on the 8th chromosome at position 8p11.1-p12 and contains 2 exons, 1 intron and encodes a 408 amino acid polypeptide. Mutational substitution of thymine in the 190th place of the gene for cytosine results in the replacement of tryptophan (Trp) in the 64th amino acid position with an arginine (Arg) residue in the first intracellular loop of the ADRB3 receptor. This mutation is associated with a tenfold decrease in the sensitivity of adipocytes to external factors that control their function. The ADRB3 gene at position 190 has a mutation site in which the presence of thymine (T) or cytosine (C) can be detected. This substitution is implemented in the protein structure at position 64 by the presence of tryptophan (Trp) or arginine (Arg).

Possible genotypes: T190T (**Trp64Trp**) – is a population norm, the owners of this genotype have normal, unchanged metabolic parameters, allowing the use of abdominal fat for energy costs;

T190C (**Trp64Arg**) – this option indicates a decrease in energy metabolism;

C190C (**Arg64Arg**) – this option indicates a decrease in energy metabolism.

Purpose of the study. Analysis of the success of junior and cadet athletes, increasing the efficiency of the selection system based on genetic criteria at the initial stage of training and at the stage of sports improvement, depending on the distribution of ADRB3 gene polymorphisms.

Materials and research methods. The object of the study was children aged 12 to 17 who were selected for a specialized children's and youth sports school, underwent a medical examination and received a medical certificate on their state of health and physical development.

A total of 50 athletes aged 12-17 years old involved in swimming and not involved in sports were examined, anthropometry was carried out (girths of the upper and lower extremities, linear body dimensions were measured), hand dynamometry was carried out, pedagogical testing and genetic examination were carried out. In parallel with the examination of children, a genetic examination of 50 athletes (group C-swimming) was carried out, whose genotypic characteristics became "model characteristics" and a genetic examination of 24 children aged 12 to 17 years of the control group (K) - schoolchildren not involved in sports. For further in-depth examination, including pedagogical testing, anthropometry, somatotyping, determination of physical performance, autonomic tone.

For molecular genetic analysis, DNA samples of the subjects isolated by the sorbent method were used in accordance with the attached instructions for use to the set of reagents for DNA extraction "Proba-PK" ("DNA-Technology", Moscow). Genomic DNA was isolated from whole peripheral venous blood. Blood sampling was performed using a vacuum system containing K2-EDTA as an anticoagulant. DNA extraction was carried out in accordance with the instructions of the DNA/RNA extraction kit.

Results of research and discussion. Analyzing data on the ADRB3(Trp/Trp, Trp/Arg, Arg/Arg) genotype, the following results were obtained:

Table 5.3

ADRB3 polymorphism contingency, % among swimmers in groups (cadets and juniors), males

Group	Gene alleles ADRB3		
	Trp/Trp	Trp/Arg	Arg / Arg
Cadets	76	9,5	14,5
Juniors	62,5	12,5	25

The frequency of occurrence of the Trp/Trp genotype of the ADRB3 gene in junior swimmers was 62.5%, in the group of cadets this figure was 76%. The Trp/Arg genotype of the ADRB3 gene in the group of junior athletes was found in 9.5% of cases compared to the group of cadets, where it was 12.5. Genotype Arg / Arg gene ADRB3 in the group of juniors was detected in 25% of athletes, in the group of cadets this figure was 14.5% (Table 5.3.).

Table 5.4

ADRB3 polymorphism contingency, % among swimmers in groups (cadets and juniors), female

Group	Gene alleles ADRB3		
	Trp/Trp	Trp/Arg	Arg / Arg
Cadets	61	27,5	11,5
Juniors	50	31,5	18,5

The frequency of occurrence of the Trp/Trp genotype of the ADRB 3 gene in junior athletes (Table 5.4) was 50%, in the group of cadets this figure was 61%. The Trp/Arg genotype of the ADRB3 gene in the group of junior athletes was found in 31.5% of cases compared to the group of cadets, where it was equal to 27.5%. The Arg / Arg genotype of the ADRB3 gene in the group of juniors was detected in 18.5% of athletes, in the group of cadets this figure was 11.5%.

Table 5.5
ADRB3 polymorphism contingency, % in the control group, males

Group	Gene alleles ADRB3		
	Trp/Trp	Trp/Arg	Arg / Arg
Schoolchildren aged 12-14	73,5	15,5	11
Schoolchildren aged 15-17	70,5	23,5	6

According to the results obtained (Table 5.5), the frequency of occurrence of the Trp/Trp genotype of the ADRB3 gene in schoolchildren aged 15-17 was 70.5%, in the group of cadets this figure was 73.5%, i.e. almost the same, while the Trp/Arg genotype of the ADRB3 gene in this group was established in 23.5% of cases compared with the group of 12-14 years old, where it was equal to 15.5%. The Arg / Arg genotype of the ADRB3 gene in the group of 15-17 years old was detected in 6% of schoolchildren, in the group of 12-14 years old this figure was 2 times higher and amounted to 11%.

Table 5.6
ADRB3 polymorphism conjugation, % in the control group, female

Group	Gene alleles ADRB3		
	Trp/Trp	Trp/Arg	Arg / Arg
Schoolchildren aged 12-14	66,5	26,5	7
Schoolchildren aged 15-17	75	12,5	12,5

As can be seen from Table 5.6, the frequency of occurrence of the Trp / Trp genotype of the ADRB3 gene in girls aged 14-17 years was 75%, in the group of 12-14 years this figure was 66.5%. The Trp/Arg genotype of the ADRB3 gene in the group of girls aged 14-17 was found in 12.5% of cases compared to the group aged 12-14, where it was 26.5%. Genotype Arg / Arg gene ADRB3 in the group of girls 14-17 years old was detected in 12.5%, in the group 12-14 years old this figure was 7%. Based on the analysis of the ADRB3 gene polymorphism of the main and control groups, the study can be divided into three groups: carriers of the Trp/Trp genotype, Trp/Arg genotype, and Arg/Arg genotype in a ratio of 1: 2: 4.

Conclusion. Based on the above data, it is necessary to emphasize the importance of phenotypic markers, since only they can reflect the influence of the environment on genetically fixed traits in ontogeny. A distinctive feature of genetic markers that do not change throughout life is the possibility of their determination immediately after birth, which means that the forecast for the development of indicators that are significant in terms of sports activities can be made very early. Take into account when selecting in many sports, including swimming, athletics and cycling, the genetic significance of the ADRB3 gene. Since normal Trp/Trp genotypes, which are the population norm and have normal, unchanged metabolic parameters, will increase the chances of athletes winning in various competitions, and in owners of mutant variants like Trp/Arg, Arg/Arg can reduce the performance indicator.

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