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ASSESSMENT OF THE RELATIONSHIP OF ALLELIC-GENOTYPE VARIANTS OF SOME SPORTS GENES WITH THE PARAMETERS OF PSYCHOTYPE AND HIGHER NERVOUS ACTIVITY OF ATHLETES

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ОЦЕНКА ВЗАИМОСВЯЗИ АЛЕЛЬНО-ГЕНОТИПНЫХ ВАРИАНТОВ НЕКОТОРЫХ СПОРТИВНЫХ ГЕНОВ С ПАРАМЕТРАМИ ПСИХОТИПА И ВЫСШЕЙ НЕРВНОЙ ДЕЯТЕЛЬНОСТИ СПОРТСМЕНОВ

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АЙРИМ СПОРТ ГЕНЛАРИНИНГ АЛЛЕЛ-ГЕНОТИП ВАРИАНТЛАРИНИ СПОРТЧИЛАРНИНГ ПСИХОТИП ВА АСАБ ФАОЛИЯТИ КЎРСАТКИЧЛАРИНИ ЎЗАРО БОҒЛИҚЛИГИНИ БАҲОЛАШ

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Abstract. *The article presents the obtained results of the assessment of the relationship between allelic-genotopic variants of the ACE, PPRA and PPRGC1a genes with the parameters of the psychotype and higher nervous activity.*
Key words: *sports genes, allele-genotypic variant, genetic markers, phenotype, motor activity of athletes.*

Резюме. *В статье приводятся полученные результаты оценки взаимосвязи аллельно-гентопных вариантов генов ACE, PPRA и PPRGC1a с параметрами психотипа и высшей нервной деятельности.*
Ключевые слова: *спортивные гены, аллельно-генотипный вариант, генетические маркеры, фенотип, двигательная деятельность спортсменов.*

Резюме. *Ушбу мақолада ACE, PPRA и PPRGC1a генларининг аллел-генотип вариантларини спортчиларнинг психофенотип ва асаб фаолияти кўрсаткичлари билан ўзаро боғлиқлини баҳолашнинг натижалари келтирилган.*
Калит сўзлар: *спорт генлари, аллел-генотип вариант, генетик маркерлар, фенотип, спортчилар ҳаракат фаолияти.*

It is known that for successful phenotypic development of athletes' fitness in terms of increasing the growth of sports indicators, it is important to take into account the individual genetic predisposition to a particular motor activity [1,8]. In this aspect, the possibilities of molecular genetics of sports can be used, in particular the use of genetic markers in combination with phenotypic diagnostics [2]. This contributes not only to the optimization and correction of the training process, but also to the prevention of various diseases associated with the professional activities of athletes [1,3]. In this case, it is necessary to take into account the total contribution of genotypes and alleles of genes in determining the hereditary predisposition to motor activity and to the development of professional pathologies of athletes. At the same time, it should be noted that the results of genetic testing do not yet allow us to obtain an unambiguous answer to the fact that an athlete will really achieve high sports results. Since unstudied gene polymorphisms in a specific individual or significant mutations in his genome can completely reduce the genetic "advantages" that were identified based on the study of a limited spectrum of candidate gene polymorphisms [4,20]. Therefore, this is very important, along with the assessment of certain alleles of genes associated with sports activities and the parameters of athletes' phenotypes. In this case, the interpretation of the results of genetic analysis should precede phenotypic diagnostics, as well as the collection of complete information about the athlete, including family history [8]. In high-performance sports, a special role is given to the degree of psychological preparedness of the athlete [7,12]. Indeed, the psychological preparation of the athlete for the training process and, especially, for the upcoming competitions is an integral part of the entire preparatory process. Athletic success depends not only on the degree of physical fitness, but also on the psychological stability and state of the athlete's higher nervous activity [15,16]. Consequently, the parameters of psychological status and higher nervous activity can be one of the indicators of the athlete's phenotype, and taking this into account is an important task of the preparatory period [10,14]. Taking into account that the prognosis of the success and adequacy of an athlete's preparation for specialized physical and mental loads largely depends on genetic characteristics, it becomes obvious that it is necessary to take into account the relationship between the parameters of the athlete's phenotype and the indicators of individual genetic predisposition to a certain motor activity.

In connection with the above, this section of the work presents data on the study of the features of the relationship between indicators of psychological status and higher nervous activity in rowers with alleles of some genes predisposing to motor activity.

Materials and methods. Based on the stated objective of our study, the frequency of occurrence of temperament types, parameters of the higher nervous system and the strength of the nervous system were studied among the examined athletes. Among the examined athletes, every third had a choleric and phlegmatic temperament, and every fourth had a sanguine temperament. And the features of a melancholic were present in every tenth examined rowers. Therefore, among the examined rowers, individuals with the features of a phlegmatic, choleric and sanguine person predominated.

Results and discussion. Analysis of the typology of the higher nervous system in the examined athletes shows that most of them are sympathotonic, only a few athletes have a predominance of the parasympathetic nervous system. Every fourth examined athlete had a mixed character of the

typology of the nervous system. Therefore, the examined rowers had a predominant sympathotonic type of the higher nervous system. Every fourth athlete had a highly expressed strength and only every seventh had below average or weakly expressed strength of nervous processes. Therefore, the examined athletes mainly had individuals with an average expressed strength of the nervous system.

Thus, the results obtained by us in studying the neuropsychological characteristics of the examined athletes indicate that among them, athletes with relatively high psychological activity and aggressiveness (cholerics and sanguine people) predominate, which is confirmed by the frequency of occurrence among them of athletes with a predominance of the sympathetic typology of the nervous system with its average strength. In all likelihood, the revealed picture of the neuropsychological status of the examined athletes to a certain extent corresponds to the specifics of the sport being studied.

We also studied the allelic variants of some genes responsible for physical performance and their association. As can be seen from the presented data, 10% of the examined subjects had a combination of three alleles of the studied ACE, PPRA and PPRGC1a genes responsible for endurance (Ins/Ins:G/G:G/G, respectively), ¼ of the athletes had a combination of two alleles of the studied genes responsible for endurance (Ins/Ins:G/G; G/G:G/G; Ins/Ins:G/G*, respectively), and ¼ of the athletes had a combination of two alleles of the studied genes responsible for endurance, strength and speed (Del/Del: G/G; Del/Del:G/G*, respectively). It should be noted that carriers of only one allele responsible for endurance were also present in 25% of the examined athletes.

The data we obtained on the association of alleles and genotypes of the studied genes allowed us to conditionally divide the examined athletes by the carriage of these genes into the following categories: athletes with pronounced endurance, with moderate endurance, with weakly expressed endurance, with weakly expressed strength and speed qualities and mixed qualities. Consequently, such a division of athletes by the predominance of certain sports qualities helps to choose the optimal distance for the athlete, taking into account the individual genetic predisposition to motor activity, as well as the formation of the most adequate training program.

Based on the fact that the examined athletes have certain characteristics, both in relation to the parameters of neuropsychology and in terms of individual genetic predisposition, we were interested in analyzing the relationship between these characteristics. First of all, an analysis of the relationship between the alleles and genotypes of the studied genes with the indicators of the psychotype and nervous system was conducted.

Among the examined athletes, depending on the genotypes of the ACE gene, there were 1.5 times more choleric people among athletes carrying the heterozygous genotype Ins/Del. At the same time, this type of temperament did not occur among athletes carrying the genotype Ins/Ins. An analysis of the frequency of another type of temperament - sanguine people, depending on the genotypes of the ACE gene shows that among athletes carrying Ins/Del, it was 1.5 times less common than among athletes carrying the genotype Del/Del. And among the athletes carrying the Ins/Ins genotype, this type of temperament occupied an intermediate position in frequency between the carriers of the Del/Del and Ins/Del genotypes. Melancholics among the examined athletes were found only among the carriers of the heterozygous Ins/Del genotype. At the same time, phlegmatics were more than 2 times more common among the carriers of the Ins/Ins genotype, compared to the carriers of the Del/Del genotype. Consequently, the types of temperament are distributed among the examined athletes in a certain dependence on the carriage of the ACE gene genotypes. If we take into account the fact that Del/Del and Ins/Ins genotypes provide different in their direction athletic qualities, strength and speed, as well as endurance, respectively [4,6,17], then it becomes obvious that the carriers of these genotypes have different types of temperament.

This type of nervous system was most frequently observed among carriers of the Del/Del genotype and least frequently among carriers of the Ins/Del genotype. Consequently, here too, the dependence of nervous system types on the ACE gene genotypes is observed. When analyzing the dependence of nervous system strength on the carriage of ACE gene genotypes, as can be seen from Fig. 5, no significant differences were found.

The results of the analysis of the relationship between the PPRA gene genotypes and the types of temperament and nervous system are presented in Fig. 6. It should be noted that this gene was represented by two genotypes among the examined athletes. The G/G genotype, which determines predisposition to endurance [1,4,9,11], and the heterozygous G/C genotype. And the C/C genotype, which is associated with strength and speed [1,4,18], was not found among the examined athletes.

Among the carriers of the G/G genotype, sanguine and choleric people are equally common and were found in almost every third athlete. The proportion of choleric people was slightly less and was found in almost every fourth athlete. And melancholic people among the examined athletes carrying this genotype were found even less often, in almost every seventh athlete. At the same time, among the carriers of the G/C genotype, the proportion of sanguine people was comparable to the carriers of the G/G genotype, phlegmatic people were almost 1.5 times more, respectively. And melancholic people were not found among the athletes carrying this genotype. In terms of the frequency of occurrence of the predominance of the sympathetic nervous system, both groups of athletes did not differ significantly in terms of carriage of the genotypes of the gene under study. At the same time, the frequency of occurrence of the mixed variant of the nervous system typology was 25.4% higher in the group of athletes carrying the G/C genotype. Consequently, in terms of the typology of the nervous system, no significant differences were found in the genotypes of the PPRA gene.

When analyzing the dependence of the strength of the nervous system on the carriage of genotypes of the PPRA gene, it was found that if carriers of the G/G genotype are characterized by a relatively frequent occurrence among athletes of a nervous system of average and below average strength, then carriers of the G/C genotype are characterized by strong and average strength, respectively. The analysis of the frequency of occurrence of the temperament type - choleric depending on the genotypes of the PPRGC1a gene shows that among athletes carrying the A/A genotype of the studied gene, their share is the highest and occurs in 2/3 of athletes. At the same time, the frequency of occurrence of sanguine people is the highest among athletes carrying the G/C genotype and occurs in almost every third athlete with this genotype. The frequency of occurrence of phlegmatic people is high among athletes with the G/G genotype (every second athlete with the G/G genotype is phlegmatic). Consequently, if among the carriers of the A/A genotype, responsible for speed-strength qualities [9,11,19,22], athletes with the choleric temperament type are most often found,

then among the carriers of the G/G genotype, responsible for endurance [4,8,9,22], athletes with the phlegmatic temperament type are most often found.

The results of the analysis of the distribution frequency of nervous system types in the examined athletes depending on the genotypes of the PPRGC1a gene show that most of the examined athletes, both carriers of the A/A and G/G genotypes, are sympathotonics. Vagotonics and a mixed type of nervous system are much less common. And among athletes, carriers of the A/A genotype are practically not found. Consequently, athletes carriers of the A/A genotype are absolute sympathotonics, and carriers of the G/G genotype are in most cases vagotonics. When analyzing the dependence of the strength of the nervous system on the genotypes of the gene under study, a clear tendency is observed that among carriers of the A/A genotype, there is a high frequency of a strong nervous system, and among carriers of the G/G genotype, there is an average strength of the nervous system, respectively.

Thus, the results of the conducted analysis indicate that there is a certain dependence between the types of temperament, nervous system and genotypes of the studied genes in the examined athletes, both in relation to individual genes and in relation to their genotypes. Moreover, if choleric people are most often found among athletes carrying the A/A genotype of the PPRGC1a gene, then sanguine people are among athletes carrying the Del/Del genotype of the ACE gene and the G/G genotype of the PPRA gene. Phlegmatic people are most often represented among carriers of the Ins/Ins genotype of the ACE gene, the G/G genotype of the PPRA gene and the A/A genotype of the PPRGC1a gene. The predominance of the sympathetic nervous system is characteristic of carriers of the Ins/Ins genotype of the ACE gene, the G/G genotype of the PPRA gene and the genotypes of both the A/A and G/G gene PPRGC1a. At the same time, if the strength of the nervous system does not have a special dependence on the genotypes of the ACE gene, then in relation to the PPRA gene there is a predominance of its average strength among carriers of the G/G genotype. And in relation to the PPRGC1a gene, there is a predominance of strongly expressed strength of the nervous system among carriers of its A/A genotype and a predominance of average strength - among carriers of the G/G genotype of the PPRGC1a gene. It is known that the genes we study have genotypes that determine predispositions opposite to each other [2,4,13]. In this case, if the genotypes Ins/Ins of the ACE gene, G/G of the PPRA gene and G/G of the PPRGC1a gene are responsible for endurance, then the genotypes Del/Del of the ACE gene and A/A of the PPRGC1a gene are responsible for speed and strength [14,21,22]. Based on the above, it becomes obvious that the features of the relationship between the genotypes of the studied genes with the indicators of the neuropsychological status of the examined athletes can serve as a kind of support for their differentiation in relation to individual motor activity in relation to the nature of the neuropsychostatus.

Cholerics are not found among the examined athletes with a pronounced degree of endurance, but among those with moderate and weak endurance, they are found in every fifth athlete. At the same time, among athletes with mixed physical performance (endurance/strength and speed), the proportion increases and reaches up to 40% of those examined. Consequently, as the degree of endurance "decreases", the frequency of occurrence among athletes with a choleric type of temperament. Unlike cholerics, the frequency of occurrence of phlegmatics, on the contrary, as the degree of endurance "decreases", decreases. In relation to sanguine and melancholic people, no clear dependence on the manifestations of physical performance was revealed. Analysis of the dependence of the types of nervous system on the degree of expression of types of performance shows that, although regardless of the expression of physical performance, sympathotonics prevail among athletes compared to vagotonics. However, it should be noted that as the expression of endurance decreases among the examined athletes, there is a slight decrease in the frequency of sympathotonics due to the appearance of vagotonic athletes and a mixed type of nervous system. When analyzing the dependence of the strength of the nervous system on the degree of endurance, a picture is traced indicating the predominance of athletes with a highly expressed strength of the nervous system among athletes with weak endurance and mixed physical performance compared to athletes with a more pronounced degree of endurance, where athletes with an average strength of the nervous system noticeably predominate. Consequently, there is also a certain dependence between the degree of endurance and the frequency of manifestations of the neuropsychological sphere of athletes, and this can be used in the formation of individual plans for training athletes.

Conclusion. Thus, the results of the conducted studies allow us to conclude that for a more complete assessment of the potential capabilities of athletes, the study and assessment of the frequency characteristics of the occurrence of alleles and genotypes of the set of genes responsible for the performance of athletes is insufficient. At the same time, it is advisable to study and analyze the relationship of indicators and features of the athlete's phenotype with the alleles and genotypes of sports genes and the nature of the athlete's motor activity due to them. Such a solution to the problem contributes to the definition of the "sports portrait" of the athlete and to develop on this basis medical-biological and tactical-technical approaches to the preparation of the athlete at the stages of sports activity.

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