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**CHRONOLOGICAL HEREDITY (ENVIRONMENTAL) ANALYSIS,  
FOOD, BLOOD GROUP, IMPORTANT VARIABLES FOR THE  
SELECTION OF ATHLETES ON VARIOUS SPORTS EVENTS**

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**Abstract** The realization of this article was imposed by the need to react concretely on the issue of correlation relationships between heredity, nutrition, blood group, and the selection of athletes on various sports events, requirements imposed to coaches of the national sports teams and not only. In this sense, this article tries to remind the importance of overcoming obstacles in determining those who are predisposed to certain physical activities through modern methods of selection, namely considering heredity, nutrition, blood group. The support of this correlation model has a high degree of precision in terms of physical abilities, as it allows the application of this approach in the specific context and, last but not least, a signal that these things should be treated more seriously and responsibly by all actors involved in conducting/practicing performance sports, regarding the problems and barriers to achieving the objections put before the physical culture and sports specialist (coaches of national sports teams).

**Introduction** Genetics (from the Greek genesis-origin) - the science of heredity and variability. Heredity is the ability of living organisms to pass on their traits to the next generation. Conversely, variability is associated with the ability to change hereditary traits and their manifestations in the process of developing organisms. Sports genetics is a branch of knowledge in the field of human genetics - anthropogenetics and developmental genetics. Sports genetics is a branch of genetics that studies the human genome in relation to physical (specifically, sports) activity. The term "genetics of physical (or motor) activity" was first proposed by Claude Bouchard in 1983. He published two reviews in an issue of the journal, where he presented generalized facts, primarily about individual differences in response to physical activity and, secondly, about the heredity of many physical, physiological and biochemical qualities involved in the process of physical activity. Preliminary diagnosis of individual human physical abilities is possible using genetic markers. They are obviously inherited, appear regardless of environment,

and do not change throughout an individual's life. The essence of genetic marking is that a gene that codes for a certain property that manifests itself at the biochemical level is sometimes closely linked (that is, located close enough on the same chromosome) to another gene that forms an external, easily observed trait. Therefore, an external trait is a marker of an externally unobservable but genetically determined trait. When identifying a marker, one can appreciate the presence or absence of a predisposition in the development of the studied morphological trait or human motor skills. Genetics of physical activity includes sport genetics and some aspects of anthropogenetics and medical genetics. In addition, in the arsenal of genetics of physical activity there are a variety of methods: molecular (detection of gene polymorphisms using the polymerase chain reaction (PCR), mapping (QTL), biochip technology, cytogenetics (study of the structure of the set of chromosomes and individual chromosomes), cytogenetics molecular (fluorescent hybridization method (FISH)), genealogical and, finally, biochemical one [12]. It should be noted that since 1980, sports genetics was officially established as a branch of knowledge in the field of anthropogenetics and developmental genetics. At the Olympic Scientific Congress "Sport in Modern Society" in Tbilisi, the creation of the "International Scientific Society for Genetics and Somatology of Sports" was proclaimed. However, this new scientific branch of knowledge has not yet taken shape as an academic discipline. Sports genetics was not included in textbooks and courses for students and coaches, as an equal section in curricula of universities and academies of physical culture, physical education faculties of pedagogical institutes, the cause being, still, the lack of genetic information. The development of physical activity genetics can be divided into two main periods: pregenomics and genomics. Even before the start of the implementation of the international project "Human Genome" it was known that many human qualities, such as physique, strength, speed, endurance, properties of the nervous system, etc., are genetically determined and are inherited. At that time, knowledge about the heritability of traits was obtained based on observational and twin methods. For example, it was found that in 50% of cases children of outstanding athletes have pronounced athletic abilities and in 70% of cases if both parents were athletes [7]. Furthermore, the ethnic nature of the inheritance of remarkable physical abilities has been discovered: African Americans are still unmatched in sprinting, but Kenyans and Ethiopians in middle and long distance running. In connection with the latter fact, a Center for the Study of the Phenomenon of Kenyan and Ethiopian runners was established at the University of Glasgow (Glasgow, Scotland). More clearly, the heritability of physical qualities has been demonstrated using twin methods. For this, data on various traits from large samples of monozygotic and dizygotic twins were used. As a result, the

heritability coefficients for each of these traits were identified. It should be taken into account that heritability coefficients can vary in different populations [14].

Of course, the achievements of genetics do not go unnoticed by doping enthusiasts. A few years ago, data was published about a method of treating congenital muscular dystrophy by injecting a gene responsible for increasing muscle mass. It soon became clear that the same technique could already be used among athletes. We note that in medicine, the tests were carried out only on mice, but no one has yet treated people, making sure of unforeseen complications. In elite sport, you're not afraid to take risks. Two more genes are now known that can be introduced into the body to improve athletic performance. This is a gene that improves blood circulation by rebuilding blood vessels and a gene that increases hemoglobin production. Experts have predicted that the first "artificial" super sportsmen will receive medals at the 2012 Olympics. The successes of genetics are such that their use may prove decisive in the near future. The temptation to apply a technique that cannot be "caught" and no analysis can prove them. Gene doping is a completely different level from pills and other "chemistry" - a gene that is introduced into the athlete's body with the help of a special virus, traces of which cannot yet be found. Apparently, the behind-the-scenes games of big sport may soon boil down to a competition between pharmacologists and geneticists. [15].

**Material-method:** The object of the study is the hereditary chronological analysis (environment), nutrition, blood group. The subject of the study were important variables for the selection of athletes in various sports events. Hypothesis: it was assumed that there is a close correlation relationship between heredity (environment), nutrition, blood group in the selection of athletes on various events in sports. The purpose of the work is to study and chronologically analyze heredity (environment), nutrition, blood group as important variables for the selection of athletes on various tests in sports. Based on the purpose, it is necessary to emphasize the following objectives: 1) chronological analysis of the study of the problem; 2) studying the concept of heredity (environment), analysis and the role of the hereditary method as the most effective for the selection of athletes on various events in sports; 3) Nutrition on the background of sports training; 4) the study of blood group in the scientific literature as a marker of physical abilities and the exploration of the role of sports genetics in the selection of individuals for various events in sports.

Analysis and generalization of data from the scientific-methodical literature; Study of statistical data; Socio-pedagogical survey; experiment; Hereditary method, nutrition, blood group and selection of performance athletes. Organization of the research. As an organizational goal, we determined the correlation relationships and hereditary chronological analysis, nutrition, blood group, important variables for the selection of athletes on various sports events and

the selection of performance athletes, we conducted a wide study on the possibility of highlighting this scientific novelty as well, which was divided into 4 research directions, as follows: Aspect no. 1. Chronological analysis of the problem study; Aspect no. 2. The study of the concept of heredity (environment), the analysis and the role of the hereditary method as the most effective for the selection of athletes on various events in sports; Aspect no. 3. Nutrition on the background of sports training; Aspect no. 4. The study of blood group in the scientific literature as a marker of physical abilities and the exploration of the role of sports genetics in the selection of individuals for various events in sports.

**Results and Discussions:** In order our research to be carried out further, we described and researched each aspect separately as a result of the study:

**Aspect no. 1.** Chronological analysis of the problem study. Speaking about the heredity of traits, it is necessary to consider the fact that the development and manifestation of a person's physical qualities depends in different proportions on both genetic and environmental factors. The more genetic factors affect certain physical qualities (high heritability), the less trainable these qualities are and vice versa. In this sense, at an early stage of sports specialization, it is relevant to identify in children a genetic predisposition to those sports events, the success of which will depend primarily on qualities with a high degree of heritability (explosive strength, speed, elasticity, etc.). In this sense, “an athlete impresses not only by psychomotricity, but also by but also by his intelligence/lucidity, which is the result of accurate and quick thinking” [8].

In the late 80s, with the active introduction of gene mapping methods, as well as within the Human Genome Project, data began to appear about genes associated with the manifestation and development of human physical qualities. In 1995, the American (formerly Canadian) scientist Claude Bouchard started an ambitious international project that involved several research centres and studied the relationship between genotypic and phenotypic data in more than 800 people after several weeks of different physical activities. C. Bouchard and his colleagues searched for polymorphic loci associated with human physical activity in two directions. One of them involved scanning the whole genome using a set of genetic markers with known chromosomal localization for associations of certain loci with different quantitative traits. In the future, targeted sequencing (determination of the nucleotide sequence) of the regions located around the found loci and the identification of polymorphisms linked to known genetic markers were assumed. This method, called QLT (quantitative trait loci mapping), is quite laborious and should be applied to close relatives (eg, monozygotic and dizygotic twins). [16].

**Aspect no. 2.** The study of the concept of heredity (environment), analysis and the role of the hereditary method as the most efficient for the selection of athletes for various sports events.

In the field of physical education and sport, heredity and environment "play the same roles as in any human activity, with some particularities determined by the physical and motor aspects, predominant in the practice of physical exercises"[18]. Physical education and "sport is one of the most dynamic social activities, which aims to improve the human being" [9].

Heredity as represented by researchers is "the set of characteristic processes (from a biological point of view) concerning the transmission of the genetic heritage (genome)" [18]. In the literature and numerous research studies there is data, which indicates that "in the children of famous athletes, on average 50% of the time, sports talent is possible. Gedda's data show that more than 70% of monozygotic twins achieve similar sporting results, while in dizygotic twins, the phenomenon occurs in 25% of cases.", other cases can be presented: father and son:" Ter -Ovanesian, Diackov, Liachovov, Tarmaki, Anisimov, Nikiforov (athletics), Fiedvotov, Czanovov (football), Bure (swimming), Lopatinov (weightlifting) etc". There are also results of research between brothers and sisters, such as:" Majorov, Ragulin, Golikov, Holik, Stiasny, Lebiedievov. Apart from genetic information, other factors played an important role in the formation of these famous athletes, such as family opinions, traditions of education at a young age, early practice of sport, etc." [18].

**Aspect no. 3.** Food on the background of sports training. When organizing nutrition against the background of training, which is mainly aimed at developing endurance, special attention should be paid to the carbohydrate component of the diet. This is due to the fact that the main source of energy that ensures the effective implementation of these training programs is muscle glycogen, thanks to which both aerobic and anaerobic resynthesis can be achieved. For optimal recovery of muscle glycogen stores, the carbohydrate content of the diet should be at least 60% of the total energy intake (8.5-14 g/kg body weight).

**Table 1**

**Consumed with foods in the form of polysaccharides**

Carbohydrates	foods containing starch and glycogen: cereals, pasta, potatoes, liver, meat, etc.
Easily digestible carbohydrates	confectionery, sugar, glucose, fructose, etc
Dietary fiber	found in rye bran, wheat and vegetables

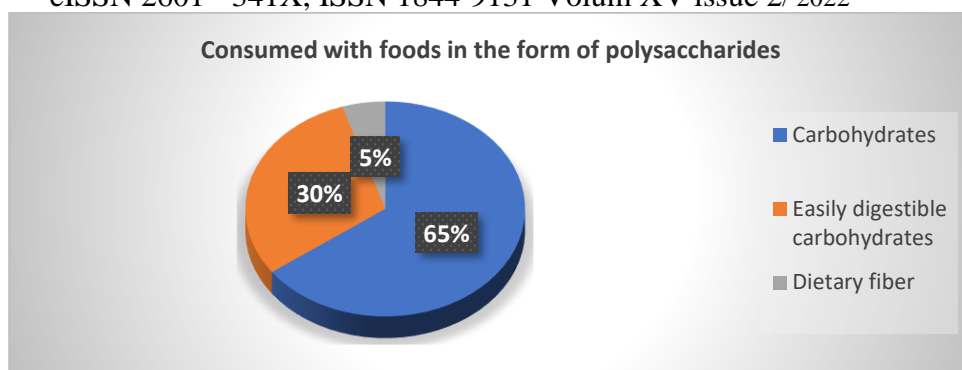


Fig. 1

It should also be considered that the recovery rate of muscle glycogen reserves is affected by the rate of carbohydrate intake in the body, their type and the intake time in combination with physical activity. It was established that the intake of carbohydrates (50 g or more) immediately after heavy loads (the first 20 minutes) associated with the manifestation of resistance, and then every two hours, contributes to a faster recovery of glycogen content in the muscles. The main meal is recommended no earlier than 30-45 minutes after training. In the literature „nutrition is considered to be the basis for the energy supply in all the forms of physical activity. Energy needs depend on gender, age, body weight and possibly the type of the physical activity. Inadequate energy intake can lead to weight loss, fatigue, lack of concentration and no athletic performance. The constant physical activity involves the consumption of carbohydrates, useful for the formation and storage of muscle glycogen. The development of healthy eating and physical activity behaviors in childhood and adolescence are very important for adult life” [10]. When organizing nutrition against the background of training, which is mainly aimed at developing speed and strength, special attention should be paid to the protein component, in particular, the content of essential amino acids, such as arginine, in the diet should be high. Anaerobic work (speed-strength and power) makes it necessary to maintain a large amount of protein and B vitamins (B1, B2, B6, B12, B15), vitamins C, PP in the diet.

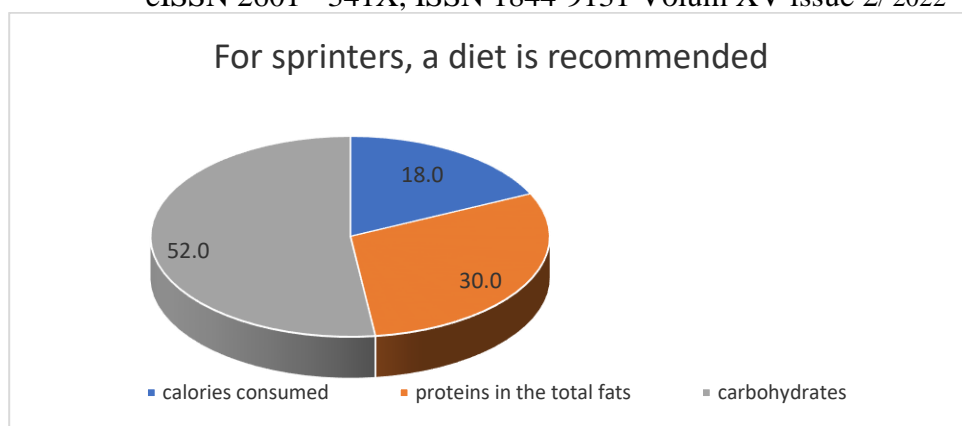


Fig. 2

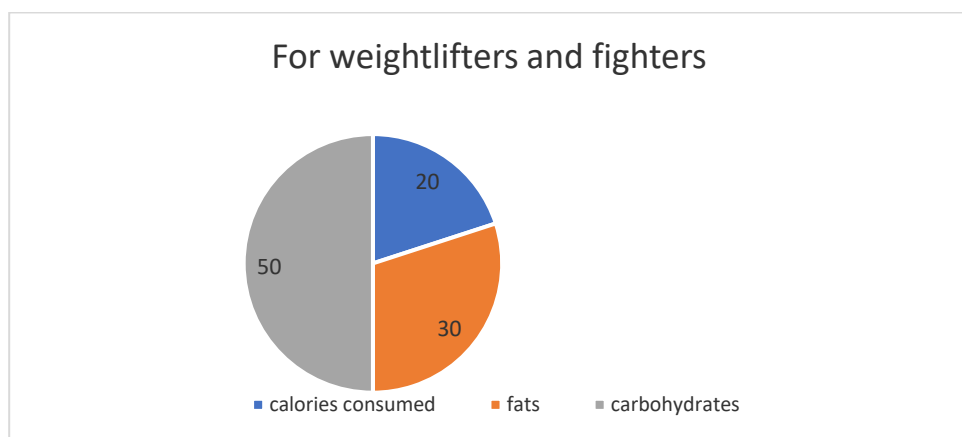


Fig. 3

As anabolic agents (increasing muscle mass) are allowed and safe, various adaptogens of plant origin (leuzea (or leuzea-based ecdysterone), eleuterococcus, ginseng and other drugs should be taken orally, preferably in the form of dragees, capsules and tablets), as well as potassium orotate (contained in dried apricots).

The use of modern molecular genetic methods makes it possible to identify the individual characteristics of the human body. Therefore, genetic testing at any stage of sports training can provide primary information to coaches for a more rational selection of personnel and individual training programs for athletes. Of major importance is the development of an individual approach to restoring the athlete's form after competitions and a period of intensive training. It is known that different people perceive training tasks differently and at different speeds. Some people adapt quickly, others recover more slowly. Most of these processes, in one way or another, are associated with the individual genetic characteristics of the organism. Numerous studies testify to the individual abilities of a person to perform

differences in physical exercises, to hereditary predisposition and in certain sports samples [3,4,5], and “the supply of oxygenated blood required by the muscles increases, carbon dioxide along with other unnecessary products are removed, and the heart beats faster to feed the muscles and remove toxins” [2].

**Aspect no. 4.** The study of the blood group in the scientific literature as a marker of physical fitness and the exploration of the role of sports genetics in the selection of individuals for various events in sports. Thus, knowing the blood group can help the coach to predict the ability of young athletes to engage in a certain sports event, to select the nature of sports exercises that are appropriate to the innate characteristics of the body. With the deepening of knowledge about the molecular structure of the human genome and the decoding of the primary DNA sequence, it has become possible to carry out a targeted search for genetic markers of predisposition to the development and manifestation of physical qualities. Currently, information is available on nearly 150 different genes that control human physical abilities, are important for proper fitness, and for the selection of potentially promising athletes. Rapidly growing genetics data markers of human physical abilities lays the foundation for a fundamentally new system of medical and genetic support for physical culture and sports - sports genetics, which will raise this important field of human life to a higher level. It is sports genetics that will accelerate the implementation of predictive and individual medicine in practice and allow you to actively plan and adjust the training process in a timely manner. The first attempts to implement genetic methods in sports were made in 1968 at the Olympic Games in Mexico. Later, in Montreal in 1976, a group of Canadian scientists continued their research looking for genetic differences between Olympic participants and non-athletes. Stable traits of the organism, easily determined, closely related to the genotype and reflecting the hereditary propensities of individual people, have been used as genetic markers. [19].

body proportions	blood groups	their topological composition	the degree of fat deposition
dermatoglyphs – fingerprints from fingers	systems of erythrocyte antigens- ABO and leukocyte antigens	systems of erythrocyte antigens	the metabolic profile
the shape of skeletal muscles	the hormonal profile and the level of hormones in the blood		toes the composition of muscle fibers



**Fig. 1 Among them are the following groups of markers**

The latest data obtained in the course of molecular genetic research have opened new opportunities in the development and application of complex diagnostics aimed at solving the problems of medical genetic selection in sports, as well as optimizing the training process. As already mentioned, by 2005 information was obtained on almost 150 different genes that control human physical development. A detailed comparative analysis of allele frequencies of these genes in different groups of athletes made it possible to identify candidate genes associated with different physical qualities of a person.

It should be noted that after the publication of the genetic map of physical activity in 2005, the range of genes associated with a predisposition to a particular sport test has expanded significantly. Human skeletal muscles consist of three main types of muscle fibers that differ in their contractile and metabolic characteristics. [17].

**Table 2 Muscle fibers**

"Slow" muscle fibers (SMF)	contract slowly, fatigue slowly, anaerobic glycolysis predominates
II "Intermediate" muscle fibers (IMF)	fast-twitch, slow-fatigue, mixed aerobic-anaerobic glycolysis
II d/x "Fast" muscle fibers (FMF)	fast-twitch, fast-fatigue, aerobic glycolysis predominates

Key characteristic that determines type of muscle fibers is the molecular organization of myosin. Myosin in different types of muscle fibers exists in several molecular isoforms and consists of light and heavy chains. By the composition of the muscle fibers, with a high degree of probability, the predisposition to physical activity can be determined. Skeletal muscle biopsy results of highly skilled athletes indicate a predominance of FC in long-seaters and BV in sprinters/strength athletes. Therefore, the composition of muscle fibers is a significant marker of predisposition to the manifestation of local (muscular) performance. The main directions of these studies concern the genes of the renin-angiotensin system. Their protein products are involved in regulating blood pressure and maintaining water-salt balance. The most studied genetic marker of physical performance is I/D polymorphism of the angiotensin-converting enzyme (ACE) gene, for which associations with physical activity have been identified. Thus, among long-distance runners and cyclists the I/I genotype predominates, while among short-distance runners, weightlifters and swimmers the D/D genotype predominates. [1]. Protein products of bone tissue metabolism genes play an important role in the formation of a certain physiological status of a person. In professional sports, which require high, often extreme, physical stress, the prevention of socially significant diseases, primarily cardiovascular and, in particular, disorders of the blood coagulation

system, is of great importance. Recent studies in the field of molecular genetics of physical activity have confirmed the usefulness of the combined approach for the analysis of genotypic characteristics of physical abilities of athletes of different genders, specializations and qualifications. [13]. Genotyping of future athletes makes it possible to obtain indicative information about the hereditary characteristics of a person's physical activity, his predisposition to a certain sport. It is assumed that such a phenotypic effect is determined by the association of these genes with the content of "slow" and "fast" muscle fibers in the muscle (SMF and FMF, respectively). Indeed, results of skeletal muscle biopsies from highly skilled athletes indicate an innate predominance of SMF in long-distance runners and FMF in sprinters/ force athletes. The fast increase in the amount of information about marker genes, the testing of allelic variants of which makes it possible to assess the suitability of an adolescent for a particular sport, as well as to indicate possible hereditary limitations with regard to professional sport, makes it critical to evaluate in terms of legal enforcement in a timely manner. As already mentioned, currently more than 150 different genes are known that control human physical development, they are important for the correct organization of fitness classes and for the effective selection of potentially promising athletes. Some of these genes have been tested on groups of athletes. Above, the functional characteristics of the allelic variants of the genes of the most important metabolic chains that determine individual physical abilities were considered. The available data make it possible to begin the formation of a variant of the athlete's genetic map, including the testing of genes that determine the physical characteristics of a person, when creating the database of his individual DNA. Genes whose mutations impose significant restrictions on professional sports, but are quite compatible with regular fitness and physical education, have also been studied in detail. To characterize a chromosome genetic marker. There are different types of markers, the most used are: 1. SNP markers (which define the mutation of a single base), are used among others to define the trees of the lineages of humanity. For the Y chromosome, they take the name XN, where X is an index defining the laboratory or company that discovered the marker and N the eleventh marker discovered in this laboratory. For example, M35 is the 35thSNPdiscovered by Stanford University. 2. And STR markers (Short Tandem Notice or microsatellites). A chromosome contains repeating sequences of nucleotides (base pairs). The number of repetitions varies from person to person. A Y chromosome STR is designated by a DYS number (Y chromosome DNA segment number). When we "test" a person, we associate the DYS marker with the number of repeats of the STR sequence of that person's chromosome. They are used to define haplotypes, haplotype resolution increases with the number of STR markers. To demonstrate these genetic markers, DNA is extracted and subjected to various physicochemical processes [16]. Sports genetics, like all predictive

medicine, is still in its infancy. Numerous experimental data and direct observations on volunteers, including athletes, have made it possible to identify at least 150 candidate genes for human physical activity, as well as factors that complicate or are predictive of sports [4]. Particularly significant progress has been made in identifying genes that determine important physical parameters such as endurance and strength/speed. The general direction of modern sports medicine is the effective selection of young athletes who are promising in their hereditary qualities for practicing a particular sport, while minimizing the risk of "big sport" for an athlete's health. Gene polymorphism analysis helps distinguish individuals who respond positively to additional physical activity from those for whom such activity may be undesirable or harmful. The integrated approach already used makes it possible to assess as fully as possible the contribution of allelic variants of different genes to a person's physical performance. It opens the way for constructing the physical activity gene networks of outstanding athletes. The search and further implementation of DNA diagnostics of genetic markers will have not only scientific, but also socio-economic significance, as it will improve the reliability and efficiency of the individual and group selection system in the training of highly skilled athletes [5]. As mentioned above, a distinctive feature of genetic diagnosis from phenotypic diagnosis is the possibility of its application immediately after the birth of a child (or before birth - in special cases), which means that the prognosis development of significant indicators in the conditions of sports activities can be compiled very early. On the other hand, genetic markers associated with sports activity are often markers of predisposition to various common diseases. Thus, it can be argued that the foundations of a fundamentally new system of medical genetic support for physical culture and sports are already being laid, which will allow raising it to a higher level, putting into practice the basics of preventive medicine and genetics, actively helping to plan and correcting the training process. Interpretation of genetic analysis data and compilation of recommendations depending on the sports group (endurance sports, sports with a predominant manifestation of speed and strength, acyclic sports). Since at the moment genetic markers of endurance, speed and strength have been discovered, but markers of mobility and flexibility remain poorly studied, when drawing conclusions, it is necessary to focus especially on markers associated with the manifestation of the qualities of endurance and speed- force and the “manifestation of coordination skills is conditioned by the ability of the perceptual system to process, analyse and make decisions and to transmit nerve impulses to the effectors acting on the motor system and by the ability to execute movements with more economy and harmony” [11]. These are conditioned by the ability to drive and process data from the analysers involved in movement and the development of motor responses. Translated with [www.DeepL.com/Translator](http://www.DeepL.com/Translator) (free version) In this

case, there are three options for conclusions: with recommendations for choosing and practicing 1) resistance sports; 2) speed-strength and strength sports; 3) acyclic sports. On the advisory side regarding nutrition, pharmacological support and training volumes, there will be differences between these options for conclusions. Below are examples of nutrition principles, depending on sports group. Insert text here. Analyse and compare your results with other similar studies, present the importance of the results, if the hypothesis is confirmed or infirmed, present the limits of the study.

**Conclusions:** The hereditary conditionality of sports talent is beyond doubt. Now it is recognized as an axiom that only a talented person, who has a certain set of genetic prerequisites for this activity, can achieve high sports results. Attempts to predict the presence of sports talent have been made by researchers, coaches and instructors since the middle of the last century. Later, in the 1980s and 1990s, scientists developed diagnostic complexes that made it possible to determine sports inclinations through serological, hormonal, morphological and functional markers.

It should be noted that the above markers refer to external signs - phenotypes, which are based on the interaction of many genotypes with environmental factors, and therefore do not allow revealing a hereditary predisposition to motor activity in the early period of human development. With the improvement of molecular biology methods, it became possible to determine sports inclinations using genetic markers already at birth. Currently, material has accumulated that indicates gene polymorphisms, that are interconnected with physical abilities at different levels of manifestation. The possibilities of molecular sports genetics make it possible to provide assistance to teachers, coaches and sports doctors of the Youth Sports School, Olympic reserve schools and schools of higher sportsmanship in determining the predisposition of children and adolescents to a certain type of motor activity (sports orientation and selection) which increases sports performances by optimizing indicators and correcting the training process, even in the prevention of various diseases associated professional activities of athletes. Body structure is one of the most important selection criteria for certain disciplines and sporting events. The training of future sports performers depends on the genetic endowment and on the biomotor potential of the individual [6].

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