

**Walery Zukow<sup>1</sup>**

Department of Spatial Management and Tourism, Faculty of Earth Sciences  
Nicolaus Copernicus University in Torun, Poland

**Andrey Kozyrev<sup>2</sup>**

Department of Physical Rehabilitation  
International Technological University Mikolaiv Polytechnic, Mykolaiv, Ukraine

**Anatoliy Gozhenko<sup>3</sup>**

Ukrainian Scientific Research Institute of Transport Medicine, Odesa, Ukraine

## **The use of molecular genetic technologies for the implementation of sports selection and provision of training-competitive process in rowing**

### **Abstract**

The question of the promise of application of molecular genetic technologies in rowing sports is considered. The main directions that can be used for sports orienteering and selection, and after their completion, are provided for providing high-level training-competitive process at the level of the sport.

**Keywords:** molecular-genetic technologies, selection in sport, rowing

The modern sport of high achievements is characterized by the active introduction of innovative technologies for providing training-competitive process. One of the medical and biological trends of these technologies is the methods of molecular diagnostics since the hereditary condition of athletic talent in the present time is unquestionable and it is recognized that only the talented person who has a certain set of genetic prerequisites for this kind of sports is connected with the high results. with genetic determination of muscular structures and energy exchange in them [1].

Rowing is a fairly vivid example of this axiom. Rowing imposes very high requirements for all, without exception, the functional systems of the body of the athlete.

The peculiarity of motor activity in rowing is the execution of movements in two environments: air and water. Moreover, all the mechanical work on moving the boat is carried out by the athlete while in the air environment, the movement of the same boat is carried out in an aquatic environment, where the water acts as an

---

<sup>1</sup> Walery Zukow, e-mail: [w.zukow@wp.pl](mailto:w.zukow@wp.pl)

<sup>2</sup> Andrey Kozyrev, e-mail: [andreykozyrev26@gmail.com](mailto:andreykozyrev26@gmail.com)

<sup>3</sup> Anatoliy Gozhenko, e-mail: [prof.gozhenko@gmail.com](mailto:prof.gozhenko@gmail.com)

external resistance to the oar movement and the progressive displacement of the entire system of the "rider-boat". Note that while in a boat and interacting with the external environment, the athlete carries out a complex of movements that are characterized not only by high coordination complexity but also by specific features of the process of energy flows. Moreover, the most important among the coordination features are those that form the basis of motor activity of the rower: cyclicity, continuity of successive movements, alternation of stress and relaxation of muscles, maintaining dynamic balance on unstable resistance [2]. The specificity of the flow of energy processes is due to the fact that in the process of rowing the muscles of the athlete are reduced in the dynamic overlocking regime (muscle groups that provide the movement of the oar in water and air) and in isometric mode (muscle groups that ensure the preservation of posture and keeping the oar). However, more significant factors influencing the nature of the process of energy processes is the intensity and duration of the implementation of the competitive exercise [3].

It is in this sport that one can see a rather close relationship between the sporting result and the complex development of the physical qualities of the athlete. In the conditions of the competition, all physical qualities are manifested simultaneously, therefore, the high level of both individual physical qualities and their combination is one of the important conditions for achieving high speed on a distance. At distances of 500 and 1000 m, the impact of sprinting endurance is 16.8 and 19.7%, while speeds are 83.2 and 80.3%, respectively. It should be noted that the inclusion in the program of International competitions distances of 200 m, required the search for solutions to problems with the development of physical qualities necessary for the successful passage of this distance. The conducted studies allowed to establish that, with increasing distance in the competitive distance, overall stability increases, and sprinting stability, on the contrary, decreases with a relatively constant value of high-speed stamina. The differentiation of the basic requirements imposed by each competitive distance to the level of development of the physical qualities of the rowers made it possible to establish the fact that the distance of 200 m imposes increased requirements for sprint (60%) and high endurance (30%). At a distance of 500 m, the prevailing quality is high endurance (40%) with equal parts of sprinting and overall endurance (30%). At a distance of 1000 m, the result is determined equally at the expense of speed and overall endurance (40%) with a lower level of sprinting endurance (20%) [2].

The task of molecular genetics in sport is to provide each athlete with the conditions necessary for the full realization of his genetic potential [1; 4]. The principles of molecular diagnostics of human hereditary predisposition to motor activity developed in conjunction with the general approach in the present time are used to create diagnostic systems aimed at assessing the genetic potential in the development and manifestation of physical abilities and other features that are relevant in sporting activities in the selection of the most optimal sports. That is why the presence of each athlete of a genetic passport, which specifies the polymorphisms of genes necessary to achieve high sports results in the chosen sport, the level of expression of these genes at rest and during physical activity, as well as the genes of the risk of the emergence and development of professional sports

pathologies, is enough relevant. A distinctive feature of molecular genetic markers that do not change throughout life - is the ability to determine them immediately after the birth of a child, and hence, the forecast of the development of indicators that are significant in sports activities can be made very early [1; 6].

Research shows that at least 120 genetic markers are related to the athlete's elite status (77 genetic markers related to endurance and 43 genetic markers related to force / speed). It is noteworthy that 11 (9%) of these genetic markers (endurance markers: ACE I, ACTN3 577X, PPARA rs4253778 G, PPARGC1A Gly482; strength / speed markers: ACE D, ACTN3 Arg577, AMPD1 Gln12, HIF1A 582Ser, MTHFR rs1801131 C, NOS3 rs2070744 T, PPARG 12Ala) showed positive associations with athlete status in three or more studies and six markers (CREM rs1531550 A, DMD rs939787 T, GALNT13 rs10196189 G, NFIA-AS1 rs1572312 C, RBFOX1 rs7191721G, TSHR rs7144481 C) were detected after conducting Global Studies on Genome-Wide Association Studies (GWAS). On the other hand, the value of 29 (24%) markers were not reproduced in at least one study. Thus, further research is needed in this direction [5].

Thus, it is now possible to use molecular genetic diagnostics for successful implementation of sports orientation and selection for rowing.

But the possibilities of the molecular genetics of sport are not limited to sports selection. In addition to genomics, other directions of molecular research are used, which allow providing training-competitive process at a high scientific level [1; 7].

Pharmacological support in sports of great achievements is a necessary component of medical and biological support, as it helps to neutralize the negative consequences of high physical activity. Rowing, of course, is no exception. Pharmacological support for the process of preparation of athletes-rowers involves the use of biologically active additives in food (nutraceuticals and parapharmaceuticals). Sports pharmacogenetics provides an opportunity to individualize the choice of pharmaceuticals and their dosage regimens based on the study of the genotype of a particular athlete. Nutrigenomics examines the effects of food components on gene expression, and nutritionists seek to understand how the human genetic status coordinates the body's response to food and allows you to determine the optimal diet for a particular person based on his genotype.

Determination of the epigenetic status of the rower (epigenetic) can reveal both active and "sleeping", in other words, inactive (methylated) genes of the individual responsible for the development of functions of the muscular, cardiovascular and other functional systems of the body, which is important for the prognosis of sports the possibilities of the organism.

Determination of the transcriptional profile (activation of which genes and to what extent) of skeletal muscles allows us to assess how effectively the adaptation of the body of athletes to certain physical activity occurs, as well as to predict their athletic performance. These studies deal with transcriptome.

One of the promising markers that can be used to develop early diagnostics and prediction of fatigue and overtraining in rowing are circulating in the blood of DNA.

To find new biomarkers indicating changes in the functional state of the

human body, postgenomic methods of analysis are used, among which proteomics technologies (proteomics) occupy leading positions.

One of the approaches to controlling the body of the rower, subject to intense physical activity, is the assessment of a complex of proteins and peptides responsible for the implementation of one or another physiological function, located in the bloodstream, during physical activity and during the recovery, and in comparison with the profile of a person who is not engaged in sports.

Determination of metabolic parameters (metabolomics) allows to solve the following tasks of complex examination: control of the functional state of the athlete-rowers, which reflects the efficiency and rationality of the individual training program, observation of adaptive changes of the main energy systems and functional reorganization of the body during the training, diagnosis of prepathological and pathological changes in metabolism of rowers, which is very relevant for rowing. Physiological mechanisms, which determine, when systematic muscle training, increase the nonspecific resistance of the body, are quite diverse and complex. The influence of extreme factors, in particular, intense physical activity, leads to significant changes in both physiological and biochemical parameters, in the development of morphofunctional changes in OPA and organ tissues. Extreme factors that violate homeostasis (forced physical activity, hypoxia, immobilization, sleep deprivation, transcontinental air travel) cause in the body a set of specific disorders and nonspecific adaptive responses, changes in the CNS, endocrine glands, metabolic processes, and reduced immunity. The specific component is determined by the nature of the current stimulus, and the non-specific is accompanied by the development of the general adaptive syndrome, which occurs under the influence of any extraordinary stimuli and characterizes the restructuring of the body's protective systems [3]. Metabolic control also allows solving such private tasks as identifying the body's response to physical activity, assessing the level of training, adequacy of the use of pharmacological and other means of recovery, the role of energy metabolic systems in muscle activity, the influence of climatic factors, etc. [8].

For the prognosis of aerobic capacity, pathology of skeletal muscles and a tendency to a long athletic career, it is promising to use information about the length of telomeres and the activity of telomerase in athletes.

## References

- [1] Akhmetov I.I. Molecular genetics of sports / I.I. Akhmetov. - Moscow: Soviet sport, 2009. - 268 p.
- [2] Mikhailova T.V. Rowing / T.B. Mikhailova. - Moscow: Academy, 2006. - 54-57 p.
- [3] Tsebrzhinsky O.I. Біохімія опорно-рухового апарату та біохімія спорту (вибрані лекції) / O.I. Tsebrzhsky. - Poltava: ASMI, 2005. - 54 p.
- [4] Andersen J.L. Muscle, genes, and athletic performance / J.L. Andersen, P.Schjerling, B. Saltin, Scientific American, 2000. - V. 283 (3). - P. 48-55.
- [5] Ahmetov I.I. Current progress in sports genomics / I.I. Ahmetov, O.N. Fedotovskaya // Advances in clinical chemistry, 2015. - V. 3. - P. 28-29.
- [6] Bouchard C. Genetic and molecular aspects of sport performance / C. Bouchard, E.P. Hoffman // N.Y: Wiley-Blackwell, 2011. - 420 p.

- [7] Collins M. Genetics and Sports / M. Collins, J. Borms, M. Hebbelinck, A.P. Hills, T. Noakes // *Medicine and Sport*. 2009. - V. 54. - P. 72-88.
- [8] Al-Khelaifi F., Diboun I., Donati F., Botrè F., Alsayrafi M., Georgakopoulos C., Suhre K., Yousri N.A., Mohamed E.A. F. Al-Khelaifi, I. Diboun, F. Donati, F. Botrè, M. Alsayrafi, C. Georgakopoulos, K. Suhre, N.A. Yousri, E.A. Mohamed // *Sports Medicine*, 2018. - Open Access 4: 2. - 15 p.