Approaches to the study of progress, monitoring of sports training and selection of athletes in a sports context

UDC 796.011.3

Dr. Hab., Professor **V.P. Guba**[1,2]
Dr. Biol., Professor **S.P. Levushkin**[1]
Dr. Hab., Professor **V.I. Lyakh**[3]
[1]The Russian University of Sport «GTSOLIFK», Moscow
[2]Smolensk State University of Sports, Smolensk
[3]Moscow State University of Sports and Tourism, Moscow

Corresponding author: smolguba67@mail.ru

Received by the editorial office on 20.04.2025

Abstract

Objective of the study is to systematise the research of domestic specialists on the development, control of physical abilities and their assessment in the selection process.

Methods and structure of the study. An analysis of literature and online sources was conducted, along with a logical comparison of the available material and reports from scientific and practical conferences by leading scientists in the field of sports training and morphofunctional diagnostics.

Results and conclusions. This article attempts to propose a research framework for studying the effectiveness of various aspects of athlete preparedness. It outlines the main aspects of a basic system of interdisciplinary research in the field of sport, carried out by Russian scientists with highly effective end results.

Keywords: *methodology, development and control, sports training, sports selection, monitoring.*

Introduction. The main focus on the development of athletes' physical abilities and their monitoring is based on the results of research conducted by Russian scientists for further analysis by specialists in the fields of sports training, physiology, morphology, and genetics.

The study of various conditions of athletes, based on interdisciplinary research, has made it possible to identify a structure for assessing the development and monitoring of athletes' physical abilities throughout their participation in their chosen sport.

Objective of the study is to systematise the research of domestic specialists on the development, control of physical abilities and their assessment in the selection process.

Methods and structure of the study. The research methods included analysis of literature and online sources, logical comparison of available material, as well as reports at scientific and practical conferences by leading scientists in the field of sports training and morphofunctional diagnostics.

Results of the study and discussion. This paper attempts to identify the most effective approaches to conducting and organising research, processing the data obtained, and interpreting it by domestic specialists, whose work has been and remains at the forefront of modern sports science (Fig. 1).

In the process of effective sports training, it is necessary to take into account a number of aspects of the athlete research system listed below.

The first aspect is physique. Analysis of the physique characteristics of both young and qualified athletes in 'polar' sports specialisations, which place different demands on the athletes' bodies [2-9, 11], showed that even at the level of average statistics, there is a clear correlation between body structure and specific motor abilities. This relationship could be examined using data analysis for representatives of virtually all species, and an answer could be given as to what the physique of a modern healthy person should be like in order to withstand the ever-increasing socio-psychological stresses without breaking down. A single generalised model of physique has not yet been created [8, 11]. The physique model of athletes can only be a rough guide, rather than a model of the mod-

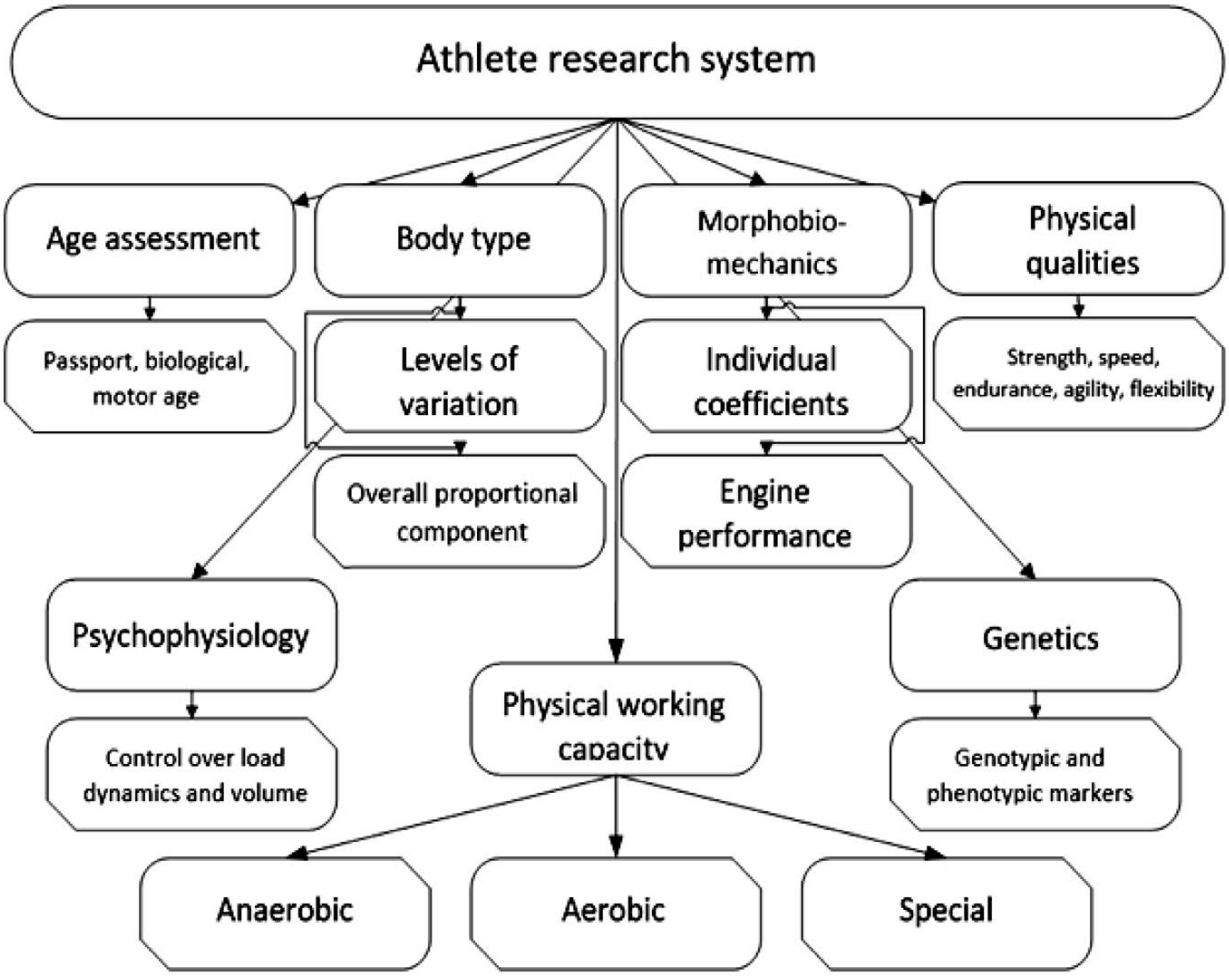

Fig. 1. Theoretical and methodological foundations of the athlete research system.

ern human being, since the latter must necessarily take into account a specific environmental factor – professional activity.

The second aspect is morphobiomechanical. A specialist whose field of activity is the human body must first and foremost understand that the human organism is a relatively open, self-regulating system, confirmed by diverse and numerous influences and morphofunctional changes throughout the course of life [4, 5, 8, 9].

For each sport, it is necessary to develop biomechanical measurement techniques that allow for high-precision monitoring of the development of motor actions and prevent injuries to the individual flexor and extensor muscles that bring the hip and lower leg into and out of position and are involved in basic sports movements. Information is needed on changes in both the total muscle mass and individual parts of the athlete's body [4, 5, 8].

Can body length and mass be used as initial values to obtain information about changes in young athletes under the influence of sports training? It turns out that this is possible and highly informative. Here are some ways to process these indicators.

Quetelet's weight-height index (BMI = weight (kg) / (height (m))). This index ranges from 0.300 to 0.650 and is usually associated with a particular sport.

Body mass index (Roher) = weight (kg) / (height (m)) . This index ranges from 2.000 to 3.200 and allows an indirect assessment of an athlete's preparedness and predisposition to a particular sport.

There are about 12 more indices that are correlated with each other and can be used, but they do not provide any new information. The Quetelet and Rorer indices are quite simple and can be recommended for use by coaches as indicators of changes under the influence of training. The indices can be measured and calculated two to four times a year, considering their

dynamics as a delayed adaptation to changing training loads [8].

It is believed that human development is determined by three main programmes: species (genetic), social and ontogenetic. The ontogenetic programme is formed as a result of the interaction between the genetic and social programmes. The social programme plays a leading role in the improvement of human motor activity, as confirmed by physical culture and sport, the continuous growth of the arsenal and biomechanical complexity of physical exercises.

The third aspect is age. The following terms can be found in the literature: 'calendar age' (also known as passport age or chronological age), 'biological age' and 'motor age' [2, 5, 6, 11].

Passport age is the time from the moment of birth, determined by the number of years, months and days lived.

Biological age indicates the degree of maturity (physical, intellectual) achieved by the organism.

The concept of 'biological age' arose due to the fact that children and adolescents of the same passport age often differ in their level of biological maturity by 4-5 years, as a result of which they usually have harmonious acceleration and greater morphofunctional capabilities than their peers.

The biological problem has long since become a social one due to the heterochrony of development in modern children in the adolescent population. Differences in age, gender, physique, and level of biological maturation subsequently determine the heterochrony of their physical development.

Often, physical and mental maturation, the functional capacity of the musculoskeletal system and internal organs, and the general condition of the body, i.e., everything that characterises the so-called biological age, does not correspond to the calendar age, either preceding it or, conversely, lagging significantly behind. This discrepancy can be further exacerbated by acceleration, which is understood as a complex set of phenomena characterised by the following main features: accelerated physical development, earlier puberty, and increased body size compared to peers [4, 8].

The relationship between the passport and biological age of children and adolescents is one of the pressing issues attracting the attention of representatives of many scientific and practical disciplines (sports medicine, age physiology, pedagogy, theory and methods of physical education, etc.). This is because biological age, to a greater extent than chronological age, reflects ontogenetic maturity and the individual nature of adaptive responses to physical exertion.

Motor age is determined by the level of a child's motor development, assessed on the basis of standardised motor tests, taking into account their biological age, somatic type and chronological age.

The fourth aspect is the characteristics of physical training and physical qualities. The most significant changes in the development of children's physical qualities occur in preschool and early school age. This is convincingly demonstrated, in particular, by research conducted by us in the laboratories of the Federal Science Center of Physical Culture and Sport (VNIIFK), Research Institute of Physiology of Children and Adolescents (Age Physiology) of the Russian Academy of Education, and Smolensk State University of Sport over more than 50 years. These changes are due to the disharmonious development of body mass components and the disproportionate growth processes of the bones of the limbs. Scientists have proven that the development of motor skills in children does not follow a smooth upward curve. From 5 to 10 years of age, according to the unanimous opinion of the authors, it is necessary to 'lay the foundation' for physical (coordination and conditioning) excellence and to master basic motor skills and abilities. When training children, adolescents and young people, it is necessary to take into account the most favourable (sensitive) periods in the development of various physical qualities (abilities): strength, speed, speed-strength, endurance, flexibility, coordination abilities, taking into account the individual characteristics of each individual [1, 2, 8-10, 16, 17].

Critical periods are characterised by increased activity of individual genes and their complexes that control the development of specific qualities of the organism. During these periods, the following occur: a significant restructuring of regulatory processes; a qualitative and quantitative leap in the development of individual organs and functional systems, resulting in the ability to adapt to a new level of existence of the organism and its interaction with the environment. Such a restructuring increases the number of degrees of freedom of the organism and opens up new horizons of human behaviour, that is, in essence, it is a 'preemptive reflection of reality' (P.K. Anokhin).

Sensitive periods are periods of reduced genetic control and increased sensitivity of the organism to environmental influences, including pedagogical and training influences [5, 6, 16]. Moreover, sensitive pe-

riods in children of different body types differ, and this must be taken into account in the process of their sports training [11].

Critical and sensitive periods only partially coincide. While critical periods create the morphofunctional basis for the organism's existence in new living conditions (e.g., adolescence in teenagers), sensitive periods realise these possibilities, ensuring the adequate functioning of the body's systems in accordance with the new requirements of the environment.

The fifth aspect is the assessment of psychophysiological status. Extreme physical exertion in sports limits motor activity due to the development of bronchial obstruction, cellular infiltration of the bronchial mucosa, and remodelling of the respiratory tract. There is an increase in the capacity of the vascular capillary bed, an increase in blood viscosity, and an elongation of mucociliary clearance time; at the same time, an increase in blood filling of the lungs at maximum loads in trained athletes leads to compression of the pulmonary circulation and the development of acute respiratory distress syndrome. This serves as the basis for remodelling of the respiratory tract: hypertrophy of the respiratory muscles occurs, subendothelial fibrosis develops, a decrease in the elasticity of the bronchial wall is noted, alveolar ruptures and pulmonary capillary occlusion under conditions of mechanical and oxidative stress, and increased tone of the sympathetic division of the ANS, leading to vasoconstriction and reduction of the vascular bed [5].

The sixth aspect is sports genetics. Timely identification of factors limiting physical activity, the ability to determine these factors, and the appropriate use of corrective measures help to achieve high results in sports and maintain the health of athletes. For example, studying the distribution of polymorphisms of the 5HTT and 5HT2A genes in representatives of team sports allows for the selection of individuals predisposed to greater psychological stability and success at the early specialisation stage. The assessment of athletes' visual-motor reactions allows for the comparison of genetic and phenotypic markers for predicting successful athletic performance [5].

Intensive sports training that is not in line with genetic predisposition will lead to limited physical performance and reduced competitive results. Currently, it is considered increasingly appropriate to use the results of genetic research in the process of sports selection, choosing a sports specialisation, and identifying a person's predisposition not only to perform various types of exercise, but also the body's ability to maintain homeostasis, avoid maladjustment, and develop pathological conditions.

The seventh aspect is physical working capacity.

Physical working capacity is an integral indicator of the functional state of the body, one of the objective criteria for human health, and an important indicator of the effectiveness of sports training [12]. As one of the components of an athlete's overall fitness, working capacity has become the subject of close attention by many domestic researchers at different stages and periods of sports training. In the process of testing the physical working capacity of highly qualified athletes, laboratory research methods such as gasometry, bicycle ergometry, and ergometry are widely used to determine indicators characterising aerobic working capacity. The MAM test and the Wingate test are often used to determine anaerobic performance [15]. Along with the generally accepted methods for determining aerobic and anaerobic performance, methods for determining special performance are also used, involving the use of special exercises specific to a particular sport and the recording of heart rate indicators [13, 14].

C**onclusions.** The aspects of the athlete research system presented in this work, as well as the scientific materials presented in the literature by domestic specialists, on various issues of diagnostics, training, and the use of modern medical and biological knowledge in the field of managing and correcting the training process of athletes, will help coaches to better understand and improve the process of athletic selection and the system of athletic training, which will ultimately contribute to high results in sports.

References

1. Balsevich V.K., Zaporozhan V.A. Obuchenie sportivnym dvizheniyam [Training in sports movements]. Kyiv, 1986. 200 p.
2. Volkov V.M., Filin V.P. Sportivnyy otbor [Sports selection]. M., FiS, 1983. 75 p.
3. Guba V.P., Nikitushkin V.G., Kvashuk P.V. Individualizaciya podgotovki yunyh sportsmenov [Individualization of training of young athletes]. M., 2009. 276 p.
4. Guba V.P. Morfobiomekhanicheskie issledovaniya v sporte [Morphobiomechanical studies in sports]. M., 2000. 120 p.
5. Guba V.P., Marinich V.V. Teoriya i metodika sovremennyh sportivnyh issledovaniy [Theory and

methods of modern sports research]. M., 2016. 232 p.
6. Guba V.P., Bulykina L.V., Achkasov E.E., Bezuglov E.N. Sensitivnye periody razvitiya detey. Opredelenie sportivnogo talanta [Sensitive periods of children's development. Definition of sports talent]. M., 2021. 172 p.
7. Guba V.P., Martynenko I.V., Marinich V.V. Osobennosti fizicheskoy nagruzki v sporte: diagnostika utomleniya, rabotosposobnosti i adaptacii [Features of physical activity in sports: diagnostics of fatigue, performance and adaptation]. M., 2025. 202 p.
8. Dorokhov R.N., Guba V.P. Sportivnaya morfologiya [Sports morphology]. M., 2002. 260 p.
9. Issurin V.B., Lyakh V.I. Nauchnye i metodicheskie osnovy podgotovki kvalificirovannyh sportsmenov [Scientific and methodological foundations for training qualified athletes]. M.: Sport, 2019. 177 p.
10. Kvashchuk P.V. Differencirovannyy podhod k postroeniyu trenirovochnogo processa yunyh sportsmenov na etapah mnogoletney podgotovki: avtoref. dis. ... dokt. ped. nauk 13.00.04. [Differentiated approach to building the training process of young athletes at the stages of long-term preparation: author's abstract. dis. ... doctor of ped. sciences 13.00.04.]. M., 2003. 49 p.
11. Levushkin S.P. Fizicheskaya podgotovka shkolnikov 7-17 let, imeyushhih raznye morfofunkcionalnye tipy [Physical training of schoolchildren aged 7-17 years with different morphofunctional types]. Ulyanovsk: UIPK PRO, 2006. 232 p.
12. Levushkin S.P. Kompleksnaya ocenka fizicheskoy rabotosposobnosti yunoshey [Comprehensive assessment of physical performance of young men]. Human Physiology. 2001. No. 5. Pp. 68-75.
13. Levushkin S.P., Barchukova G.V., Laptev A.I. Metodika opredeleniya i ocenki specialnoy rabotosposobnosti v nastolnom tennise [Methodology for determining and assessing special performance in table tennis]. Bulletin of sports science. 2019. No. 3. Pp. 19-22.
14. Levushkin S.P., Kalinin E.M., Leksakov A.V. Ocenka specialnoy rabotosposobnosti yunyh futbolistov na osnove ispolzovaniya specificheskih nagruzok i dannyh pulsometrii [Assessment of the special performance of young football players based on the use of specific loads and heart rate monitoring data]. Teoriya i praktika fizicheskoy kultury. 2025. No. 2. Pp. 14-16.
15. Levushkin S.P., Zhiyar M.V., Medvedev V.G., Zhukov O.F. Model nauchno-metodicheskogo obespecheniya podgotovki vysokokvalificirovannyh sportsmenov [Model of scientific and methodological support for the training of highly qualified athletes]. Sports and pedagogical education. 2023. No. 1. Pp. 19-25.
16. Lyakh V.I. Senzitivnye periody razvitiya koordinacionnyh sposobnostey v shkolnom vozraste [Sensitive periods of development of coordination abilities at school age]. Teoriya i praktika fizicheskoy kultury. 1990. No. 3. Pp. 17-20.
17. Lyakh V.I. Razvitie koordinacionnyh sposobnostey u doshkolnikov [Development of coordination abilities in preschoolers]. M.: Sport, 2019. 128 p.