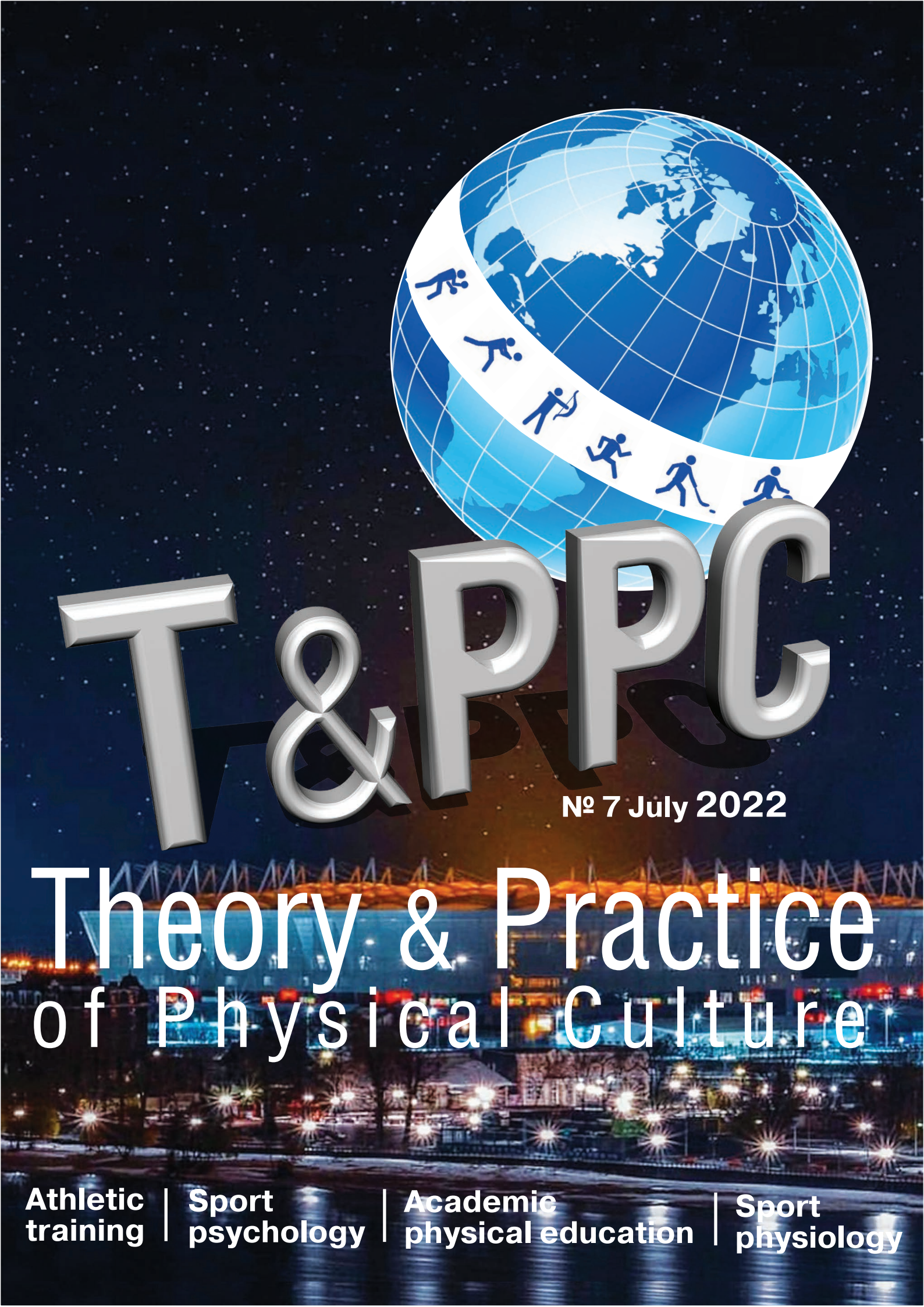


T&PPC

№ 7 July 2022

Theory & Practice of Physical Culture

Athletic training | Sport psychology | Academic physical education | Sport physiology

Key issues of the modern sports science for discussion

Integration of education and science in the system of physical education training

Traditionally, the educational process, consisting of lectures, seminars, laboratory workshops and the organization of research work, is considered at the university as different types of activities. Nevertheless, at various stages of training, they penetrate one another as complementary and reinforcing the effect of educational and scientific directions.

At the same time, it can be stated that there is an opinion according to which educational and research activities are two independent professional fields that are not very similar to each other. Each of them involves solving a large number of tasks, so it is almost impossible to deal effectively with both at the same time. For example, educational activity requires the teacher to have the skills and abilities to develop educational documentation, conduct lectures and seminars, and organize independent work of students. It is known that teaching is not only the transfer of knowledge, but also a special art of communication with a student, the ability to clearly present the educational material, to interest students in further mastering knowledge. In this context, it is appropriate to ask the question: is a researcher capable of solving educational tasks? Can he be assigned the duty of a teacher when teaching students research methods? There is no definite answer to these questions yet.

At the same time, methodically verified courses, as a rule, contain conservative material or outdated methods that have been taught for many years and no longer reflect the achievements of modern science. Of course, new methods are more meaningful and understandable to those who practically implement them in the process of scientific activity.

In any case, the ideal of integration will be to involve actively working researchers in teaching, who possess advanced techniques and scientific achievements in their field of scientific knowledge, at the same time able to present educational material to students in an accessible way. It is possible to strive for such an ideal and implement it in isolated moments at the present time and in the future to move in this direction.

The integration of science and education will also require the redistribution of the duties of the teacher: he must find time for methodical work and research, writing scientific articles, reports on grants. Such a wide range of responsibilities, apparently, is only possible for those teachers who are really interested and motivated for scientific work.

Along with the redistribution of responsibilities, the question arises about the rational allocation of teachers' time for academic and scientific work. The form of online education already mastered by higher educational institutions can help here. The recorded course of lectures posted on the educational electronic platform will allow students to listen to the lecture on their own, answer control questions, and complete tasks. In this regard, the teacher will have the opportunity to optimally allocate time for educational and scientific work without increasing the academic load.

What should be the balance in teaching established knowledge, new skills and abilities, how to achieve their integration and bring the learning process to the level of modern scientific knowledge?

In conclusion, I would like to emphasize that the interdisciplinary approach and the use of innovative technologies in various fields of science and sports practice in the performance of educational and research work at each level of education will become the fundamental principle of the integration process of educational and scientific activities in a sports university.

We invite scientists to publish articles that are aimed at finding new approaches in the development of the Olympic movement and large-scale sports events.

Chief Editor of TiPFC,
Honored Worker of Physical Culture of the Russian Federation,
doctor of pedagogical sciences, professor L.I. Lubysheva

Theory and Practice of Physical Culture

7'2022

Monthly Scientific-theoretical Journal, founded in 2013

ISSN 2409-4234

CHIEF EDITOR
Lubysheva L.I.

EDITORIAL BOARD:
Bakulev Sergey
Guba Vladimir
Grets Georgiy
Kravtsov Alexander
Matytsin Oleg
Manolaki Vyacheslav (Moldova)
Neverkovich Sergey
Platonov Vladimir (Ukraine)
Rozhkov Pavel
Waldemar Moska
Jerzy Sadowski
Teresa Socha (Poland)
Zhong Bingshu (China)

©ANO SPC «Theory and Practice of Physical Culture and Sport»

105122 Moscow, Sirenevy blvd, 4.
e-mail: fizkult@teoriya.ru

http://www.tpfk.ru

Theory and Practice of Physical Culture

Contents

Building a training process highly qualified ski racers At the final stage of preparation for the XXIV winter Olympic games in beijing

UDC 796.92

PhD **A.I. Golovachev**[1]
PhD **V.I. Kolykhmatov**[1]
PhD **S.V. Shirokova**[1]
PhD **N.B. Novikova**[2]
[1]Federal Scientific Center of Physical Culture and Sport (VNIIFK), Moscow
[2]Saint- Petersburg Scientific-Research Institute for Physical Culture, St. Peters-burg

Corresponding author: volodchenkova.e.n@vniifk.ru

Abstract

Objective of the study was to determine the methodological direction of building the structure and content of the training process of highly qualified ski racers specializing in distance racing at the site of the final stage of preparation for the main start of the season.

Methods and structure of the study. The work was attended by five cross-country skiers with qualifications from Master of Sports (MS) to Honored Master of Sports (WMS), who were on centralized training for 18 days in the conditions of the middle mountains (Passo de Lavace pass, altitude 1800-2000 m, Italy) at the final stage of preparation for the XXIV Winter Olympic Games 2022 in Beijing (China).

The methodological basis for the construction of the training process was the as-sumption that the participation of leading athletes in a series of Tour de Ski races, followed by a five-day microcycle of a restorative character ensures the preserva-tion of the effect of pre-stay in hypoxia conditions, which allows after 1 microcy-cle (MCC) of a retracting nature to begin high-intensity muscle activity of a devel-oping nature already in 2 MCC.

Results and conclusions. It has been established that when staying in mid-mountain conditions, an increase in the efficiency of the training process is achieved due to the complex effect of the following factors: functional systems of the body that provide muscle activity; 2) systemic application of strength-oriented training in the gym, preceding the performance of speed-strength and strength-oriented loads in special skiing vehicles; 3) increase in the share of high-intensity muscular work in the 2nd and 3rd MCC.

Keywords: *highly qualified cross-country skiers, the final stage of training, high-intensity muscular activity, adaptation to mid-mountain conditions, training loads, intensity.*

Introduction. The current level of development of cross-country skiing places increased demands on the search for new methodological approaches to building the training process both in long-term and annual training cycles. Of particular importance in modern science and practice is the assessment of the effectiveness of building a training process based on the use of high-intensity training loads, as well as their combination with loads of moderate and low intensity in athletes of various qualifications and ages at various stages of the annual training cycle [1-3]. At the same time, one of the most important places is given to the study of the final stage of preparation (FSP) for the main start of the season [4], taking into account the peculiarities of the chronobiological and climatic-geographic adaptation of athletes to the competition venue [5-7]. However, the problematic positions associated with the algorithm for distributing the parameters of training loads by means and intensity zones, in relation to the conditions of the venue for the FSP before the XXIV Winter Olympic Games in 2022 in Beijing (China), have not been studied and require systematic study with a view to Lew scientific substantiation of planning the training of athletes.

Objective of the study was to determine the methodological direction of build-ing the structure and content of the training process of highly qualified ski racers specializing in distance racing at the site of the final stage of preparation for the main start of the season.

Methods and structure of the study. The work was attended by five ski racers aged 24 to 31 years, with qualifications from Master of Sports to Honored

Master of Sports, who were on central training for 18 days in mid-altitude conditions (accommodation at an altitude of 2000 m, training at an altitude of 1800 m) at the final stage of preparations for the XXIV Winter Olympic Games 2022 in Beijing (China), two of whom took part in the individual race for 15 km (classic style) and 50 km (skating style) at the Olympics.

For athletes, a program of the final stage of preparation (FSP) was developed, which included three microcycles: 1MCC retracting, 2MCC developing (shock) and 3MCC developing (transforming to achieve a high level of implementation readiness).

The study was carried out as part of the research work "Research on the chronobiological and climatic-geographic adaptation of highly qualified athletes in cyclic sports" for 2021-2022.

Results of the study and their discussion. A systematic study of the methodological orientation of building a training process on the FSP at the Passo de Lavace pass (height 1800-2000 m, Italy) for the Olympic Games of ski racers participating in the experimental study was carried out on the basis of establishing the ratio of the total volume of cyclic load (TVCL) by training means and its distribution by intensity zones (see table).

Analysis of the presented data of the total volume of cyclic load by means of training and intensity zones made it possible to establish the following features:

- for the final stage of preparation, the amount of work in special vehicles for skiing in classic and skating styles clearly prevails, while the ratio of work in different styles is balanced;

- the ratio of the amount of work performed in the intensity zones clearly prevails in zones I-II over III-V zones (88:12), reflecting the specifics of cross-country skiing as a type of muscular activity with priority development of endurance, provided mainly by oxidative energy supply (aerobic possibilities).

It should be noted that an even more complete picture of the methodological orientation of building the training process on the FSP was obtained by establishing the proportion (in percent) of the volume of the load performed in the intensity zones in relation to the TVCL in each microcycle, combined according to the metabolic orientation of the impact on the systems energy supply (see Figure A, B, C).

The presented data indicate that in the study group:

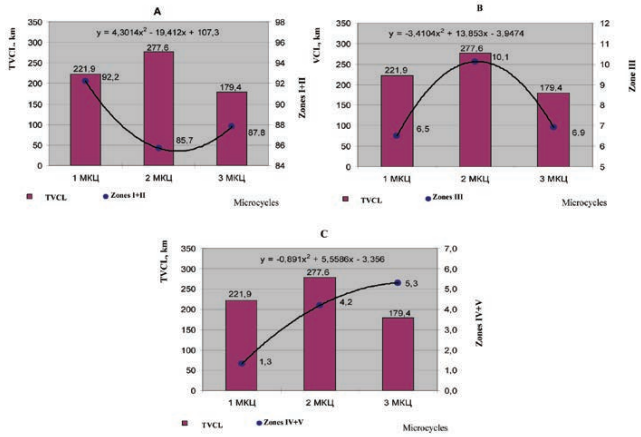
- the partial volume of load in zones I and II (aerobic orientation) in relation to the TVCL in the MCC was exponential, reaching a maximum level in the 2 MCC, in terms of the absolute value of the cyclic load - 237.8 ± 52.7 km, while its share in the ROCF was 85.7%, reflecting the redistribution of the load towards high-intensity muscle work performed in zones III, IV and V (14.3%) (see Fig. A);

- the partial volume of load in zone III (mainly work at the level of AT) in relation to the TVCL (see Fig. B) was exponential, reaching a maximum level in the 2 MCC in terms of the volume of cyclic load - 28.1 ± 6.2 km and its share in the TVCL is 10.1%, reflecting the developmental nature of the 2 MCC;

– partial volume of load in zones IV and V ("mixed" mode of energy supply with a dominant anaerobic glycolysis, Fig. C) in relation to the TVCL was of an increasing nature (ascending part of the exponent) with the dominance of the work performed in 2nd and 3rd MCC (11 ,7 ± 3.8 km and 9.5 ± 3.2 km, respectively), with the largest share in the 3 MCC (5.3%), reflecting the orientation of the training process (the transforming nature of the 3 MCC), which forms a stable level of functioning of energy systems and their implementation readiness, after the "shock" load in the 2 MCC.

Distribution of the total volume of cyclic load in microcycles at the final stage of preparation for the main start (average group data)

Indicators training process		1 MCC	2 MCC	3 MCC	Total volume
		mean	mean	mean	
Training process	Number of training days	6,0±0,5	6,0±0,4	4,0±0,5	16
	Number of workouts	9,0±1,9	10,8±1,1	7,8±3,5	28
	Number of competitions	0	1	0	1
Means	Running, km	5,8±4,7	9,1±5,70	4,2±0,3	19,1±11,6
	Skiing classic, km	123,1±26,4	119,3±12,8	101,5±16,0	343,9±33,6
	Ski skate, km	92,9±20,5	149,2±28,1	73,8±18,8	315,9±47,1
TVCL, km	1st zone	158,8±35,5	170,7±29,9	122,9±36,5	452,4±90,2
	2nd zone	45,8±10,8	67,1±14,8	34,6±12,0	147,5±30,7
	3rd zone	14,4±2,1	28,1±8,3	12,4±2,5	54,9±15,8
	4th zone	2,7±2,0	9,8±1,9	6,8±1,5	19,2±9,8
	5th zone	0,2±	1,9±0,9	2,7±1,1	4,9±1,7
	Total	221,9±46,7	277,6±30,0	179,4±34,6	678,8±85,7
TVCL, hour		15:21:00±2:58:43	18:56:48±1:46:48	12:46:00±2:15:11	47:03:48±3:46:59



Dynamics of partial volumes of cyclic load in the MCC at the final stage of preparation (A - zone I + II; B - zone III; C - zone IV + V)

Conclusions. The results of the study show that when you are in the mid-mountain conditions at the Passo de Lavace (Italy), an increase in the efficiency of the training process, taking into account the target setting, focused on preparing for distance sports (skiathlon, individual race for 15 km, relay race and marathon) of competitive activity, was provided with a developed version of the methodological orientation of building the training process, the structural elements of which had the following content content: the total volume of cyclic load was 678.8 ± 85.7 km, the total volume of cyclic and acyclic load in hours was 55:53:45 ± 5:30:24 h, maintaining the balance of work in the zones of aerobic and anaerobic orientation in three microcycles 88:12% between I-II and III-V zones of intensity, providing achieving a high sustainable level of physical performance by the end of the 3rd MCC in the period between the 16th and 18th days of stay at a given height (with the variant being studied again 1st stay on the top after participating in the Tour de Ski).

The presented data allow a detailed approach to solving issues related to the influence of the following factors on adaptation processes:

- performing training loads at an altitude of 1800 m, and living at a higher altitude - 2000 m, which has an additional hypoxic effect on the functional systems of the body that provide muscle activity (by analogy with the principle of “live high-train low” (LHTL);

- systemic application of strength-oriented training in the gym (with weights of different weights, static-dynamic nature, on simulators, stabilization exercises), preceding the performance of speed-strength and strength-oriented loads in special skiing vehicles.

The research was carried out within the framework of the state task of the FGBU FNTs VNIIFK No. 777-00005-21-00 (subject code No. 001-21/2).

References

1. Golovachev A.I., Kolykhmatov V.I., Shirokova S.V. Postroyeniye trenirovochnogo protsessa vysokokvalifitsirovannykh lyzhnikov-sprinterov na zaklyuchitelnom etape podgotovki k krupneyshim sorevnovaniyam [Construction of the training process of highly qualified skiers-sprinters at the final stage of preparation for the largest competitions]. Vestnik sportivnoy nauki. 2017. No. 4. pp. 3-8.
2. Golovachev A.I., Abramova T.F., Gorbunova E.A., Novikova N.B. Osobennosti stanovleniya funktsionalnogo sostoyaniya vysokokvalifitsirovannykh lyzhnikov-gonshchikov s uchetom mesta provedeniya zaklyuchitelnogo etapa podgotovki k glavnomu startu sezona [Features of the formation of the functional state of highly qualified cross-country skiers, taking into account the location of the final stage of preparation for the main start of the season]. Teoriya i praktika fiziheskoy kultury. 2021. No. 8. pp. 27-29.
3. Golovachev A.I., Kolykhmatov V.I., Shirokova S.V. Poisk rezervov povysheniya effektivnosti vystupleniya na XXIII Olimpiyskikh zinikh igrakh 2018 goda v Pkhenchkhane (Respublika Koreya) [Search for reserves to increase the effectiveness of performance at the XXIII Olympic Winter Games 2018 in Pyeongchang (Republic of Korea)]. Teoriya i praktika fizicheskoy kultury. 2017. No. 2. pp. 11-13.
4. Golovachev A.I., Kolykhmatov V.I., Shirokova S.V. Modelnyye pokazateli fizicheskoy podgotovlennosti lyzhnits-gonshchits vysokoy kvalifikatsii pri podgotovke k XXIV zimnim Olimpiyskim igram 2022 goda v Pekine (Kitay) [Model indicators of physical fitness of highly qualified ski racers in preparation for the XXIV Winter Olympic Games in 2022 in Beijing (China)]. Chelovek. Sport. Meditsina. 2019. No. S2 (19). pp. 81-87.
5. Engel F.A., Ackermann A., Chtourou H. and Sperlich B. High-Intensity Interval Training Performed by Young Athletes: A Systematic Review and Meta-Analysis. Front. Physiol. 9:1012. 2018
6. Sandbakk Ø. and Holmberg H.C. A Reappraisal of Success Factors for Olympic Cross-Country Skiing. International Journal of Sports Physiology and Performance. 2014. Vol.9 (1), pp. 117-121.
7. Sandbakk, Ø., Solli, G.S., Talsnes, R.K. et al. Preparing for the Nordic Skiing Events at the Beijing Olympics in 2022: Evidence-Based Recommendations and Unanswered Questions. Journal of Science in Sport and Exercise. 2021. Vol. 3. pp. 257-269.

Dynamics of indicators of physical fitness and economy as a factor of sports results of high-class biathlonists

UDC 796.012

P.E. Myakinchenko[1]
A.V. Adodin[1]
Dr. Hab. **E.B. Myakinchenko**[1]
[1]Federal Scientific Center of Physical Culture and Sport (VNIIFK), Moscow

Corresponding author: mpe_mail@mail.ru

Abstract

Objective of the study was to study the dynamics of indicators of physical fitness and economy in the context of differences in the characteristics of the competitive activity of high-class biathletes.

Methods and structure of the study. Four men and four women in "successful" and "unsuccessful" seasons according to the rating criterion in the World Cup studied the values and dynamics of 34 functional and motor indicators obtained from May to November of the preparatory period, as well as the dynamics of distance speed, last lap speed and accuracy shooting while standing during the competitive period.

Results and conclusions. In addition to the well-known ones, another criterion for the effectiveness of the training process has been identified: "the dynamics of the functional and motor abilities of athletes in the preparatory period." For most indicators, the dynamics should be linear or exponentially increasing. The difference and dynamics of the result in the competitive period is largely determined by the distance speed.

Keywords: *biathlon, sports result, adaptation, physical readiness.*

Introduction. The results of athletes in cyclic sports associated with the manifestation of endurance correlate with such factors as maximum oxygen consumption (VO2max), the percentage of aerobic/anaerobic threshold relative to VO2max, economy, and anaerobic power [6]. In addition, studies of recent decades have shown that strength and power training can play a significant role in increasing the endurance and aerobic abilities of athletes [7]. Traditionally, the criteria for the effectiveness of the training process in the preparatory period are indicators of the corresponding physiological capabilities and related motor abilities.

It is also generally accepted that the improvement of these indicators in the medium (months) and long-term (years) perspective is associated with the processes of morphofunctional specialization, that is, the adaptation of the body of athletes [2], which in turn is characterized by: complex interaction, different reactivity to the load, heterochrony in development, variability in terms of "retention" and loss of various aspects of adaptability. This, in turn, leads to the need to build a training process based on the periodization of loads, the use of means and methods of various directions [4].

However, if different aspects of increasing the listed capabilities/abilities and their impact on sports results have been the objects of numerous studies for decades, then the temporal patterns of the course of adaptation of the corresponding fitness factors have been studied rather poorly. At the same time, a recent study [5] suggests that the “optimal” organization of training loads of various directions during the preparatory period, compared with the “non-optimal” one, can in a certain way affect the dynamics of key indicators of biathletes’ fitness and will be associated with the final performance and the success of the key components of the competitive exercise.

Objective of the study was to study the dynamics of indicators of physical fitness and economy in

the context of differences in the characteristics of the competitive activity of high-class biathletes.

Methods and structure of the study. The work analyzed the data obtained during the stage complex surveys and examination of the competitive activity of the leaders of the sports team of Russia. In the period 2015-2021 according to the criterion of the average final rating in the Biathlon World Cup of four men and four women - team leaders - "successful" and "unsuccessful" seasons were identified. The “successful” seasons were 2015/2016 and 2019/2020 for women and 2015/2016 and 2021/2022 for men. “Unsuccessful” - 2016/2017 and 2017/2018 for women, 2018/2019 and 2019/2020 for men. In addition to the final rating, the performance dynamics of the athletes was determined from the 1st stage of the World Cup (SWC) to the main start (championship-W C), as well as the dynamics of distance speed, relative speed on the last lap and shooting accuracy, standing in sprint races according to the method described earlier [5]. The dynamics of 34 fitness indicators of the same athletes was determined by averaging the

data of tests conducted in May-June, July-August and September-November. The testing technique is described earlier [3]. Group differences were determined by the Mann-Whitney test.

Results and conclusions. It has been established that "successful" seasons differ from "unsuccessful" ones in terms of the average effectiveness of performances at the 1st-6th World Cup Stage and the World Championship (p=0.041), as well as in terms of distance speed (p=0.026). The speed of the last circle and the accuracy of shooting while standing did not differ (Fig. 1). Russian biathletes, both in "successful" and "unsuccessful" years, could not approach the main start in the best shape.

Examples of the dynamics of some indicators that reflect the main aspects of the preparedness of athletes are shown in Figure 2.

A comparative analysis of the data obtained showed that the preparatory period in "successful" years and in "unsuccessful" years was characterized, first of all, by clear differences in the dynamics of indicators, as well as higher values of the heart stroke volume index, oxygen pulse, oxygen consumption during handwork and threshold running power on the treadmill by the end of the preparatory period. Profitability had a negative trend and did not differ by the end of the prepara-

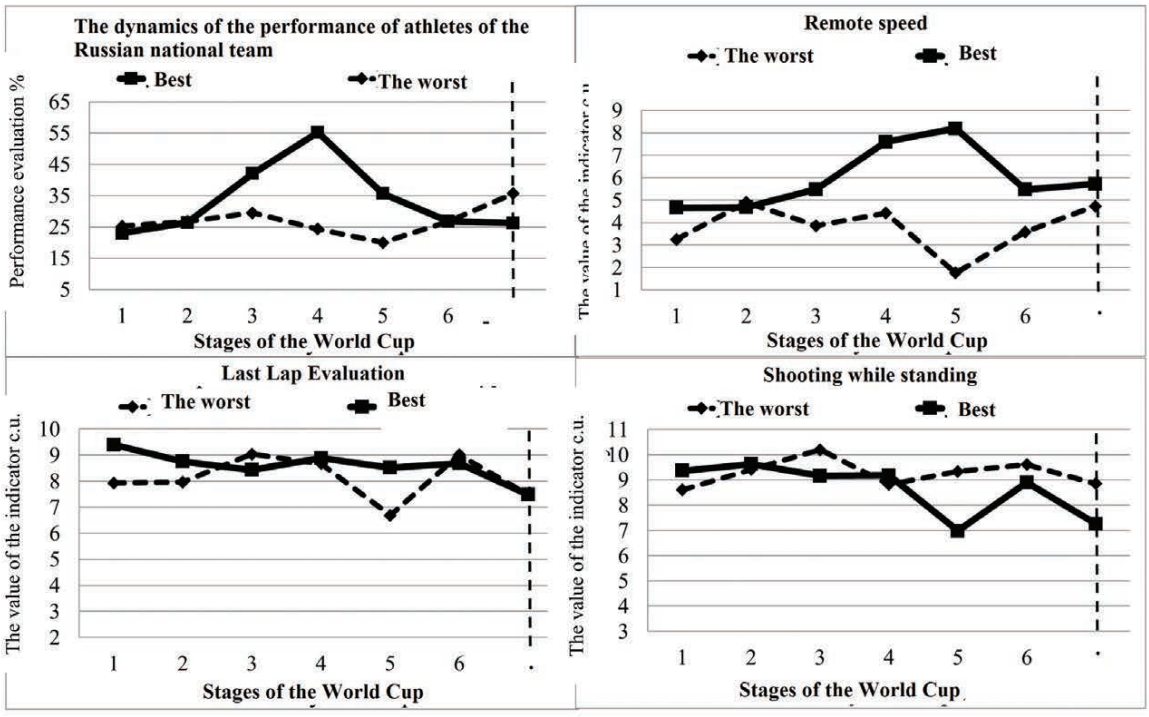


Figure 1. *Dynamics of performance and the most important components of a competitive exercise in "successful" (solid line) and "unsuccessful" years (dashed line) in four men and four women - the leaders of the Russian biathlon team*

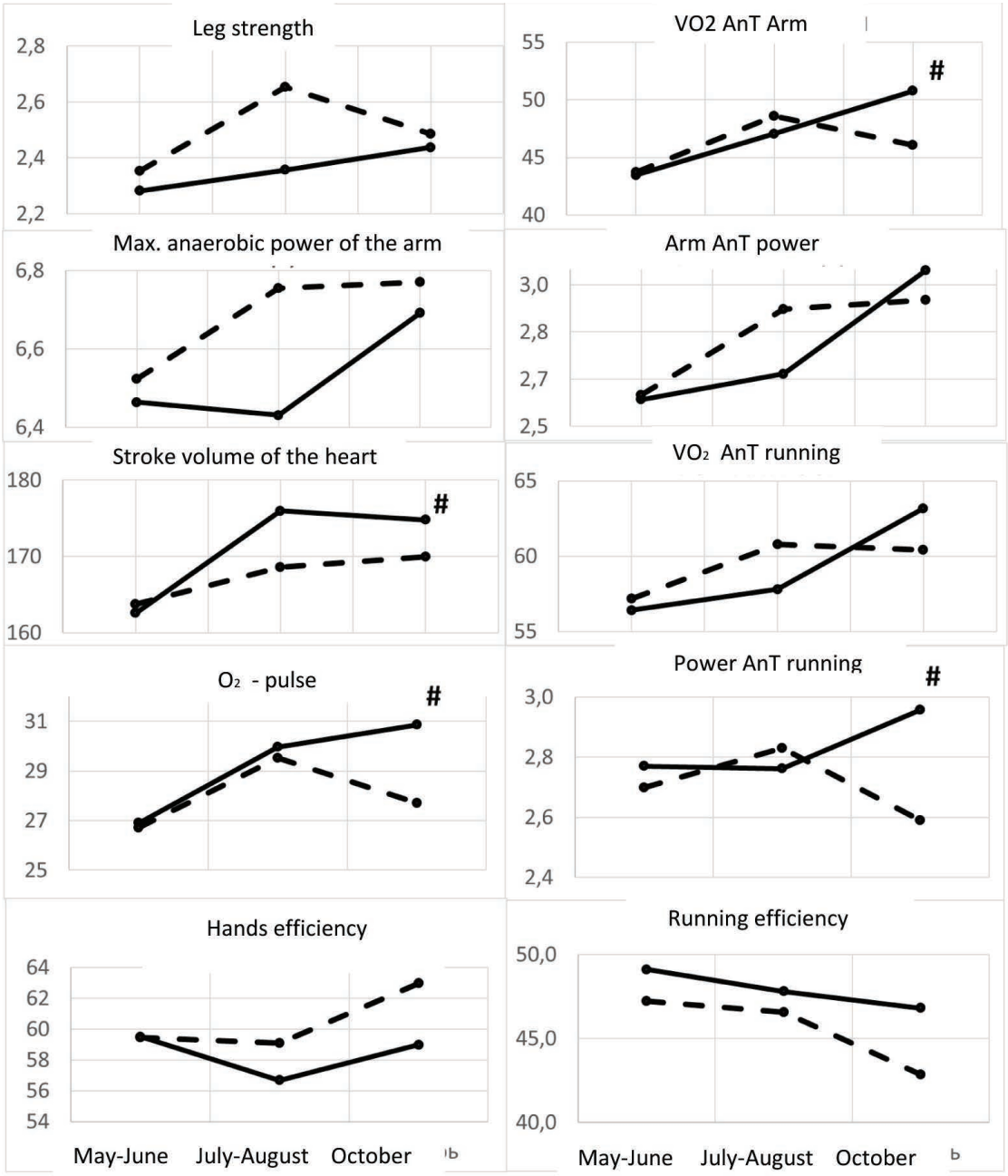


Figure 2. *The most characteristic examples of the dynamics of some average indicators in "successful" (solid line) and "unsuccessful" (dashed line) years for four men and four women - leaders of the Russian biathlon team*

tory period. The difference and dynamics of the result in the competitive period is determined only by the distance speed.

Conclusions. The data obtained allow us to suggest that in addition to the already known ones, another criterion for the effectiveness of the training process is the "dynamics of the key abilities of athletes in the preparatory period." Signs of "optimal dynamics" for power, speed-strength and aerobic performance of high-class biathletes can be considered their linear or exponentially increasing character; cardiorespiratory - the shape of a saturating curve. Distance speed was the most significant factor of sports result in the studied sample of subjects.

The work was carried out within the framework of the state task of the Federal Scientific Center of Physical Culture and Sport (VNIIFK), No. 777-00026-22-00 (subject No. 001-22/5).

References

1. Adodin N.V., Myakinchenko E.B., Zakharov G.G., Beleva N. Vzaimosvyaz parametrov sorevnovatelnoy deyatelnosti i pokazateley dinamiki fizicheskoy podgotovlennosti biatlonistov vysokogo klassa. [Interrelation of the parameters of perfomance and indicators of the dynamics of physical abilities among high-class biathletes.]. Teoriya i praktika fiz. kultury. 2021. No. 9. pp. 9-10.
2. Verkhoshansky Yu.V. Na puti k nauchnoy teorii I metodologii sportivnoy trenirovki [On the way to the scientific theory and methodology of sports training]. Teoriya i praktika fiz. kultury.1998. No. 2. pp. 21-27.
3. Kryuchkov A.S., Kaminsky Yu.M., Missina S.S., Adodin N.V. et al. Dinamika sokratitelnykh i aerobnykh vozmozhnostey skeletnykh myshts lyzhnikov-sprinterov vysokogo klassa pod vliyaniyem dvukh razlichnykh programm podgotovki [Dynamics of contractile and aerobic capabilities of the skeletal muscles of high-class XC sprinters under the influence of two different training programs]. Sovremennaya sistema sportivnoy podgotovki v biatlone [Modern sports training system in biathlon]. Proceedings national research-practical conference. 2020. pp. 72-109.
4. Matveev L.P. Problema periodizacii sportivnoy trenirovki [A problem of periodization of sports training]. Moscow: Fizkultura i sport publ., 247 p.
5. Fedoseev A.M., Adodin N.V., Myakinchenko P.E. et al. Vzaimosvyaz takticheskikh variantov prokhozhdeniya distantsii na tochnost strelby, distantsionnuyu skorost i itogovyy rezultat v gonke u biatlonistov vysokogo klassa [Interrelation of tactical options for passing the distance on shooting accuracy, distance speed and the final result in the race among high-class biathletes]. Vestnik sportivnoy nauki. 2018. No. 6. pp. 18-22.
6. Lundby C., Robach P. Performance enhancement: what are the physiological limits? Physiology (Bethesda). 2015. No. 30 (4). pp. 282-92.
7. Murlasits Z., Kneffel Z., Thalib L. The physiological effects of concurrent strength and endurance training sequence: a systematic review and meta-analysis. J. Sports Sci. 2018. Vol. 36. No. 11. pp. 1212-1219.

Features of adaptation to intensive physical load of skilled cyclists specializing in mountain bike

UDC 796.015

Dr. Hab., Professor **P.V. Kvashuk**[1,2]
Dr. Biol. **A.V. Voronov**[1]
PhD **G.N. Semaeva**[1,2]
R.V. Malkin[1]
[1]Federal Scientific Center of Physical Culture and Sport (VNIIFK), Moscow
[2]Federal Training Sports Center of the Representative Teams of Russia, Moscow

Corresponding author: volodchenkova.e.n@vniifk.ru

Abstract

Objective of the study was to identify the features of the adaptation of the neuromuscular apparatus and vegetative functions to physical activity of progressively increasing power and the mechanisms for maintaining the performance of qualified cyclists specializing in mountain biking.

Methods and structure of the study. The work was attended by five cyclists of CMS and MS qualifications, specializing in mountain biking (MTB). As a model testing load, a standard stepwise test was used, performed to "failure". The test load was performed on an ELITE bike machine, REAL-TURBO-MUIN model (Italy).

Results and conclusions. This study shows that, along with additional activation of presumably fast muscle fibers at a power of 75-80% max, an effective mechanism for maintaining the special performance of qualified cyclists is the level of intermuscular coordination, which provides synergism in the work of the thigh and lower leg muscles with a further increase in pedaling power.

Keywords: *cyclists, mountain bike, working capacity, adaptation, physical activity, working capacity.*

Introduction. In order to identify effective training means of special speed-strength training of qualified athletes specializing in sports whose competitive activity is associated with a high manifestation of power qualities, including mountain biking, it is necessary to have an idea about the features of the regulation of the locomotor apparatus and vegetative functions when performing exercises in different intensity modes.

In scientific research, to assess the activation of working muscles, vegetative and metabolic reactions of athletes, methods of registration of surface electromyogram (EMG), indicators of external respiration and gas exchange are used.

When athletes perform loads of increasing power, researchers identify threshold changes in EMG (EMGTh) [3,8]. It has been shown that EMG thresholds correlate with lactate and ventilation thresholds [6].

It is believed that performance in the zone of aerobic-anaerobic transition and, accordingly, in the zone of submaximal power is ensured by additional activation of type II-A (FR - Fast Fatique Resistant) muscle fibers, which positively affects the increase in the functionality of the neuromuscular apparatus [7,9].

At the same time, it is known today that in professional cyclists, changes in the nature of recruitment of motor units do not depend on the composition of muscle fibers [4,6]. Maybe it has to do with the pedaling technique. It is assumed that each muscle performs a specific task depending on the ability of the athlete to press and pull the pedal [2].

Objective of the study was to identify the features of the adaptation of the neuromuscular apparatus and vegetative functions to physical activity of progressively increasing power and the mechanisms for main-

taining the performance of qualified cyclists specializing in mountain biking.

Methods and structure of the study. The focus of this study is determined by the state task of the Federal Scientific Center of Physical Culture and Sport (VNIIFK), No. 777-026-22 (topic No. 001-22/4).

The indicators of adaptation of the neuromuscular apparatus and vegetative functions in qualified cyclists were studied during the performance of a special bicycle load in different intensity modes. The study involved five cyclists with the qualification of Candidate for Master of Sports and Master of Sports, specializing in mountain biking (MTB). Age - 18.2±0.9 years, body length - 177.2±4.8 cm, body weight - 67.3±3.1 kg.

As a model testing load, a standard stepwise test was used, performed to "failure". The study was carried out in laboratory conditions. The test load was performed on an ELITE bike machine, model REAL-TURBO-MUIN (Italy) (athletes used their racing bikes), step time - 2 min, initial power - 140 W, with an increase in power by 30 W at subsequent work steps.

The electromyographic activity of the muscles was recorded using the SportLab hardware and software system (Russia), consisting of an eight-channel telemetric electromyography, an accelerometer, a video camera, and a synchronization device. During the testing load, the electrical activity of the following muscle groups was studied: thigh muscles - m. vastus lateralis; m. rectus femoris; m. biceps femoris caput longus; leg muscles - m. tibialis anterior; m. soleus; m. gastrocnemius medialis. All measurements were taken on the right side. The electromyogram was inverted and smoothed by the moving average method (averaging window, 50 ms). The indicators of the average myocost of one revolution of the pedal and myoroborot per minute were calculated [8].

To study external respiration and gas exchange during the test, the system of cardiorespiratory stress diagnostics Meta Lyzer 3B manufactured by CORTEX (Germany) was used. The air flow was measured using a turbine transducer (Triple V). A two-point gas calibration (first gas 15% O_2, 5% CO_2; second gas ambient air) was performed daily. Prior to each test, a one-point gas calibration was performed using ambient air, as well as a flow sensor calibration using a 3 L syringe (Hans Rudolph, Kansas City, USA).

In the process of performing the testing load, the dynamics of pulmonary ventilation (VE), oxygen consumption (VO_2), carbon dioxide release (VCO_2), respiratory equivalents for O_2 and CO_2 (VE/O_2 and VE/CO_2) were studied. Ventilatory thresholds (VT1 and VT2) were determined based on the dynamics of VE/O_2 and VE/CO_2 [9].

Results of the study and their discussion. The maximum indicators of aerobic performance, work power and lactate concentration ($M \pm \sigma$) in MTB cyclists participating in the study, respectively, were: VO_2max - 4.58 ± 0.19 l (68.7 ± 0.78 ml/min/kg); Power - 473±13 W (7.09±0.11 W/kg); La - 11.6 ± 1.2 mmol / l.

On Figure 1 (A, B) shows the dynamics of ventilation equivalents (VE/VO2 and VE/VCO2) and myowork, identifying the parameters of ventilation (VT1 and VT2) and electromyographic (EMGTh1 and EMGTh2) thresholds.

It was found that the threshold power indicators (VT1 and EMGTh1) demonstrate similar values (55-60% Powermax). At the same time, it can be seen that EMGTh1 for the thigh muscles is localized at a power of 55%, and EMGTh1 for the calf muscles, at a power of 60% of the maximum power achieved in the test.

Threshold power indicators (VT2 and EMGTh2) also have close values (75-80% Powermax). At the same time, EMGTh2 for both thigh and calf muscles is localized at the output power level of 75% max. At the same time, the tension of the thigh muscles (60% max) is significantly higher than the tension of the calf muscles (50% max).

Obviously, muscle groups or individual muscles of the thigh and lower leg have different values of electromyographic thresholds, which, apparently, is necessary for effective adaptation to different motor modes.

An analysis of the electrical activity (myoratory work) of different muscle groups during the stepwise test showed that the thigh muscles perform the greatest work in the process of pedaling: the lateral (lateral) head of the quadriceps femoris muscle - m. vastus lateralis, anterior head of the quadriceps femoris muscle - m. rectus femoris and biceps femoris - m. biceps femoris caput longus. Leg muscles: tibialis anterior - tibialis anterior; calf muscle - m. gastrocnemius; soleus muscle - m. soleus also take an active part in pedaling, however, their electrical activity begins to increase significantly only at high intensity (power) modes.

A high synergistic effect of the muscle groups of the thigh and lower leg is manifested when their EMG activity reaches more than 80% max.

Thus, in order to achieve a coordinated work of different muscle groups of the lower extremities in real-

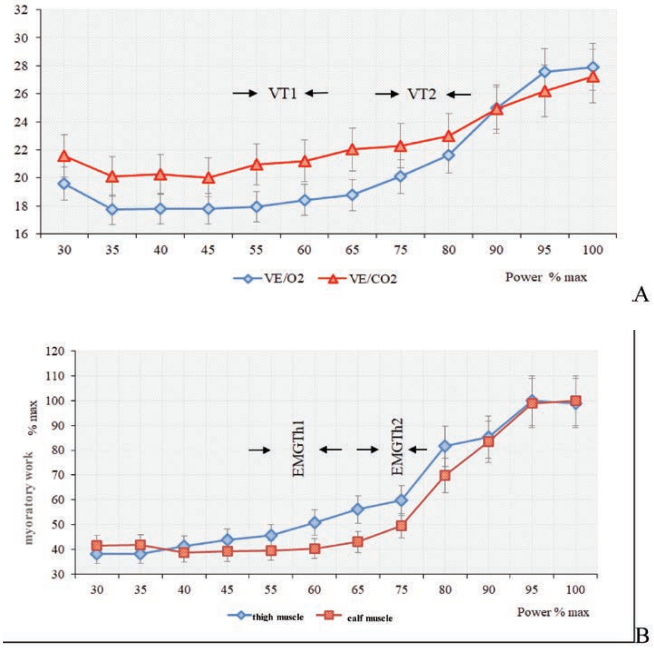


Figure 1. *Dynamics of ventilatory equivalents (VE/VO2 and VE/VCO$_2$), EMG amplitudes, parameters of ventilatory (VT1 and VT$_2$) and electromyographic (EMGTh1 and EMGTh2) thresholds recorded during the maximum test with increasing load*

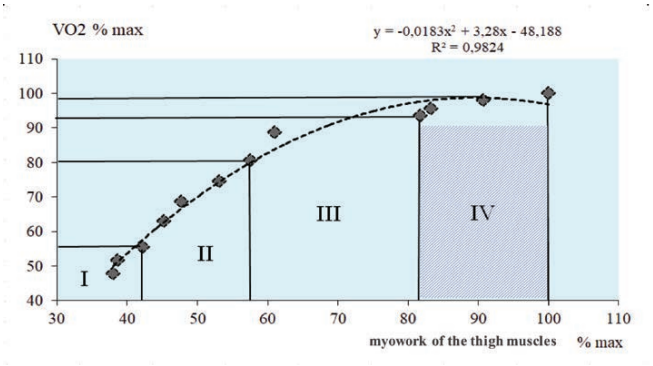


Figure 2. *Interrelation of indicators of aerobic metabolism and the implementation of the power capabilities of the muscles of qualified MTB cyclists when performing a load of different physiological power: I - zone of moderate power (active recovery); II - zone of moderate power (development of aerobic endurance); III - zone of high power (ANP); IV - zone of submaximal (critical) power.*

izing their power potential, it is necessary to increase the intensity (power) of the load performed to a submaximal level (90% max).

On Figure 2 shows the relationship between the indicators of aerobic metabolism and the implementation of the power capabilities of the muscles of qualified MTB cyclists when performing loads of different physiological power. It was revealed that the realization of the power potential of the muscles of the lower extremities in MTB cyclists reaches high values when they achieve aerobic performance at the level of 90% VO2max and above.

Of particular interest is the identification of the fact of a sharp increase in the gradient (rate of rise) of the myowork of muscle groups in the zone of submaximal power. The high speed of activation of the mechanism of intermuscular coordination to coordinate the work of different muscle groups with an increase in the requirements of the external load ensures the maintenance of the required level of performance.

Conclusions. It was found that the threshold power indicators (VT1 and EMGTh1) and (VT2 and EMGTh2) demonstrate similar values, respectively 55-60% and 75-80% Powermax. When the threshold values (EMGTh1 and EMGTh2) of the pedaling power are reached, the indicators of myowork for the muscles of the thigh and lower leg have differences. The muscle work of the thigh muscles increases in proportion to the pedaling power up to the level of EMGTh2, while the indicators of the muscle work of the lower leg muscles are significantly lower. Then the muscle work of the thigh and lower leg muscles actively increases, reaching a synergistic effect at the level of 90% of the maximum pedaling power (Fig. 1, bottom).

This study shows that, along with additional activation of presumably fast muscle fibers at a power of 75-80% max, an effective mechanism for maintaining the special performance of qualified cyclists is the level of intermuscular coordination, which provides synergism in the work of the thigh and lower leg muscles with a further increase in pedaling power.

These results suggest that training exercises performed in the submaximal power mode (90-95% max) will be the most effective for the development of special strength qualities of highly qualified cyclists specializing in mountain biking.

The work was carried out within the framework of the state task of the 1Federal Scientific Center of Physical Culture (VNIIFK), No. 777-00026-22-00 (subject code No. 001-22/4).

References

1. Aulik I.V. Opredeleniye fizicheskoy rabotosposobnosti v klinike i sporte [Determination of physical performance in the clinic and sports]. 2nd ed., rev., sup.. Moscow: Meditsina, 1990. 191 p.

2. Voronova A.A., Voronov A.V., Kvashuk P.V. Opredeleniye metodami elektromiografii myshechnykh grupp, vliyayushchikh na rezultat v skorostnom sportivnom skalolazanii [Determination of muscle groups influencing the result in high-speed sport climbing by electromyography methods]. Teoriya i praktika fizicheskoy kultury. 2019. No. 12. pp. 24-26.
3. Chwalbinska-Moneta J., Kaciuba-Uscilko H., Krysztofiak H., Ziemba A., Krzeminski K., Kruk B., Nazar K. Relationship between EMG blood lactate, and plasma catecholamine thresholds during graded exercise in men. J Physiol Pharmacol. 1998. Vol. 49. pp. 33-41.
4. Hug F., Faucher M., Kipson N., Jammes Y. EMG signs of neuromuscular fatigue related to the ventilatory threshold during cycling exercise. Clin Physiol Funct Imaging. 2003. Vol. 23. pp. 208-214.
5. Jorge M., Hull M. Analysis of EMG measurements during bicycle pedalling. – J Biomech. 1986. Vol. 19. pp. 683-694.
6. Lucia A., Sanchez O., Carvajal A., Chicharro J. Analysis of the aerobic-anaerobic transition in elite cyclists during incremental exercise with the use of electromyography. Br J Sports Med. 1999. Vol. 33. pp. 178-185.
7. Moritani T., deVries H.A. Re-examination of the relationship between the surface integrated electromyogram (iEMG) and force of isometric contraction. Am J Phys Med. 1978. Vol. 57. pp. 263-277.
8. Nagata A., Muro M., Moritani T., Yoshida T. Anaerobic threshold determination by blood lactate and myoelectric signals. Jpn J Physiol. 1981. Vol. 31. pp. 585-597.
9. Vanhatalo A., Black M.I., DiMenna F.J., Blackwellet J.R. et al. The mechanistic bases of the power-time relationship: muscle metabolic responses and relationships to muscle fibre type. Journal of Physiology. 2016. Vol. 594. pp. 1-17.

Differentiated use of auxiliary projectiles in the preparation of high-class javelin throwers based on the consideration of biomechanical features of the implementation of the final effort

UDC 796.012

Postgraduate student **M.V. Abakumova**[1]
Dr. Hab., Dr. Biol., Professor **K.D. Chermit**[1]
PhD, Associate Professor **A.G. Zabolotny**[1]
[1]Adyghe State University, Maikop

Corresponding author: zabolotniy-tol1@yandex.ru

Abstract

Objective of the study was to substantiate and experimentally test the methodological conditions for the shared use of auxiliary projectiles in the preparation of high-class javelin throwers.

Methods and structure of the study. In the presented work, the methodological conditions in the preparation of javelin throwers using the swoop throwing technique and the rebound throwing technique are determined. The classification of auxiliary projectiles has been carried out.

Results and conclusions. Managing the training of throwers using swoop throwing technique involves the organization of pedagogical influence aimed at developing the athlete's mechanisms for the manifestation of force in the links of the kinematic chain of the motor apparatus. The main methodological condition for the shared use of auxiliary projectiles in the group of athletes using the rebound throwing technique was the use of weighted projectiles, lightweight projectiles thrown at the wall, and lightweight projectiles thrown at a distance, in a ratio of 20% -50% -30%. This made it possible to achieve an increase in the speed of angular movements in the kinematic chains of the motor apparatus in two athletes of the rank of CMS and one - MS, in addition, in the master of sports and one candidate for the master of sports to achieve an increase in the results of throwing the main projectile, and in the honored master of sports to maintain high rates of speed potential of the kinematic chain.

Keywords: *javelin throwing technique, kinematic characteristics of javelin throwing, final effort, final effort realization phases, thrower's tasks.*

Introduction. The study of the kinematic order of the generation of the speed of angular displacements in the kinematic chains of the motor apparatus of high-class athletes when performing javelin throw, carried out by us in previous studies [2], allows us to establish two ways to perform the final effort. These are the technique of performing the final effort with a rebound and the technique of performing the final effort with a swoop. Each method is characterized by its own system-forming factors, its own cause-and-effect relationships and risks. Rebound throwing allows more efficient use of the speed run-up potential, which is mainly determined by the mechanisms of coordination of the control of the speed of angular movements in the links of the kinematic chain of a motor athlete. Leap throwing allows more efficient use of the athlete's speed-strength capabilities, which is mainly determined by the work of the mechanisms that determine the manifestation of force in the links of the kinematic chain of the motor athlete.

The prevalence of any throwing method in an athlete is determined by the dominance of the coordination or speed-strength components in the physical condition of the athlete. Such an individual feature causes different approaches to the management of the training process of athletes using one of the types of throwing [3].

Objective of the study was to substantiate and experimentally test the methodological conditions for the shared use of auxiliary projectiles in the preparation of high-class javelin throwers.

Methods and structure of the study. In the framework of this study, the basis for managing the

sports training of throwers is the idea of using auxiliary projectiles, based on the biomechanical features of the throwing method formed by the athlete. It was assumed that the process of training athletes using the technique of rebound throwing, which is based on the ability to control the high speed of angular movements in the kinematic chain of the motor apparatus, should be based on the predominant use of lightweight auxiliary projectiles. In turn, the process of training athletes using swoop throwing technique, which is based on the ability to manifest force in the kinematic chains of the motor apparatus, should be based on the centralized use of weighted projectiles.

This assumption was tested experimentally. A group of throwers was selected, including athletes of the Candidate Master of Sports (CMS), Master of Sports (MS), Honored Master of Sports (HMS) level, whose biomechanical characteristics of the final effort technique were established based on the use of an optical system for video analysis of movements, which made it possible to establish a method for its implementation. The first group included throwers using the rebound throwing method, and the second group included throwers using the swoop throwing method. To increase the reliability, each subject had 10 attempts. The formative experiment was carried out in the preparatory period of sports training. During the training process, both groups were faced with the task of ensuring the acquisition of biomechanical parameters that characterize the improvement of sports form. To ensure a positive effect, special exercises for throwing light and heavy auxiliary projectiles were included in the training process of each group based on the principle of shared use. To implement this principle, when compiling individual programs, auxiliary projectiles were divided into three groups:

1) weighted auxiliary projectiles, the use of which is aimed at developing the power potential of the thrower;

2) lightweight auxiliary projectiles designed for wall throwing and used to develop the thrower's coordination abilities;

3) lightweight auxiliary projectiles designed for throwing at a distance and helping to develop the speed abilities of the thrower.

In order to verify the results reliably, the following share ratio of exercises with the use of auxiliary equipment for athletes using different throwing methods was proposed:

1) for athletes using the bouncing technique, the proportion of exercises using weighted projectiles was 20%, the share of exercises using lightweight projectiles thrown at the wall was 50%, and the share of exercises using lightweight projectiles thrown at a distance was 30%;

2) for athletes using the swoop throwing technique, the share of exercises using weighted projectiles was 30%, the share of exercises using lightweight projectiles thrown at the wall was 20%, and the share of exercises using lightweight projectiles thrown at a distance was 50%.

Throwing a competitive projectile was planned independently. When analyzing individual plans developed on the basis of the principle of shared use of auxiliary exercises, it was possible to establish that the participants in the experiment did not throw the competitive apparatus more than 1-2 times a week, the rest of the time was devoted to throwing auxiliary apparatus. At the same time, each athlete led the preparation process in accordance with an individual program. Innovations in the field of management of the training process concerned only the share ratio of the use of auxiliary projectiles. The duration of the experiment was three months. The definition of the kinematic characteristics of throwing was implemented on the basis of the optical system of three-dimensional video analysis of motions of the company "Biosoft" [1]. Processing of the results of the experiment was carried out in the laboratory of ergonomic biomechanics of the Adyghe State University.

Results of the study and their discussion. To determine the criteria for evaluating the effectiveness of the application of building individual plans based on the share ratio of the use of auxiliary projectiles in athletes using various throwing methods, indicators of the speed of angular movements in the links of the kinematic chain of the motor apparatus were selected, which have high values determined by using a system of three-dimensional video analysis of human movements. Five indicators were taken as the most significant for the athletes of both groups (see table).

The introduction of the principle of shared use of an auxiliary projectile into the process of managing the training process in a group of athletes using the swoop throwing technique made it possible to achieve an increase in the speed of angular movements in the kinematic chains of the motor apparatus in three athletes, and in two athletes to achieve an increase in the results of throwing the main projectile and maintain high rates of speed potential kinematic chain of an athlete with the title of HMS. These results allow us to speak about the effectiveness of introducing the principle of shared use of an auxiliary projectile into the process of managing the training process of javelin throwers.

The study of similar data in the group of athletes using the bounce throwing technique made it possible to establish the implementation of the principle of shared use of an auxiliary projectile in the process of managing the training process in the group of athletes using the bounce throwing technique. The introduction of this principle, in particular, made it possible to achieve an increase in the speed of angular movements in the kinematic chains of the motor apparatus

Indicators of the speed of angular displacements in the kinematic chains of the motor apparatus of athletes.

Members experiment	The speed of angular displacements in the kinematic chains of the propulsion apparatus (°/c - degrees per second)									
	Speed of extension in the ankle joint in the phase of taking the final position		Speed extension at the knee joint in the final position phase		The speed of extension in the hip joint in the phase of the final actions		Speed of extension in the shoulder joint in the phase of performing the final actions		The speed of extension in the elbow joint in the phase of the execution of the final actions	
	Before experiment	After experiment	Before experiment	After experiment	Before experiment	After experiment	Before experiment	After experiment	Before experiment	After experiment
Using the technique of throwing a rush										
Cr----------z (KMS)	122±18	*182±22	201±17	183±25	165±11	163±5	209±22	216±31	142±21	*404±43
Pu----------a (KMS)	201±23	224±19	76±8	*145±19	158±18	148±12	203±31	198±25	235±34	*368±25
Ab---------a (HMS)	362±14	352±11	91±9	103±24	142±14	146±9	211±12	242±9	429±23	578±32
Pi---------s (MS)	327±18	355±25	54±14	*113±25	110±25	105±35	276±19	341±42	418±34	*674±71
Using the rebound throwing technique										
To----------n (HMS)	365±24	387±35	187±14	225±25	170±12	183±16	251±14	275±18	731±57	831±77
To----------n (KMS)	249±27	241±29	10±2	*51±15	57±14	79±11	250±24	*311±21	280±41	*411±31
Ша---------н (MC)	383±31	371±32	29±5	*85±17	31±11	54±14	251±31	271±29	350±32	*451±12
Zo----------v (MS)	131±35	*243±27	111±12	84±17	41±14	52±10	197±28	221±35	195±32	*276±43

* *Significance of data differences before and after the experiment, p<0,05.*

in three athletes, and in two - to achieve an increase in the results of throwing the main projectile. Such results allow us to conclude that the principle of shared use of an auxiliary projectile is effective in managing the training process of javelin throwers.

Conclusions. Managing the training of throwers using the technique of rebound throwing mainly requires the formation of mechanisms for coordinating the manifestation of the speed of angular movements in the links of the kinematic chain of the motor apparatus in the athlete. Managing the training of throwers using swoop throwing technique involves the organization of pedagogical influence aimed at developing the athlete's mechanisms for the manifestation of force in the links of the kinematic chain of the motor apparatus.

The main methodological condition for the shared use of auxiliary projectiles in the group of athletes using the rebound throwing technique was the use of weighted projectiles, lightweight projectiles thrown at the wall, and lightweight projectiles thrown at a distance, in a ratio of 20% -50% -30%. This made it possible to achieve an increase in the speed of angular movements in the kinematic chains of the locomotor apparatus in two athletes of the rank of CMS and one - MS, in addition, in the master of sports and one candidate for the master of sports to achieve an increase in the results of throwing the main projectile, and in the honored master of sports to maintain high performance speed potential of the kinematic chain.

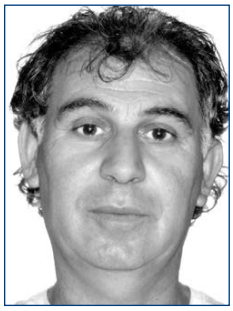
The main methodological condition for the shared use of auxiliary projectiles in the group of athletes using the swoop throwing technique was the use of weighted projectiles, lightweight projectiles thrown at the wall, and lightweight projectiles thrown at a distance, in a ratio of 30% -20% -50%. This also made it possible to achieve an increase in the speed of angular movements in the kinematic chains of the locomotor apparatus in two athletes of the CMS rank and one - MS, in addition, in the master of sports and one candidate for the master of sports to achieve an increase in the results of throwing the main projectile, and in the honored master of sports to maintain high indicators of the speed potential of the kinematic chain.

References

1. Voronov A.V. Imitatsionnoye biomekhanicheskoye modelirovaniye kak metod izucheniya dvigatelnykh deystviy cheloveka [Imitating Biomechanical Modeling as Method of Studying of Human Motor Actions]. Teoriya i praktika fiz. kultury. 2004. No. 2. pp. 22-26, 39-40.
2. Abakumova M.V., Chermit K.D., Zabolotny A.G. Klassifikatsiya sposobov vypolneniya finalnogo usiliya tekhniki metaniya kopya [Classification of ways to perform the final effort of the javelin throwing technique]. Teoriya i praktika fiz. kultury. 2020. No. 10. pp. 80-82.
3. Campos J., Brizuela G., Ramon V. Three-dimensional kinematic analysis of elite javelin throwers at the 1999 IAAF World Championships in Athletics. Available at: http://www.iaaf-rdc.ru/ru/docs/publication/64.html.

Features of indicators of high-qualified tennis service acceptance at us open 2020, atp final tournament 2020 and australian open 2021

UDC 796.342



PhD, Associate Professor **Mohaned Al Khalili**[1]
M.E. Stepanova[1]
[1]Russian State University of Physical Education, Sports, Youth and Tourism (SCOLIPE), Moscow

Corresponding author: rgufk@list.ru

Abstract

Objective of the study was to identifying the number of indicators and the versatility of serving reception among the top eight tennis players in the world in 2020 according to the results of the rating of the Association of Tennis Professionals (ATP).

Methods and structure of the study. In the course of the work, a video analysis of the Grand Slam tournaments of 2021, the Australian Open in 2021, the final championship of the ATP tour in 2020, the US Open in 2020 was used. The percentage of hitting the first serve from the first match to the last among eight leading players in the ATP ranking, in tournaments during 2020-2021.

Results and conclusions. In tennis, the execution of the reception of the serve depends not only on the receiver, but also on the direction of the server's serve. Depending on the server, where he sends his serve, the receiver finds himself in different conditions, however, how the receiver sends the ball from the reception and at what speed, his position, as well as the position of the server in this draw, will depend. The surface of the tennis court also plays a huge role.

The article presents the directions of feed options (feed zones: A, B, C, D, E) and varieties of classifications for receiving feed in the direction from the first square.

Keywords: *feature, indicator, serve reception, highly qualified tennis players and tournament.*

Introduction. The competitive activity of highly qualified tennis players is one of the most important problems in the field of theory and practice of tennis. Specialists and practitioners are always in search of new data and research results, tools and methods for planning the technical and tactical training of tennis players, this is the relevance of our work.

Objective of the study was to identifying the number of indicators and the versatility of serving reception among the top eight tennis players in the world in 2020 according to the results of the rating of the Association of Tennis Professionals (ATP).

Methods and structure of the study. The competitive activity of highly qualified tennis players is one of the most important problems in the field of theory and practice of tennis. Specialists and practitioners are always in search of new data and research results, tools and methods for planning the technical and tactical training of tennis players, this is the relevance of our work.

Results of the study and their discussion. Table 1 shows the percentage of the number of points won at the reception of the serve from the total number of receptions of the serve. A. Karatsev had the highest percentage of winning hits in the AO tournament in the second round (64%), S. Tsitsipas (26%) in the 1/4 round had the smallest percentage of points won, who dropped out of the game after the semi-finals.

From Table 1 shows that A. Rublev (37.6%) has the minimum average value of the percentage of points won at the reception of the serve throughout the tournament, and R. Nadal (46.00%) has the best indicators. The finalists of this championship were N. Djokovic and D. Medvedev, whose final scores are 47.50 and 43.28%. In the US Open, the average value of the percentage of points won at the reception of the serve ranges from 40.20 to 43.57%, and in the Australian Open tournament - from 37.60 to 40.00%.

Table 1. *Percentage of points won at receptions (of total receptions) (%), at Australian Open and US Open tournaments 2021*

Player	Percentage of points won at admission, %														Average values, %	
	AO	USO	AO	USO	AO	USO	AO	USO	AO	USO	AO	USO	AO	USO	AO	USO
	1st round		2nd round		3rd round		4th round		1/4		1/2		Finale			
N. Djokovic	50	**53**	38	**42**	33	**46**	35	33	35	-	50	-	44	-	47,5	43,50
D. Medvedev	44	**46**	56	**44**	42	**52**	43	57	41	29	45	**31**	32	-	43,28	43,16
S. Tsitsipas	56	**53**	38	**37**	53	**35**	49	-	28	-	26	-		-	41,66	41,66
A. Karatsev	44	**48**	64	**36**	45	-	36	-	46	-	32	-		-	44,50	42.00
A. Rublev	44	**42**	32	**41**	37	**60**	44	37	31	21	-	-		-	37,60	40,20
D. Tim	51	**42**	50	**48**	30	**38**	33	48	-	**50**	-	**39**		**40**	41,50	43,57
R. Nadal	48	-	47	-	44	-	46	-	45	-	-	-		-	46,00	-
A. Zverev	38	**32**	38	**37**	45	**42**	41	57	35	**34**	-	**42**		**39**	39,40	40,42

Note:AO – Australian Open; USO – US Open.

From Table 2 shows that that the finalists of the final tournament in the final have almost the same percentage of the number of points won at the reception of the serve, however, the final performance indicator shows the advantage of the winner of the Final tournament D. Medvedev, his indicator is 40.7%, while D. Tim the indicator is 10.5% less and equals 30.2%. The lowest final indicator of the stability of the reception of the serve is observed in S. Tsitsipas, who dropped out after the 2nd round, and is equal to 30%.

From Table 3, we see that the serve consistency rates of the top eight tennis players in the world range from 24% to 47% at the 2021 Australian Open; 23% to 62% at the 2020 US Open; between 47% and 74% at the 2020 ATP Finals. The world's top serve hitters range from 7% to 12% at the 2021 Australian Open; from 7 to 24% at the US Open 2020 tournament; 9% to 21% at the 2020 ATP Finals. Serve hit rates for the world's top tennis players range from 32% to 56% at the 2021 Australian Open; 34% to 86% at US Open 2020; 59% to 89% at the 2020 ATP Finals

In Table 4 shows the average values of the reception rates at the Australian Open 2021 tournament for the eight leading tennis players in the world, where Karatsev showed the best results - 44.5%, and Rublev - the worst - 37.6%. We see above-average values in winning reception in the 1st square for Medvedev - 56% (62% for the left-hander Nadal in the 2nd square, which is a mirror image of the first for right-handers), and the worst indicator for Rublev - 34%. Above-average values in the winning reception in the 2nd square for Rublev - 66%, for Zverev - 34%, while for Tsitsipas - only 13% of points. Djokovic's second serve wins are above average with 54%, while Nadal's is only 21%.

The table shows the directions of the serving options (serving zones) and the varieties of classifications for receiving the serve in the direction from the first square by the eight leading tennis players in the world, which most often tennis players accept cross-country serves, which is 60% (from zone A - 15.20%; from zone B - 17.29%; from zone C - 19.37%; from zone D - 18.12%; from zone E - 30.0%). The reception on the line is 27.62% (from zone A - 21.71%; from zone B - 23.98%; from zone C - 28.95%; from zone D - 13.57%, and E - 11.76 %); and the least accepted

Table 2. *Percentage of points won at the reception (of the total number of receptions) (%), at the tournament of the final championship of the ATP Tour*

Group	Player	Percentage of points won at admission, %				The average value of the effectiveness of the reception of the serve, %
		1st round	2nd round	1/2	Finale	
Tokyo	N. Djokovic	48	27	28	-	34,3
	D. Medvedev	44	43	42	34	40,7
	A. Zverev	32	44	-	-	38
	D. Schwartzman	28	34	-	-	31
London	D. Tim	35	25	29	32	30,2
	R. Nadal	33	39	32	-	34,7
	S. Tsitsipas	34	26	-	-	30,0
	A. Rublev	26	43	-	-	34,5

Table 3. *Consistency, scoring and pitching efficiency metrics for the 2020 US Open, 2020 ATP Finals and 2021 Australian Open*

Player	Australian Open 2021			US Open 2020			ATP Final Tournament 2020		
	CS %	CR%	CE%	CS%	CR%	CE%	CS%	CR%	CE%
N. Djokovic	47	9	56	43	18	61	59	13	72
D. Medvedev	37	8	45	41	15	56	74	15	89
S. Tsitsipas	26	10	36	32	13	45	47	12	59
A. Karatsev	24	12	32	27	7	34	55	9	64
A. Rublev	26	9	35	23	11	34	68	21	89
D. Tim	31	7	38	62	24	86	54	13	67
R. Nadal	33	11	46	-	-	-	58	11	69
A. Zverev	29	10	39	29	9	38	49	11	60

Note: CS - feed reception stability coefficient; CR - the coefficient of effectiveness of receiving the feed; CE - coefficient of efficiency of feed reception.

Table 4. *Average values of the number of points won at the reception of the serve at the Australian Open 2021 tournament, from the top eight tennis players in the world, %*

Значения	N. Djokovic	D. Medvedev	S. Tsitsipas	A. Karatsev	A. Rublev	D. Tim	R. Nadal	A. Zverev
Serves won, %	40,7	43,3	40,2	44,5	37,6	41	42	39,4
Points won at the reception in 1 square,%	53	56	43	46	34	41	38*	46
Points won at the reception in 2 square,%	47	44	57	54	66	59	62*	54
Points won from the first serve, %	31	27	13	29	20	29	23	34
Points won from the second serve, %	54	35	46	31	36	38	21	41

** the player is left-handed; for a correct comparison with other participants in the study, it is advisable to take square 1 for square 2 in calculations and vice versa.*

in the center - 12.37% (from zone A - 20.20%; from zone B - 15.15%; from zone C - 17.17%; from zone D - 25.25%; from zone E - 22.22%) of the total number of serves in the first square.

And when we consider the technical and tactical actions of each tennis player, we see that N. Djokovic most of all takes crosses from zone E, B, along the line from zone A, B, and the least takes in the center from zone C. D. Medvedev, most of all received by crosses from zone D, E, along the line from zone C, and the least received by the center from zone B. Rublev A. most of all received by crosses from zone E, along the line from zone B, and least of all received by the center from zone B. Karatsev A. most of all received cross from zone E, C, along the line from zone B, A, and least of all received in the center from zone C, D.

The tables show the directions of the service options (service zones) and the varieties of classifications of the reception of the service in the direction from the second square of the eight leading tennis players in the world. It can be seen that most often tennis players receive cross serves, which is 55.75%, line reception is 26.00%; and the least often accepted in the center - 18.25% of the total number of serving receptions in the first square of the top eight tennis players in the world, most often tennis players receive cross-country serves.

Conclusions. The study and analysis of literary sources in the field of theory and methodology of tennis show that the percentage of serving is 17.8 ± 2.2% of the total number of hits in the match. The average value of the percentage of points won at the reception of the serve in the US Open tournament ranges from 40.20 to 43.57%; at the Australian Open tournament - from 37.60 to 40.00%, and at the ATP Finals 2020 tournament they range from 30.00 to 40.70%. Averages of percentages of serve consistency for eight of the world's top tennis players at the 2021 Australian Open tournaments; US Open 2020 and ATP Finals 2020 range from 29.33% to 61.00%, average perfor-

Table 5. *General indicators of the number of receptions in the 1st and 2nd squares of the world's leading tennis players (%)*

Submission hit zone	Line reception															
	N. Djokovic		D. Medvedev		S. Tsitsipas		A. Karatsev		A. Rublev		D. Tim		R. Nadal		A. Zverev	
	1к	2 к	1к	2к	1к	2к	1к	2к	1к	2к	1к	2к	1к	2к	1к	2к
A	11	**7**	5	**8**	6	**10**	7	**6**	5	**8**	4	**7**	4	**5**	6	**9**
B	10	**9**	3	**12**	5	**6**	8	**10**	8	**6**	6	**9**	6	**4**	7	**8**
C	9	**3**	8	**5**	3	**2**	6	**5**	7	**1**	12	**4**	10	**2**	9	**6**
D	3	**4**	2	**3**	1	**5**	5	**3**	3	**6**	4	**2**	8	**4**	4	**2**
E	1	**6**	2	**2**	2	**1**	3	**3**	4	**2**	5	**2**	7	**7**	2	**4**
	Cross-country reception															
	1к	2к	1к	2к	1к	2к	1к	2к	1к	2к	1к	2к	1к	2к	1к	2к
A	10	**9**	13	**10**	9	**7**	11	**10**	9	**5**	7	**9**	8	**11**	6	**7**
B	12	**7**	9	**4**	12	**6**	8	**9**	11	**9**	8	**9**	11	**7**	12	**6**
C	8	**14**	11	**6**	13	**9**	14	**7**	10	**10**	21	**5**	9	**6**	14	**5**
D	9	**10**	17	**11**	14	**13**	9	**9**	7	**14**	18	**16**	6	**10**	9	**12**
E	14	**21**	16	**24**	23	**19**	17	**23**	18	**17**	12	**18**	21	**22**	23	**20**
Reception in the center																
A	3	**3**	2	**6**	1	**8**	5	**4**	4	**2**	1	**6**	2	**4**	2	**8**
B	2	**2**	1	**1**	2	**2**	2	**1**	2	**3**	3	**3**	2	**6**	1	**2**
C	1	**1**	3	**3**	5	**4**	1	**3**	3	**7**	2	**5**	1	**2**	1	**3**
D	3	**3**	5	**2**	3	**3**	1	**2**	4	**4**	6	**2**	2	**7**	1	**4**
E	4	**1**	3	**3**	1	**5**	3	**5**	4	**6**	1	**3**	3	**3**	3	**4**

mance figures range from 7.66% to 19.00%; the average values of the reception efficiency indicators range from 41.66 to 77.00%.

Indicators of the variety of classifications of serve receptions in the direction from the first square of the top eight tennis players in the world in tournaments indicate that most often tennis players receive cross-country serves - 60%, reception along the line is 27.62%, and least of all they receive in the center.

The indicators of the variety of classifications of serve receptions in the direction from the second square of the eight leading tennis players in the world at tournaments show that most often tennis players receive cross-country serves, which is 55.75%, reception along the line is 26.00%, and least often they receive in the center - 18 .25% of the total number of servings.

References

1. Al Khalili M. Effektivnost priyema podachi u vedushchikh tennisistov mira [Efficiency of serve reception among the world's leading tennis players]. Ekstremalnaya deyatelnost cheloveka. 2018. No. 3. pp. 38-40.
2. Al Khalili M., Stepanova M.E., Abitaev I.O., Kulyabin A.V. [Identification of performance indicators in clay tennis]. Teoriya i praktika fizicheskoy kultury. 2020. No. 2. pp. 86-88.
3. Migalina T.M., Barchukova G.V., Brusovankin V.S. Analiz effektivnosti sovershenstvovaniya tekhnicheskoy podgotovki yunykh badmintonistov s pomoshchyu trenazhera dlya igrovykh peremeshcheniy [Analysis of the effectiveness of improving the technical training of young badminton players using a simulator for gaming movements]. Teoriya i praktika fizicheskoy kultury. 2021. No. 10. pp. 100-103.
4. Website "Championship". Available at: https://www.championat.com/

Characteristics of competitive activity of football players of various playing roles in youth national teams

UDC 796.093

PhD **E.M. Kalinin**[1,3]
V.A. Kuzmichev[1]
A.A. Khomyakova[1,2]
PhD, Associate Professor **A.V. Leksakov**[1,2]
[1]Russian Football Union, Moscow
[2]Russian State University of Physical Education, Sports, Youth and Tourism (SCOLIPE), Moscow
[3]Moscow Institute of Physics and Technology, Dolgoprudny, Moscow Region

Corresponding author: emkalinin@gmail.com

Abstract

Objective of the study was to determine the characteristics of the competitive activity of players of different roles in national teams based on data received from GPS equipment.

Methods and structure of the study. In the course of the work, the motor activity of highly qualified players (267 players), who are members of the Russian national sports teams, who played 95 ± 3 minutes, was studied, which was measured by the RealTrack System GPS tracking system, Spain, and then classified according to speed ranges, accelerations and decelerations. Significance of differences was determined using one-way analysis of variance in the Statistica 10.0 software.

Results and conclusions. According to the results of the study, the characteristics of the motor activity of football players of various roles in the conditions of competitions, which are characterized by a certain structure of movements, were obtained. Accounting for positional requirements for competitive activity in the form of various movements is necessary when planning subsequent training sessions of various directions.

Keywords: *range, accelerations, decelerations, motor actions, football.*

Introduction. Understanding the requirements for physical fitness in football requires an accurate and objective quantitative assessment of the competitive activity of players. It is well known that football is characterized by low-intensity (for example, standing and walking) and high-intensity (for example, running at high speed and sprinting) motor actions [10]. Along with specific actions (e.g. martial arts, turning, heading and kicking, dribbling), motor activities make up the overall load that a player experiences during a match.

Previously, attempts were made to quantify this load, for example, by measuring the heart rate of players [2], determining the distance and intensity of running using video analysis [7,9]. Recently, computer analysis of actions has been increasingly used [8]. All this expanded the understanding of the requirements of individual game roles and football in general. But these analyzes miss such important indicators for football in terms of load assessment as accelerations and decelerations, which can be assessed using GPS-based equipment [5]. And the data used in the analysis are usually taken from football academies or clubs [1,3], which limits information about motor activity in national teams.

Objective of the study was to determine the characteristics of the competitive activity of players of different roles in national teams based on data received from GPS equipment.

Methods and structure of the study. To achieve this goal, the motor activity of players (267 players, age - 17.7±2.0 years; body length - 182.3±5.7 cm; body weight - 73.6±6.9 kg) was studied in the sports teams of Russia, who played 95 ± 3 minutes. Motor activity was measured with a tracking system from RealTrack System, Wimu PRO, Spain, consisting of a device fixed on the player with two built-in sensors: a navigation satellite system and a GNSS / GPS positioning system with a frequency of 10 Hz, compatible with the Galileo navigation system, as well as an

accelerometer (1000 Hz), magnetometer (100 Hz), gyroscope (1000 Hz), barometer (100 Hz) [4]. All motor actions performed by the players were classified according to speed ranges [10] and acceleration and deceleration ranges [6], which we combined for their simple perception and presentation up to >2 m/s and <–2 m/s . The significance of differences was determined using one-way analysis of variance in the Statistica 10.0 software.

Results of the study and their discussion. All players were divided into roles: central defender, flank defender, central midfielder, flank midfielder, forward (central). Based on the results of the study, a profile of motor activity was compiled, classified by speed and acceleration for each role (Tables 1, 2).

Central defenders are characterized by lower values: total distance volume ($p<0.05$, except for the attacker - $p>0.5$), maximum speed ($p<0.01$, except for the central midfielder and flank midfielder - $p>0.1$), high-intensity running ($p<0.001$), sprinting ($p<0.001$, except for the central midfielder – $p>0.5$), number ($p<0.001$ compared to the central midfielder) and volume of accelerations ($p<0.01$ compared to the flank defender and central midfielder), braking ($p<0.001$ compared to wingback and central midfielder), and intensity of braking ($p<0.05$, except for central midfielder).

Wing defenders are characterized by significantly higher values: maximum speed, “sprint” when compared with the central defender and central midfielder ($p<0.05$). At the same time, the number of accelerations of the flank defenders is lower than that of the central midfielder ($p<0.05$), and the volume does not differ ($p>0.05$). Also, flank defenders are characterized by a greater number and intensity of braking than a central defender ($p<0.001$).

Central midfielders are characterized by higher values: the volume of the total distance compared to players of other roles ($p<0.001$), high-intensity running compared to the central defender ($p<0.001$), the number of accelerations compared to the central defenders and flank defenders ($p<0.05$), acceleration volume compared to central defenders ($p<0.001$), braking volume ($p<0.05$) and highest braking volume ($p<0.001$ except H–$p>0.1$), lowest maximum speed and sprint volume , the differences are significant ($p<0.05$), except for the central defender.

Wing midfielders are characterized by identical values as wingbacks, since they perform movements on the flanks. Wing midfielders perform one of the largest volumes of acceleration, but at the same time a smaller amount of braking (significant differences, $p<0.05$, between central midfielders), and are characterized by the highest braking intensity (significant differences, $p<0.05$, when compared with a central defender and central midfielder).

Forwards are characterized by significantly higher values: maximum speed, sprint volume ($p<0.05$, except for flank defenders and flank midfielders), intensity of braking ($p<0.05$ when compared with a central defender) and the lowest values of acceleration and braking ($p<0$ .05 when compared to the central midfielder).

Conclusions. According to the results of the study and comparative analysis of the players of the Russian national teams of different roles, it was found that the players of different positions perform motional actions peculiar only to them during the game. The greatest amount of movement in a sprint is performed by flank players and attackers, who are characterized by the highest maximum speed that the playing space allows them to achieve and high maximum braking values. Central midfielders have the highest amount of total distance, acceleration and braking, and the lowest top

Table 1. *Parameters of intense motor activity of football players of various roles, classified by speed*

Role*	Total distance, m	Running at 19.8-25.2 km/h (m)	> 25.2 km/h (m) «sprint»	Speed, max., km/h
	x±σ	x±σ	x±σ	x±σ
Central defender (n=92)	10070±695	358±120	74±55	29,5±1,7
Flank defender (n=66)	10690±598$	567±109$	163±84$♣	30,9±1,8$♣
Central midfielder (n=67)	11468±1043$#¶§	602±214$	84±54	29,2±1,6
Flank midfielder (n=24)	10840±737$	606±142$	153±84$♣	30,6±1,5♣
Forward (n=18)	10428±767	602±161$	204±81$♣	31,3±1,7$♣
All (n=267)	10667±948	510±187	115±81	30,0±1,9

Note: Differences are significant at p<0.05: $ – more than the central defender; # - more than a flank defender ♣ - more than a central midfielder; ¶ – more than a flank midfielder; § - more than a forward.*

Table 2. *Parameters of intense motor activity of football players of different roles, classified by accelerations*

Role*	Accelerations >2 м/с², x±σ			Braking >2 м/с², x±σ		
	Times	Meters	Max.	Times	Meters	Max.
Central defender (n=92)	203±37	1395±260	5,27	193±33	951±225	–6,37
Flank defender (n=66)	207±30	1568±252$	5,23	219±31$	1169±185$	–6,79$
Central midfielder (n=67)	225±42$#	1618±325$	5,11	236±39$#¶§	1316±263$#¶	–6,60
Flank midfielder (n=24)	207±28	1621±214	5,12	204±27	1047±136	–7,39$♣
Forward (n=18)	198±38	1539±252	5,33	199±37	1128±259	–7,17$
All (n=267)	210±37	1522±286	5,21	212±38	1115±263	–6,68

Note: The differences are significant at p<0.05: $ – more than the central defender; # - more than a flank defender; ♣ - more than a central midfielder; ¶ - more than a flank midfielder; § - more than a forward.*

speed due to limited free space in the center of the field. Central defenders demonstrate the least amount of motor activity both in terms of acceleration and braking, and in terms of speed.

References

1. Gasanova N.B., Zaitseva T.V., Zolotarev A.P. et al. Sravnitelnyy analiz pokazateley dvigatelnoy aktivnosti vysokokvalifitsirovannykh futbolistok raznykh igrovykh amplua v usloviyakh sorevnovatelnoy deyatelnosti [Comparative analysis of indicators of motor activity of highly qualified female football players of different game roles in conditions of competitive activity]. Uchenye zapiski universiteta im. P.F. Lesgafta. 2020. No. 3. pp. 97-101.
2. Godik M.A., Skorodumova A.P. Kompleksnyy kontrol v sportivnykh igrakh [Complex control in sports games]. Moscow: Sovetskiy sport, 2010. 336 p.
3. Shergin A.V. Upravleniye protsessom sportivnoy podgotovki futbolistov vysokoy kvalifikatsii s ispolzovaniyem pokazateley dvigatelnoy aktivnosti sorevnovatel'noy deyatelnosti [Management of the process of sports training of highly qualified football players using indicators of motor activity of competitive activity]. Vestnik Tambovskogo gosudarstvennogo universiteta. 2012. No. 11. pp. 208-212.
4. Bastida-Castillo A., Gómez-Carmona C.D., Sánchez E., Ortega J.P. Comparing accuracy between global positioning systems and ultra–wideband–based position tracking systems used for tactical analyses in soccer. European journal of sport science. 2019. No. 19. pp. 1157-1165.
5. Dalen T., Ettema G., Hjelde G. et al. Player load, acceleration, and deceleration during forty–five competitive matches of elite soccer. The journal of strength and conditioning research. 2016. Vol. 30. pp. 351-359.
6. Dalen T., Loras H., Hjelde G. H., Kjosnes T.N. Accelerations – a new approach to quantify physical performance decline in male elite soccer? European journal of sport science. 2019. Vol. 19. pp. 1015-1023.
7. Castellano J., Alvarez–Pastor D., Bradley P.S. Evaluation of research using computerised tracking systems (Amisco and Prozone) to analyze physical performance in elite soccer: a systematic review. Sport medicine. 2014. Vol. 44. pp. 701-712.
8. Osgnach C., Poser S., Bernardini R., Rinaldo R. Energy cost and metabolic power in elite soccer: a new match analysis approach / Medicine and science in sports and exercise. 2010. Vol. 42 (1). pp. 170-178.
9. Otero–Saborido F.M., Aguado–Méndez R.D., Torreblanca-Martínez V.M. et al. Technical–tactical performance from data providers: a Systematic review in regular football leagues. Sustainability. 2021. Vol. 13. pp. 1-14.
10. Rampinini E., Coutts A.J., Castagna C., Sassi R. Variation in top level soccer match performance. International journal of sports medicine. 2007. Vol. 28. pp. 1018-1024.

Prediction of adverse changes in the functional state of the heart in junior athletes

UDC 796.01:612

PhD **A.S. Kryuchkov**[1]
PhD **M.A. Dikunets**[1]
G.A. Dudko[1]
E.V. Buchina[1]
[1]Federal Scientific Center of Physical Culture and Sport (VNIIFK), Moscow

Corresponding author: kriuchkov.a.s@vniifk.ru

Abstract

Objective of the study was to evaluate the prognostic significance of markers for the early diagnosis of cardiac overstrain.

Methods and structure of the study. A survey was made of an athlete of the Russian junior national cross-country skiing team (18 years old, 175.5 cm, 68.2 kg, 6 years of experience), who complained of low performance, which had been going on for the past few months. Functional testing of the athlete was carried out on a h/p/cosmos venus 200/100r running treadmill (h/p/cosmos sports & medical gmbh, Germany) with registration of oxygen consumption using the MetaMax 3B ergospirometry system (Cortex, Germany). Before and after the treadmill test, a standard 12-lead ECG was recorded on a Cardisuny C300 electrocardiograph, Fukuda Denshi, Japan. Analysis of blood samples taken by venipuncture was performed on analyzers cobas c 311 and cobas e 411 (Roche, Germany) and an ultrafast liquid chromatography-mass spectrometer with a triple quadrupole LCMS-8060 (Shimadzu, Japan).

Results and conclusions. The ECG after the treadmill test showed signs of a violation of the processes of repolarization of the posterior wall of the myocardium. Analysis of the activity of nonspecific markers and concentrations of cardiospecific proteins showed that the most sensitive, specific and prognostic marker for the detection of minor violations of the contractility of the left ventricle is the N-terminal polypeptide of natriuretic hormone.

Keywords: *cardiovascular system, heart strain, biomarker, predictive value, sensitivity.*

Introduction. Cross-country skiing, as a sport, places increased demands on the cardiovascular system (CVS) of athletes. At the same time, to maintain the speed of movement along the distance, skiers must have high aerobic capabilities of skeletal muscles. In particular, the most important element of tissue respiration and energy supply of muscle contractions is oxygen. In this case, the CVS is one of the leaders in ensuring its delivery to the working muscles of athletes [1]. Highly qualified skiers of the level of the Russian national team in laboratory conditions demonstrate high rates of maximum oxygen consumption, reaching 82–84 ml/kg/min, which indicates, among other things, the high functionality of the CVS in supplying working muscles with oxygen [8]. The stroke volume of the heart in professional skiers at rest reaches 100–140 ml, which is one of the necessary conditions for ensuring a high level of minute volume of blood flow, as well as economizing the work of the heart in extreme conditions of training and competitive activities.

The process of preparing skiers, starting from the stage of in-depth sports specialization, provides for the inclusion of an accentuated training effect, the purpose of which is to expand the functional capabilities of the CVS. In athletes involved in endurance sports, myocardial hypertrophy usually develops both due to the expansion of its cavities and due to thickening of the walls [7]. Unlike skeletal muscles, which are able to passively recover after the cessation of training exposure, the heart muscle never stops working throughout a person's life, developing tension and maintaining the body's vitality. In addition, when performing high-intensity loads, a diastolic defect can occur - a state of the heart muscle in which it does not

have time to relax, as it needs to contract again [3]. A diastolic defect occurs, as a rule, at a heart rate (HR) exceeding 180 beats / min. Cardiac muscle cells at this level of heart rate begin to work under anaerobic conditions - they accumulate metabolic products and increase the level of free radicals [9]. The latter oxidize phospholipids and damage cell membranes, which ultimately provokes the death of cardiomyocytes and, as a result, myocardial dystrophy [5].

High-intensity loads pose a particular danger to the heart of young athletes aged 14-18, since the increase in heart volume at this age is significantly ahead of the increase in the diameter of the aorta, while due to the age-related increase in body length, the vessels are stretched and narrowed. In addition, the rate of growth of heart valves at this age stage of development of the body is inferior to the rate of change in the size of the myocardium, which leads to asynchrony in the work of the papillary muscles of the heart [2]. With such "immaturity" of the cardiorespiratory system, the heart of young athletes experiences increased stress when performing physical exercises, and especially when working in cyclic high-speed motor modes. All of the above makes increased demands on the control of changes in the state of the cardiovascular system in young skiers.

One of the varieties of such control is biochemical monitoring. The main requirements for it are the prognostic value and efficiency of obtaining biochemical parameters, which allow to identify and prevent possible negative changes in the cardiovascular system of athletes [6].

In our opinion, today, in pursuit of the efficiency and availability of obtaining biochemical parameters in the conditions of the training process, assessing the state of the athlete's CVS, the prognostic value of biomarkers, which allow identifying pre-pathological changes in this system of the body, has faded into the background. In particular, currently in the practice of biochemical monitoring, markers are used that do not allow one to unambiguously judge possible morphological changes occurring in the heart muscle, or have a weak sensitivity in response to functional overload of the myocardium. Therefore, their use for predicting a possible breakdown in the adaptation of the athlete's heart to the proposed loads is not possible. This hypothesis is confirmed by the literature data, which indicate the unequal prognostic value of biochemical markers that reflect the degree of myocardial tension in athletes.

Accordingly, for the timely diagnosis of preclinical manifestations of overvoltage, it is important to choose more informative and highly specific biochemical markers that respond to structural changes in the heart muscle of athletes.

Objective of the study was to evaluate the prognostic significance of markers for the early diagnosis of cardiac overstrain.

Methods and structure of the study. The observation involved an athlete of the Russian junior national skiing team (18 years old, 175.5 cm, 68.2 kg, 6 years of experience), who signed an informed consent to participate in the survey. The sportsman complained about low working capacity, which persisted for the last few months prior to the examination. He argued that an increase in the rest period between high-intensity loads within a weekly microcycle did not lead to the restoration of the level of physical condition. The study was approved by the ethics committee of the Federal Scientific Center of Physical Culture and Sport.

To assess the level and identify possible reasons for the decline in performance, the athlete was asked to undergo functional testing (step test) on a running treadmill h/p/cosmos venus 200/100r (h/p/cosmos sports & medical gmbh, Germany) with registration of the level of oxygen consumption at aerobic (AeT) and anaerobic (ANOT) thresholds using the Meta Max 3B ergospirometry system (Cortex, Germany). The initial running speed in the step test was 6 km/h for 2 minutes, then every subsequent minute it increased by 0.5 km/h at a constant treadmill blade inclination angle (10 degrees) until the athlete reached the level of ANOT. Before and after the stepwise test (5 min recovery), the functional state and autonomic orthostatic stability of the athlete's CVS were assessed by ECG diagnostics using a 12-channel Cardisuny C300 electrocardiograph (Fukuda Denshi, Japan).

Prior to functional testing, after a 12-hour fast and 24-hour absence of training, the athlete's blood was taken from the cubital vein into vacuum tubes with a clotting activator and a separator gel for biochemical analysis of serum (Greiner Bio One, Austria). The activity of AST, ALT, CPK and the concentration of CPK-MB, glucose, urea, triglycerides were measured on an automatic biochemical analyzer cobas c 311 (Roche/Hitachi, Japan). For the quantitative determination of myoglobin, N-terminal natriuretic hormone polypeptide (NT-proBNP), and troponin T (cTnT), a cobas e 411 automated immunochemical analyzer (Roche, Germany) was used. Quantitative determination of testosterone and cortisol was performed on an ultra-fast liquid chromato-mass spectrometer with a triple quadrupole LCMS-8060 (Shimadzu, Japan).

Results of the study and their discussion. The indi-

cators of oxygen consumption at the power of AeT and ANOT were 56 and 68 ml/kg/min, respectively, which indicates a fairly high level of aerobic capacity of both slow and fast muscle fibers. The heart rate indicators for AeT and ANOT were 156 and 182 beats/min, respectively, and did not go beyond the limits of normal values for this athlete. It should be noted that at the level of ANOT, an athlete develops a heart rate at which a diastole defect can already be observed, and at the same time, such loads occur from one to three times in a weekly microcycle, and their duration ranges from 10 to 40 minutes of pure work time. In any case, under load, we did not reveal any deviations from the individual pulse corridors in the athlete. The characteristics of the ECG obtained before functional testing also did not reflect abnormalities in the work of the heart, however, after the stepwise test, signs of a violation of the processes of repolarization of the posterior wall of the myocardium were revealed.

Biochemical markers included in the stage comprehensive examination program: hemoglobin, hematocrit, testosterone, cortisol, urea, ALT, AST, CPK, iron, glucose, triglycerides and lactate, used to assess mechanical damage to skeletal muscle cells, features of metabolic adaptation under load, the depth of impact, the course of the recovery process and the level of training of the athlete did not go beyond the boundaries of the reference intervals established by us for this sport, which can serve as a criterion for the adequacy of the reactions of the athlete's body to loads. Analysis of the activity of non-specific markers (ALT, AST) did not reveal damage to skeletal muscle and liver cells, as well as a pre-pathological state of the skier's heart muscle under the influence of mechanical or metabolic stress.

The concentrations of cardiospecific proteins CPK-MB, myoglobin and cTnT did not go beyond the reference values, while the level of NT-proBNP was above the upper limit of the reference interval. The main stimulus for natriuretic peptide release is myocyte stretch and atrial volume overload, and the main signal for entry into the bloodstream is an increase in myocardial tension [4].

Conclusions. Despite the fact that the adaptation of the heart of athletes involved in endurance sports to the training load is associated with an increase in the thickness of the left ventricular wall, which is compatible with hypertrophic cardiomyopathy, for young athletes, increased heart stress can become a real threat of adaptation failure. Non-specific markers used in the program of stage complex examination of athletes do not allow characterizing the pre-pathological state of the heart muscle with sufficient reliability. At the same time, cardiospecific markers for detecting the presence of CVS overvoltage, which are widely used in laboratory diagnostics, have different sensitivities.

As a result of the study, we have shown that NT-proBNP, which is secreted in response to cardiomyocyte stress and reflects myocardial stress in the left ventricular wall, has the greatest prognostic significance.

Financing. The work was carried out within the framework of the state task of the Federal Scientific Center of Physical Culture and Sport (VNIIFK), No. 777-00026-22-00 (subject code No. 001-22/3).

References

1. Volkov N.I., Oleinikov Bioenergetika sporta [Bioenergetics of sports]. Moscow: Sovetskiy sport publ., 2011. 210 p.
2. Lyakso E.E., Nozdrachev A.D., Sokolova L.V. Vozrastnaya fiziologiya i psikhofiziologiya [Age physiology and psychophysiology]. Moscow: Yurayt publ., 2020. 396 p.
3. Meyerson F.Z. Adaptatsiya, deadaptatsiya i nedostatochnost serdtsa [Adaptation, deadaptation and heart failure]. Moscow: Medicina publ., 1978. 343 p.
4. Dorofeikov V.V., Sitnikova M.Yu., Lelyavina T.A. et al. Mozgovoy natriyureticheskiy peptid v kardiologii i kardiokhirurgii [Brain natriuretic peptide in cardiology and cardiac surgery]. Meditsinskiy alfavit. 2014. Vol. 1. No. 3. pp. 49-56.
5. Seluyanov V.N., Myakinchenko E.B., Gavrilov V.B. Sportivnaya adaptologiya. Fizicheskaya podgotovka v tsiklicheskikh vidakh sporta [Sports adaptology. Physical training in cyclic sports]. Moscow: TVT Divizion publ., 2021. 524 p.
6. Brancaccio P., Maffulli N., Buonauro R., et al. Serum enzyme monitoring in sports medicine. Clin. Sports Med. 2008. 27(1). pp.1-18.
7. 7. McCann G.P., Muir D.F., Hillis W.S. Athletic left ventricular hypertrophy: long-term studies are required. Eur. Heart J. 2000. 21(5). pp. 351-353.
8. 8. Myakinchenko E.B., Kriuchkov A.S., Adodin N.V., et al. One-year periodization of training loads of Russian and Norwegian elite cross-country skiers. J. Hum. Sport Exerc. 2021. 16(2). pp.701-710.
9. 9. Su Q.S., Zhang J.G., Dong R. et al. Comparison of changes in markers of muscle damage induced by eccentric exercise and ischemia/reperfusion. Scand. J. Med. Sci. Sports. 2010. 20(5). pp. 748-756.

Cardiometric characteristics of physical load in men and women aged 50-59 years when performing tests of the all-russian physical and sports complex "ready for labor and defense"

UDC 796.01:61

PhD **E.A. Zyurin**[1]
Dr. Biol. **T.F. Abramova**[1]
Dr. Hab. **A.P. Matveev**[1]
E.N. Petruk[1]
[1]Federal Scientific Center of Physical Culture and Sport (VNIIFK), Moscow

Corresponding author: volodchenkova.e.n@vniifk.ru

Abstract

Objective of the study was to identify the cardiometric characteristics of physical activity when performing tests of the All-Russian physical culture and sports complex "Ready for Labor and Defense" (GTO).

Methods and structure of the study. We studied the response of the cardiovascular system (CVS) to physical activity in the period of preparation for testing the GTO and directly during testing. The experiment involved 50 men and 50 women aged 50 to 59 years with different levels of physical activity. Heart rate indicators during training sessions and testing were recorded using individual "wearable" fitness gadgets. Contradictions were revealed between the zones of intensity of loads during preparation and testing, the most energy-intensive types of tests were identified, these include endurance exercises and "swimming". The obtained data of the CVS response to physical activity in the classes in preparation for testing and when performing GTO tests will optimize the pedagogical process of training, taking into account the functional preparedness of the population and the level of complexity of the tests performed.

Keywords: *adult population, heart rate, load, physical fitness, tests of the GTO complex.*

Introduction. Improving the physical health of the population is one of the fundamental tasks of the state policy of the Russian Federation [6]. The participation of the population in various physical culture and sports and health and fitness activities, including the events of the All-Russian Physical Culture and Sports Complex “Ready for Labor and Defense” (GTO), is designed to help maintain the physical activity of the population, aimed at maintaining health, increasing the number of citizens , systematically engaged in physical culture and sports, to increase the level of physical fitness of the population through the improvement of physical qualities, maintaining working capacity and slowing down the influence of age-related changes on the regression of vital motor skills and abilities.

When choosing physical exercises to prepare for testing, each person sets himself two tasks: prepare for testing and, while maintaining his “sports” form, perform all types of tests in accordance with the standards of the age group. The implementation of the test preparation program contributes to an increase in physical activity in the weekly cycle of the motor regime, proportional to the increase in physical activity (PA).

The control of adaptive responses of the body to physical activity in mass physical culture is carried out mainly by heart rate (HR), since pulse monitoring is the most accessible control method that allows measurements, both by palpation and using remote means. The level and response of heart rate to physical activity make it possible to objec-

tively judge the functional state of a person's cardiovascular system, individual load tolerance directly determining physical performance [1, 2]. At the same time, it should be taken into account that the goal of preparing for testing the GTO is not the maximum result in individual types, but the optimal and comprehensive improvement of physical qualities in certain types of tests in accordance with the number of types of tests and standards that ensure the receipt of an insignia [4]. Due to the fact that the adult population prepares for testing mostly on their own, the study of a person's CVS response to various physical exercises during the testing of the GTO complex is relevant from the standpoint of individualizing loads, determining the boundaries of the functional capabilities of one's body, and optimizing the construction of the training process.

Objective of the study was to identify the cardiometric characteristics of physical activity when performing tests of the All-Russian physical culture and sports complex "Ready for Labor and Defense" (GTO).

Methods and structure of the study. We studied the CVS response to various physical activities during the period of preparation for the tests and directly in testing, including the recovery time, in men and women aged 50-59 with different levels of motor activity, admitted to the tests of the complex. The studied contingent belongs to the age category of the IX stage of the GTO (average age - 54 and 55 years) and is characterized by average values of physiological parameters normal for this age group: body mass index - 27.7 and 26.4; the value of heart rate at rest - 70 beats / min and 72 beats / min. The calculated values of maximum heart rate (HR_{max}) in terms of average age correspond to 166 beats/min for men and 165 beats/min for women [8].

Preparation for testing was carried out in the course of a comprehensive self-training according to individual programs, including the number of compulsory physical exercises and exercises of choice, which will allow you to get a badge of distinction. The duration of classes is at least 1.5 hours, two to four classes per week. The assessment of physical readiness was carried out in accordance with the levels of complexity of the GTO [5]. Heart rate registration during training sessions and testing was carried out using individual "wearable" fitness gadgets (Samsung Health; Huawei Health; Mi Fit and Mi Health; Apple Health). The results of the timing were transmitted after each lesson and processed by the method of mathematical statistics (Excel 2010).

Results of the study and their discussion. An analysis of the indicators of the response of heart rate to physical activity in persons of both sexes of the second mature age made it possible to identify the pulse limits of the intensity of the load during training for the performance of GTO tests: in men, the average heart rate values range from 85.9 ± 3.2 beats / min to 143 .9±16.8 beats/min; in women - from 89.1±7.8 beats/min to 122.4±13.1 beats/min. Comparison of the obtained results with the value of HR_{max} for this age showed that the pulse limits of the load in men cover 52-87% of HR_{max}, in women - from 54-74% (Table 1) [8].

The data obtained make it possible to interpret physical activity during the entire period of preparation for testing as work within the boundaries of moderate power: the minimum load corresponds to the recovery zone, the maximum - to the aerobic power zone [3,7]. Work within these limits of heart rate is characterized by a stable state of aerobic metabolism - increased respiration and blood circulation in proportion to the intensity of work and the absence of accumulation of anaerobic decay products [3]. At the same time, it has been shown that performing a load with an intensity exceeding the maximum age-related pulse (approximately 166 beats/min for men and 165 beats/min for women) requires an increase in the duration of the recovery (rest) period to three to four days, which limits the

Table 1. *The reaction of the cardiovascular system to physical activity in the process of preparing for testing in men and women aged 50-59 years when performing various physical exercises included in the content of the GTO complex (n=100)*

Gender	X HR in the process of training for the performance of GTO tests (beats / min)			
	HR_{min}		R_{max}	
	abs	Percentage of HR_{max}	abs	Percentage of HR_{max}
Men (n=50)	85,9±3,2	51,7%	143,9±16,8	86,7%
Women (n=50)	89,1±7,8	54%	122,4±13,1	74,1%

Table 2. *Responses of the cardiovascular system to physical activity during the performance of tests of the GTO complex among men and women aged 50-59 years*

Contingent	Indicators	Running 2 km	High/low bar pull-ups	Flexion and extension of the arms in emphasis lying on the floor	Lean forward	Raising the body from a prone position	Skiing 5/2 km	Swimming 50m
Men	X fulfilled standard ±m	13,0±1,0	5,7±2,8	10,9±4,2	1,2±2,8	17,9±5,7	36,4±9,6	1,20±0,2
	X heart rate when fulfilling the standard (beats / min) ± m	160,8±5,4	94,0±14,13	111,2±7,4	70,8±9,3	110,6±19,6	160,7± 4,9	157,3±8,4
Women	X fulfilled standard ±m	18,50±1,3	6,9±4,3	5,7±2,4	8,3±1,1	13,5±4,4	25,20±1,8	1,30±0,1
	X heart rate when fulfilling the standard (beats / min) ± m	162,3±6,3	122,4±6,4	122,5±6,8	73,9±6,6	133,8±5,5	165,2±6,6	157,5±13,4

number classes no more than twice a week, thereby lengthening the period of preparation for testing, in some cases provoking a refusal to further prepare for testing.

Thus, the training of the adult population aged 50-59 is characterized by low physical loads of a complex nature, stimulating the development of various physical qualities and motor skills.

At the same time, the response of the cardiovascular system to physical activity during tests exceeds that in preparation for testing: in men it is 71-161 beats/min, in women it is 74-165 beats/min, which approaches the upper limits of HR_{max} at this age (Table 2).

It is important to note the different costs of GTO tests: the most energy-intensive types are 2 km running, skiing and swimming.

When performing the tests “running 2 km”, “running skiing 2/5 km” in women, the average heart rate is within the limits of heart ratemax, in men it is 97% of heart ratemax. At the same time, for women, the result in the 2 km run according to the standards of the IX (1) stage corresponds to a level below the bronze mark, in the IX (2) stage - to the bronze mark; in cross-country skiing - to the silver mark. For men, in the 2 km run of the IX (1) stage, the result corresponds to a silver sign, in the IX (2) stage - to a bronze sign: in skiing in the IX (1) stage - to a silver sign, in IX (2) stages - to a gold one.

The test “swimming 50 m” is characterized by almost the maximum age level of heart rate (95% for men and women). The average value of the standard for men of the IX level is within the limits of the silver mark, for women in the IX (1) stage it corresponds to the gold mark, and in the IX (2) stage - to the silver mark.

When performing the tests “pulling up on a high / low crossbar”, “flexion and extension of the arms in an emphasis lying on the floor”, “lifting the body from a prone position”, a slight increase in heart rate was observed in people of both sexes within a moderate load zone.

Conclusions. In the course of the study, it was found that the fulfillment of test standards (tests) leads to an increase in heart rate to maximum and above maximum values, creating a risk of a strained CVS reaction and injury, limiting the possibility of performing GTO tests, especially in endurance tests.

Taking into account the cardiometric characteristics of physical activity when performing tests of the GTO complex will allow you to effectively create training training programs based on the level of functional fitness of men and women aged 50-59, which will contribute to the performance of tests for distinctions with the formation of positive motivation for the further continuation of systematic physical exercises, maintaining the achieved level of physical and functional fitness.

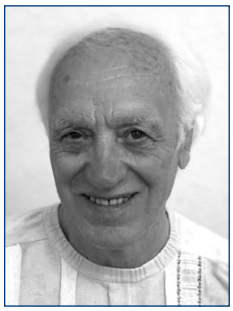
The work was carried out within the framework of the state task of the Federal Scientific Center of Physical Culture and Sport (VNIIFK), No. 777-00005-21-00 (subject code No. 001-21/4).

References

1. Bodin O.N., Polosin V.G., Balakhonova S.A. Prognozirovaniye maksimalnoy chastoty serdechnykh sokrashcheniy dlya rascheta intensivnosti fizicheskikh nagruzok [Forecasting the maximum heart rate for calculating the intensity of physical activity]. Izmereniye. Monitoring. Upravleniye. Kontrol. 2013. No. 1 (3). pp. 50-54.
2. Vorobyov L.V. Analiz i kontrol serdechnoy deyatelnosti pri fizicheskikh nagruzkakh [Analysis and control of cardiac activity during physical exertion]. Mezhdunarodnyy zhurnal prikladnykh i fundamentalnykh issledovaniy. 2016. No. 8-3. pp. 378-382. Available at: https://applied-research.ru/ru/article/view?id=10038 (date of access: 03.04.2022).
3. Kots Ya.M. Sportivnaya fiziologiya [Sports physiology]. Textbook for institutes of physical culture. Moscow: Fizkultura i sport publ., 1998. pp. 25-40.
4. Poliatlon [Polyathlon]. Study guide. Tyumen: Avanpost publ., 2001. pp. 91-94
5. Ob utverzhdenii gosudarstvennykh trebovaniy Vserossiyskogo fizkulturno-sportivnogo kompleksa «Gotov k trudu i oborone» [On approval of the state requirements of the All-Russian physical culture and sports complex “Ready for work and defense”]. Order of the Ministry of Sports of the Russian Federation of February 12, 2019 No. 90. Available at: https://www.garant.ru/products/ipo/prime/doc/72093512/ (date of access: 03.04.2022).
6. Ob utverzhdenii strategii razvitiya fizicheskoy kultury i sporta v Rossiyskoy Federatsii na period do 2030 goda [On approval of the strategy for the development of physical culture and sports in the Russian Federation for the period up to 2030]. Decree of the Government of the Russian Federation dated November 24, 2020. No. 3081-r. Available at: http://static.government.ru/media/files/Rr4JTrKDQ5nANTR1Oj29BM7zJBHXM05d.pdf (date of access: 02.17.2022).
7. Jansen Peter CHSS, laktat i trenirovki na vynoslivost [Heart rate, lactate and endurance training]. Murmansk: Tuloma publ., 2006, pp. 34-38.
8. The science of exercise prescription: Martti Karvonen and his contributions. BCMJ. Vol. 59, No. 1, January February 2017. pp. 38–41.

Manifestation of the maximum motor possibilities of a human in run in the second phase of ontogenesis

UDC 796.012.412.5



Dr. Hab. **V.D. Kryazhev**[1]
PhD, Associate Professor **M.V. Eremin**[2]
PhD, Associate Professor **E.D. Bakulina**[3]
PhD, Associate Professor **A.N. Lutkov**[4]
[1]Federal Scientific Center of Physical Culture and Sport (VNIIFK), Moscow
[2,3]Russian State Social University, Moscow
[4]Penza State University, Penza

Corresponding author: kryzev@mail.ru

Abstract

Objective of the study was to identify the features of changes in the indicators of maximum motor capabilities in running among veterans who regularly go in for sports based on their personal achievements in the age range of 35–105 years.

Methods and structure of the study. Data from the IAAF Sheet World Athletics World Record for Veterans in the 100m and 5,000m dashes were used, reflecting the display of speed and endurance.

Results and conclusions. In the age range of 35–75 years, the indicators of the maximum values of motor abilities in running decrease according to a linear law, approximately by 6–9% for each age decade or by 0.6–0.9% annually. After the age of 75, the values of both maximum speed and endurance indicators begin to decrease much more intensively. In the range from 75 to 85 years, this decrease is from 12.1 to 27.9%. In the age range of 85-95 years, an even more intense decrease in maximum motor abilities is observed: 26.2-40.6%. After the age of 95, the amount of regressive development of motor abilities can exceed 5% per year. The obtained patterns of the dynamics of maximum motor abilities in running (maximum speed and endurance) reflect the general biological pattern of the regressive development of locomotor functions in the second phase of human ontogenesis.

Keywords: *motor abilities, human ontogeny, sports veterans, athletics, 100m run, 5000m run, elderly people.*

Introduction. The ability to move is given to man by nature. This innate ability to move is called a motor or locomotor function and is described by motor capabilities, which are understood as a complex of morphofunctional features of the body, physical qualities, motor skills, abilities and health [2]. Motor function develops naturally from birth, up to about 18 years of age 20 years, and can be stimulated by sports exercises [1, 2]. After 30-35 years of age, a process of decrease in motor abilities is observed, which is especially noticeable after 60-65 years [1, 2, 4]. Professor V.K. Balsevich [1]. Although a lot of work has been devoted to the study of locomotor function after the age of 65, nevertheless, researchers have encountered significant difficulties. This is due to the fact that motor function is affected by its natural decline with age, as well as a sedentary lifestyle and diseases [2,4,5]. Recently, the highest achievements in athletics have been recorded among sports veterans in the age range of 35–105 years [3]. This opens up new possibilities in the study of motor function and its changes with age. It was assumed that the regularities of the dynamics of motor abilities at an older age can be identified by studying the maximum indicators obtained when setting world records by track and field veterans who continue to play sports regularly almost until the end of their lives.

Objective of the study was to identify the features of changes in the indicators of maximum motor capabilities in running among veterans who regularly go in for sports based on their personal achievements in the age range of 35–105 years.

Methods and structure of the study. We used data on the highest world achievements in athletics among veterans in the 100-meter run, reflecting the manifestation of speed, and in the 5000-meter run, reflecting the manifestation of endurance. For this, the IAAF Sports Veterans List was used [3]. Since the

result in a 100-meter run consists of several factors - reaction time, starting acceleration, the achieved running speed at a distance and its decrease at the finish line - only the Vmax indicator was used in the study - running speed in the middle of the distance, which is close to the maximum speed. This value in practice is estimated by a simple formula: Vmax = 100 / (T-Tlosses). For highly skilled runners, Tlosses is typically around 1 second. It was assumed that the loss of time for acceleration and at the finish line increases with age according to the same law as a sports result changes. Therefore, the formula for estimating Vmax in a 100m run was as follows: Vmax =100/(T100-0.1T100), where T100 is a sports result, s. To assess endurance, the distance running speed indicator is used, calculated by the formula: Vav = 5000m/T5000. The determination of the regression relationships of the studied indicators with age, as well as the assessment of their reliability, was carried out on the basis of the Excel application package.

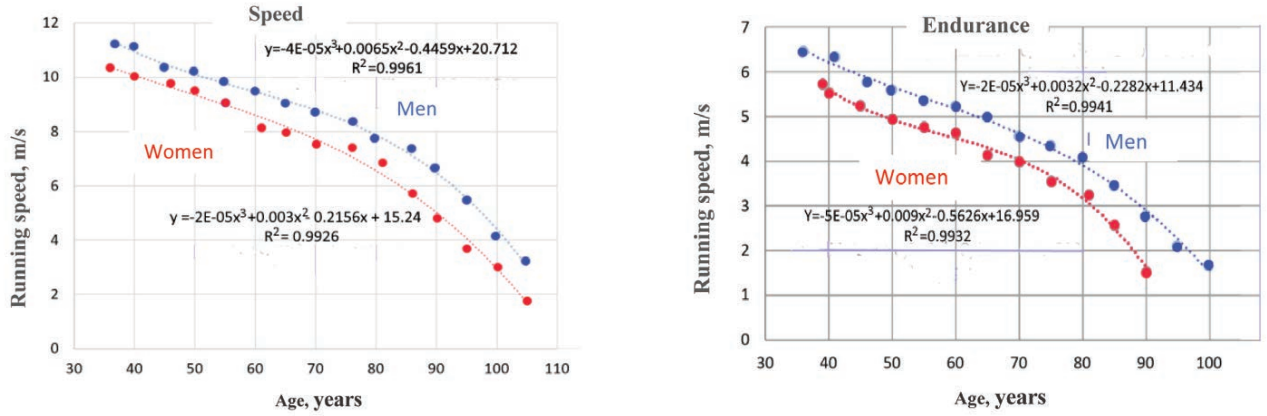
Results of the study and their discussion. It was revealed that the manifestation of maximum speed capabilities and endurance changes approximately according to the same law in the range of 35–105 years, with a high level of reliability described by a polynomial of the third degree (Table 1, figure).

The decrease in the studied parameters with age occurs unevenly. In the period of 35–75 years, the indicators of motor abilities decrease according to a linear law, approximately by 6–9% per decade or by 0.6–0.9% annually (Table 2). This pattern corresponds to the previously obtained by V.K. Balsevich [1] data on the regressive development of locomotor function at the age of 40–65 years. After the age of 75, the indicators of both maximum speed and endurance begin to fall much more intensively. From 75 to 85 years, this decline is from 12.1 to 27.9% per decade. In the age range of 85–95 years, the decrease in maximum motor abilities is even more intense: 26.2–40.6%. After 95 years of age, the amount of regressive development of motor abilities exceeds 5% per year. According to reviews [4–6], strength and speed of muscle contraction decrease with age, motor reaction time increases, and testosterone levels decrease by about 10% every decade in the range of 40–65 years. This explains the linear decrease in running speed. Age-related changes leading to a decrease in lung capacity by about 1% per year, a decrease in the ability to maximize oxygen consumption, a decrease in cardiac performance, an increase in resistance to peripheral blood flow, a decrease in the conductivity of the nerve fiber of the lower extremities and mitochondrial oxidative capacity by about 10% per decade explains a linear decrease in the manifestation of endurance at the age of 35 to 75 years [4-6].

However, a sharp drop in motor abilities after 75 years has not yet received a sufficiently substantiated scientific explanation. This is due to the fact that the study of age dynamics in this range is very difficult, since lifestyle, the level of physical activity, genetic

Table 1. *Dynamics of indicators of maximum speed capabilities and human endurance in the range of 35–105 years.*

Age, years	Maximum running speed, m/s		Average running speed for 5km, m/s	
	Men	Women	Men	Women
35+	11,18	10,34	6,47	5,72
40+	11,11	10,02	6,35	5,52
45+	10,36	9,79	5,78	5,23
50+	10,21	9,51	5,60	4,94
55+	9,83	9,07	5,37	4,76
60+	9,49	8,15	5,23	4,63
65+	9,02	7,98	5,00	4,14
70+	8,70	7,54	4,56	3,98
75+	8,38	7,41	4,36	3,55
80+	7,74	6,83	4,09	3,25
85+	7,37	5,73	3,46	2,56
90+	6,66	4,80	2,77	1,52
95+	5,44	3,68	2,09	
100+	4,15	3,02	1,66	
105+	3,22	1,76		



Dynamics of indicators of manifestation of maximum motor abilities (maximum running speed and endurance) in the age range of 30–105 years

predisposition, and the presence of diseases have a strong influence [2,4,6]. The data obtained on the basis of studying the world records of track and field veterans obviously reflect the biological pattern of the development of the human body in ontogenesis, since these data are not random outliers, but reflect the results close to the personal achievements of the elite group of track and field athletics veterans who lead a healthy lifestyle and maintain training process throughout life.

According to experts [4,6], negative age-related changes can be compensated to some extent by physical culture and sports. However, in our case, such compensation is hardly possible, since veterans of the sport, noted in the list of world record holders, have been training regularly for a long time and have been in the top group of the best world results for decades. Therefore, the dynamics of world records is close to the age dynamics of personal records of the strongest track and field athletics veterans.

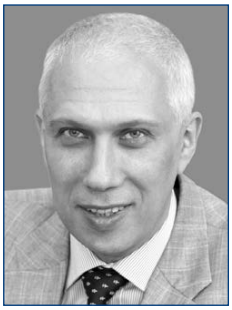
Conclusions. The obtained patterns of the dynamics of maximum motor abilities in running (maximum speed and endurance) reflect the general biological pattern of the regressive development of locomotor functions in the second part of human ontogenesis: a linear decrease in the range of 35–75 years, approximately 1% per year, and then accelerated up to 105 -years of age (up to 5% per year).

References

1. Balsevich V.K. Ontokineziologiya cheloveka [Human ontokinesiology]. Moscow: Teoriya i praktika fizicheskoy kultury publ., 2000. 275 p.
2. Kryazhev V.D. Razvitiye, sokhraneniye i vosstanovleniye dvigatelnykh vozmozhnostey cheloveka [Development, preservation and restoration of human motor abilities]. Moscow: VNIIFK publ., 2002. 247 p.
3. En.wikipedia.org/wiki/List_of_world_records_in_masters_athletics#cite_note-1.
4. Mazzeo R.S., Cavanagh P., Evans, W.J., Fiatarone M., Hagberg J., McAuley E., & Startzell J. (1998). Exercise and physical activity for older adults. Medicine and Science in Sports and Exercise, 30*(6),* 992-1008. Available at: https://doi.org/10.1097/00005768-199806000-00033.
5. Paterson Donald & Jones, Gareth & Rice, Charles. (2007). Ageing and physical activity: Evidence to develop exercise recommendations for older adults. Canadian journal of public health. Revue canadienne de sant publique. 98 Suppl 2. S69-108. 10.1139/H07-111.
6. Teut Michael & Ortiz, Miriam. (2021). Integrative Medicine and Ageing. Complementary Medicine Research. 28. 1-4. 10.1159/000519159.

Model of implementation of the program of universal swimming teaching, according to indicators of swimming pools provision and the number of children of primary school age in the russian federation

UDC 796.06



Dr. Psych., Associate Professor **V.B. Myakonkov**[1,2]
PhD, Associate Professor **D.V. Mustafina**[1]
[1]Lesgaft National State University of Physical Education, Sports and Health, St. Petersburg
[2]Federal Scientific Center of Physical Culture and Sport (VNIIFK), Moscow

Corresponding author: 62sport@gmail.com

Abstract

Objective of the study was to develop a model for the implementation of a program for universal swimming education, taking into account the indicators of the availability of swimming pools and the number of children of primary school age in the Russian Federation.

Methods and structure of the study. To achieve the goal of this study, a modeling method was used to calculate the number of participants in the interdepartmental program for teaching swimming in the framework of the lessons "Physical Education" with children of primary school age.

Results and conclusions. Approbation of the model for the implementation of the program of universal swimming training was carried out on the example of the Ivanovo region. It has been established that the maximum number of participants in the interdepartmental program in this region is 63% of the average number of children of primary school age. The results of the study allow scaling this model to the entire territory of the Russian Federation in order to effectively manage and monitor the interdepartmental program of universal swimming education.

Keywords: *universal swimming education, swimming for all, children of primary school age, number of participants, provision of sports swimming pools.*

Introduction. In accordance with the List of Orders of the President of the Russian Federation Pr-1919 dated October 07, 2021, paragraph 5, the Government of the Russian Federation was instructed to develop and approve an interdepartmental program aimed at universal teaching children to swim as a basic life-supporting skill. [2]. In turn, Decree of the Government of the Russian Federation No. 3894-r dated December 28, 2021 “On Approval of the Concept for the Development of Children and Youth Sports in the Russian Federation until 2030” sets a target number of 500 thousand children (from among children who cannot swim) in all subjects of the Russian Federation, which should annually become participants in the interdepartmental swimming training program [4]. However, the implementation of this solution is difficult to implement without calculating the number of participants in the interdepartmental program in accordance with the availability of swimming pools in the constituent entities of the Russian Federation, taking into account their walking and transport accessibility, as well as the requirements for the parameters of the pools for mastering the program for teaching swimming to children of primary school age.

Objective of the study was to develop a model for the implementation of a program for universal swimming education, taking into account the indicators of the availability of swimming pools and the number of children of primary school age in the Russian Federation.

Implementation of this model will make it possible to comply with the principle of "equalization of opportunities" when making decisions on financing program participants representing various constituent entities of the Russian Federation in accordance with their different levels of availability of swimming pools and other socio-economic indicators, as well as to develop proposals for the construction and reconstruction of swimming pools.

Methods and structure of the study. To achieve the goal of this program, a modeling method was used to determine the relationship of the cognizing subject and the cognized object by reproducing a certain fragment of reality.

At the same time, the number of participants in the interdepartmental program for teaching swimming within the framework of the lessons "Physical Education" with children of primary school age in the *i*-th subject of the Russian Federation is determined by the formula:

$$Q_i = \sum_{k=1}^{sh_i} p_k + \sum_{j=1}^{s_i} \left(\sum_{l=1}^{5} h_{lj} \times q_j\right), \quad (1)$$

where: sh_i is the number of educational institutions/schools equipped with a swimming pool in the *i*-th subject of the Russian Federation (if $sh_i = 0$, then the first term of formula (1) is equal to zero);

p_k is the number of primary school students studying in the *k*-th school and not able to swim;

S_i is the number of swimming pools in the *i*-th subject of the Russian Federation, the parameters of which allow the implementation of an interdepartmental program for teaching swimming;

h_{lj} is the number of hours provided by the *j*-th pool during the daytime (training) time on t *l*-th is day of the week for teaching schoolchildren to swim;

q_j is the number of students per hour in *j*-th pool who do not know how to swim (in one hour, one class can learn to swim as part of the subject "physical education").

The number of swimming pools in which it is possible to implement an interdepartmental program is presented on the site https://swimstandart.ru for the i-subject of the Russian Federation, thus the values of sh_i, s_i of formula (1) will become known; the value *qj* can be taken equal to the average class occupancy rate in the i-th subject of the Russian Federation (d_i); it is also possible to take the average number of hours provided by swimming pools during school hours per day (h_i), in this case the value $p_k = 5 \times hi \times d_i$. Transforming formula (1), we obtain the maximum number of participants in the interdepartmental program for teaching swimming in the framework of the lesson "Physical Education" by children of primary school age in the *i*-th subject of the Russian Federation:

$$Q_{imax} = 5 \times (sh_i + s_i) \times h_i \times d_i \quad (2)$$

Accordingly, the annual (maximum) number of participants in the interdepartmental program for teaching swimming as part of the "physical education" lesson by children of primary school age in the Russian Federation is determined as the sum of the number of participants in the interdepartmental program of all subjects of the Russian Federation:

$$Q = \sum_{i=1}^{85} Q_i \ (Q_{max} = \sum_{i=1}^{85} Q_{i\_max}). \quad (3)$$

Results of the study and their discussion. As a basic work program for teaching swimming to primary school students, the "Exemplary work program of the subject "physical culture" ("swimming" module) for educational organizations implementing educational programs of primary general and basic general education, including a 36-hour program learning to swim [3]. The organization of swimming training within the framework of the physical education subject, based on the duration of the academic year of 34 academic weeks for schoolchildren of grades 2-4, is possible in the form of lessons one, two or three times a week, lasting one academic hour. Thus, for one academic hour in one swimming pool during one academic year, one, two or three training classes, respectively, can be taught.

Taking into account the regional features of the development of physical culture and sports [1], in order to apply the model for implementing a swimming training program on the example of one of the constituent entities of the Russian Federation, in particular the Ivanovo region, we will use the following data. The average number of children of primary school age (born in 2011–2014) in the Ivanovo region, according to Rosstat, is 11,117 people [5]; there are no educational institutions equipped with a swimming pool (sh_{37}); 14 swimming pools (sh_{37}), the parameters of which allow the implementation of an interdepartmental swimming training program, including six pools with private ownership (it is assumed that all swimming pools, regardless of the form of ownership, participate in the program); the average class occupancy rate (d_{37}) is 25 people. Since swimming pools are mostly busy during the daytime and evening hours, it is possible to conduct classes in the morning hours as part of an interdepartmental program - four hours a day (h_{37}), five days a week. Thus, the maximum number of participants in the interdepartmental program for children of primary school age in the Ivanovo region is:

$$Q_{37\_max} = 5 \times (sh_{37} + s_{37}) \times h_{37} \times d_{37} = 5 * 14 * 4 * 25 = 7000,$$

which is 63% of the average number of children of primary school age.

Of course, it is worth considering the walking and transport accessibility for teaching swimming to students of educational institutions separately in each city and district municipality of the Ivanovo region. In this case, we will be able to calculate more accurately the number of children of primary school age that can be attracted to participate in an interagency program aimed at teaching children to swim as a basic life-supporting skill for everyone, and identify municipalities in which it is not possible to organize swimming lessons as part of an educational subject "physical culture", respectively, to calculate the number of children of primary school age who will not be able to take part in the interdepartmental program due to the lack of swimming pools within walking distance and transport accessibility.

Having calculated the number of children of primary school age in urban districts and municipal districts of the Ivanovo region without swimming pools, that is, those who do not have access to swimming pools on foot or transport, and, accordingly, without the possibility of organizing swimming lessons as part of the physical education subject, we get 3507 children, which is 32% of the average number of children of primary school age.

C**onclusions.** The calculation of the number of children of primary school age in the Ivanovo region, taking into account the indicators of the availability of swimming pools within the framework of the developed model, allows scaling its results to the entire territory of the Russian Federation in order to effectively manage and monitor the interdepartmental program of universal swimming education.

References

1. Kadyrov A.R. Problemy otsenki vliyaniya obespechennosti obyektami sportivnoy infrastruktury na razvitiye massovogo sporta i ekonomiku regionov privolzhskogo federalnogo okruga [Problems of assessing the impact of the provision of sports infrastructure facilities on the development of mass sports and the economy of the regions of the Volga Federal District]. Kazanskiy ekonomicheskiy vestnik. 2019. No. 5 (43). pp. 37-42.
2. Perechen porucheniy Prezidenta Rossiyskoy Federatsii po itogam zasedaniya Soveta pri Prezidente Rossiyskoy Federatsii po razvitiyu fizicheskoy kultury i sporta 10 sentyabrya 2021 g. № Pr-1919 ot 07.10.2021 [List of instructions of the President of the Russian Federation following the meeting of the Council under the President of the Russian Federation for the development of physical culture and sports on September 10, 2021 No. Pr-1919 dated 07.10.2021] [Electronic resource]. Available at: http://kremlin.ru/acts/assignments /orders/66882 (date of access: 02.19.2022).
3. Primernaya rabochaya programma uchebnogo predmeta «fizicheskaya kultura» (modul «plavaniye») dlya obrazovatelnykh organizatsiy, realizuyushchikh obrazovatelnyye programmy nachalnogo obshchego i osnovnogo obshchego obrazovaniya, vklyuchayushchaya 36-chasovuyu programmu obucheniya plavaniyu [An exemplary work program for the subject "physical culture" (module "swimming") for educational organizations implementing educational programs for primary general and basic general education, including a 36-hour swimming training program]. Salnikova V.V., Fedchenko N.S. [ed.] [Electronic resource]. Available at: http://xn--b1atfb1adk.xn--1ai/files/ioe/documents/KBR4J5MCLL4H891X2WV2.pdf (date of access: 19.02.2022).
4. Ob utverzhdenii Kontseptsiya razvitiya detsko-yunosheskogo sporta Rossiyskoy Federatsii do 2030 goda [On Approval of the Concept for the Development of Children and Youth Sports in the Russian Federation until 2030]. Decree of the Government of the Russian Federation No. 3894-r dated December 28, 2021 [Electronic resource]. Available at: http://static.government.ru/media/files/BzNG3VRui0oPR1XemJKbuIZ6UeXTwTD2. pdf (date of access: 19.02.2022).
5. Federalnaya sluzhba gosudarstvennoy statistiki. Statisticheskiy byulleten «Chislennost naseleniya rossiyskoy federatsii po polu i vozrastu na 1 yanvarya 2021 goda» [Federal State Statistics Service. Statistical bulletin "The population of the Russian Federation by sex and age as of January 1, 2021"] [Electronic resource]. Available at: https://rosstat.gov.ru/storage/mediabank/Bul_chislen_nasel-pv_01-01-2021.pdf (date of access: 02.19.2022).

Physical fitness and morphofunctional status of boys aged 6-8 years

UDC 796.011

Dr. Biol. **T.F. Abramova**[1]
PhD **T.M. Nikitina**[1]
A.V. Polfuntikova[1]
[1]Federal Scientific Center of Physical Culture and Sport (VNIIFK), Moscow

Corresponding author: volodchenkova.e.n@vniifk.ru

Abstract

Objective of the study was to identify the relationship between the morphofunctional status and physical fitness in modern boys aged 6-8 years.

Methods and structure of the study. The work used standardized methods for assessing physical development and physical fitness. Morphofunctional status was determined using the methods of anthropometry, caliperometry, spirometry, pulsometry and tonometry [1,4]. Physical fitness was assessed based on the results of test tasks, used in the field of physical education and VFSK "GTO": 30 m run; shuttle run, 3 10 m (s); 6-minute run (m); standing long jump with two legs (cm); standing forward bend (flexibility, cm); carpal dynamometry, flexion and extension of the arms in an emphasis lying on the floor, lifting the torso into a sitting position from a supine position in 1 min [2,3].

Results and conclusions. Based on a comparative analysis of the level and pace of morphofunctional development and preparedness, it was revealed that the indicators of morphofunctional status and physical fitness differ significantly among boys aged 6 and 7, 7 and 8; the greatest increase in physical fitness with the priority of speed-strength qualities and endurance is typical for the period from 6 to 7 years, with a decrease in rates in the period from 7 to 8 years on average twice against the background of relatively uniform and lower rates of annual changes in morphological and functional indicators. The results obtained indicate that the standards of physical fitness for boys of age groups of 6, 7 and 8 years old, characterized by normal physical development, should be developed for each age group, taking into account the greatest coverage of territorial variability.

Keywords: *physical fitness, physical development, boys, 6-8 years old.*

Introduction. Improving the physical fitness of children is one of the main tasks of the state in the field of physical culture and sports. The leading tools for assessing the physical fitness of children aged 6 to 8 years are regulatory requirements that differ in the systems of categorical assessments and the list of tests in the practice of physical education and the GTO complex (I stage), which generally updates the development of a unified assessment system [2-3, 6].

The development of physical fitness standards for children of senior preschool and primary school age obviously faces the heterochrony of the processes of growth and functional development as the basis for the development and manifestation of physical qualities [7].

Objective of the study was to identify the relationship between the morphofunctional status and physical fitness in modern boys aged 6-8 years.

Methods and structure of the study. The work used standardized methods for assessing physical development and physical fitness. The morphofunctional status was determined using the methods of anthropometry, caliperometry, spirometry, pulsometry and tonometry [1, 4]. Physical fitness was assessed based on the results of test tasks performed in the field of physical education and VFSK “GTO”: 30 m run; shuttle run 3 10 m (s); 6-minute run (m); standing long jump with two legs (cm); standing forward bend (flexibility, cm); carpal dynamometry, flex-

ion and extension of the arms in an emphasis lying on the floor, lifting the torso into a sitting position from a supine position in 1 min [2, 3].

In order to determine the actual limits of the variability of the main physical qualities according to a single comprehensive program, 725 boys of 6-8 years old with different motor activity were examined (41.8% - athletes; game, cyclic, complex coordination sports and wrestling; experience of training - 0, 8-1.5 years old), living in the territories of the Central Federal District (Moscow, Yaroslavl), the North-Western Federal District (Saint Petersburg), the Southern Federal District (Volgograd), the North Caucasian Federal District (Stavropol Territory), Far Eastern Federal District (Khabarovsk), Far North (Yakutia, Churapcha village). The filling of the combined age groups is 226-250 people. The examinations were carried out with the consent of the parents.

Results of the study and their discussion. A preliminary analysis of the physical development of boys aged 6-8 showed that the age-territorial variability of indicators has a mosaic character, determined, among other things, by chance and a small number of samples. However, the data obtained for all the considered subjects of the Russian Federation are characterized by average values of total body sizes, with individual variability from low to high in accordance with the unified interregional standards for the physical development of children and adolescents [5]. In this regard, the combined age groups were considered as a model of the variability of the indicators of the physical development of boys aged 6-8, potentially reflecting the variability of the development of physical fitness.

Analysis of the data of the generalized groups of boys showed for the most part a statistically significant and regular age-related change in the indicators of morphofunctional development and readiness (Table 1). Attention is drawn to the growth rates of indicators of various properties. In the period from 6 to 7 years, indicators of physical development on average increase by 4.6%, physical fitness - by 14.0%; the highest growth rates are characteristic of body

Table 1. *Morphofunctional status, physical fitness of boys aged 6-8 and the level of statistical significance of intergroup differences*

Index	6 years (n=226)		7 years (n=249)		8 years (n=250)		t- Student's criterion*		
	X	V,%	X	V,%	X	V,%	6-7	7–8	6–8
Morphofunctional status									
Body length, cm	118,3	4,40	123,8	4,38	129,9	5,00	-11,30	-11,37	-21,32
Body weight, kg	21,6	14,95	24,5	16,78	28,1	21,42	-8,58	-7,66	-14,43
BMI, kg/m^2	15,4	10,32	16,0	11,81	16,6	14,64	-3,71	-3,05	-6,30
Chest girth, cm	58,0	5,66	60,4	6,66	63,0	8,63	-6,99	-6,09	-12,00
Muscle mass,%	41,5	8,96	41,9	9,16	43,2	9,75	-1,00	-3,69	-4,58
Fat mass, %	14,8	37,36	15,0	34,13	17,2	41,34	-0,45	-3,94	-4,07
VC, l	1,3	23,85	1,5	26,00	1,7	28,82	-4,50	-5,28	-9,36
Heart rate, beats/min	92,7	14,48	88,7	14,86	86,1	15,12	3,12	2,20	5,24
ADS, mm Hg Art.	101,0	10,29	104,1	12,11	104,2	9,78	-2,82	-0,14	-3,33
ADD, mm Hg Art.	64,8	14,77	66,9	18,27	66,5	12,38	-2,12	0,50	-2,08
Physical fitness									
30 м, s	7,7	11,56	7,0	11,71	6,8	11,91	6,27	2,68	8,79
shuttle run 3×10м, s	11,1	10,90	10,3	10,00	9,9	10,40	7,26	4,91	11,90
Standing long jump, cm	111	15,86	123	14,15	130	13,62	-7,28	-4,81	-11,85
Flexion and extension of the arms in emphasis lying on the floor, quantity	11,2	80,63	13,5	70,30	14,0	70,86	-2,06	-0,36	-2,31
Raising the body from a supine position, quantity	18,5	63,62	23,2	47,07	26,0	42,73	-3,42	-2,21	-5,32
Brush strength, kg	7,0	34,57	8,4	34,64	9,9	29,49	-5,30	-5,28	-10,69
Brush strength, %	32,2	32,02	34,5	30,67	35,6	28,40	-2,13	-1,13	-3,30
6-minute run, m	752	25,94	877	19,49	974	15,83	-6,59	-6,17	-12,67
Standing forward bend, cm	3,2	150,63	3,5	158,29	3,4	177,65	-0,69	0,20	-0,44

– p =0.05 with t-test =1.96

Table 2. *Factor structure of the complex of indicators of the morphofunctional status and physical fitness of boys aged 6-8 years with different physical activity*

6 years		7 years		8 years	
1st factor					
30 m run	-.868	Running 6 minutes	-.870	Body mass	.912
Lifting the torso	.860	30 m run	.835	Chest girth	.821
Flexion and extension of the arms in the lying position	.840	long jump	-.820	BMI	.738
Shuttle run	-.780	Shuttle run	.799	Body length	.720
Running 6 minutes	.779	Lifting the torso	-.781	-	-
-	-	-	-	-	-
Percentage of total variance	20,0	23,0		21,0	
2nd factor					
Body mass	.950	Body mass	.971	Lifting the torso	-.842
Chest girth	.830	Chest girth	.872	long jump	-.786
Body length	.762	BMI	.840	Running 6 minutes	-.750
BMI	.700	Body length, cm	.676	Flexion and extension of the arms in the lying position	-.688
Percentage of total variance	17,7	18,1		18,8	
3rd factor					
Brush strength, kg	.932	Brush strength, kg	.941	Brush strength, kg	.916
Brush strength, %	.907	Brush strength, %	.824	Brush strength, %	.822
-	-	Flexion and extension of the arms in the lying position	.702	Fat mass, %	-.776
Percentage of total variance	14,3	15,8		18,5	
4th factor					
ADS	-.921	heart rate	-.760	ADS	.861
ADD	-.908	Fat mass, %	.706	ADD	.855
Percentage of total variance	10.6	10.7		10.9	
5th factor					
Standing forward bend	-.781	ADS	.929	Standing forward bend	-.806
heart rate	-.701	ADD	.864	-	-
Percentage of total variance	10.5	10.4		7,1	

weight (13.4%), indicators of strength fitness of the muscles of the trunk and arms (20.1-25.4%), endurance (16.6%); the smallest - for muscle and fat mass (1.0-1.4%).

In the period from 7 to 8 years, the rate of change in morphological and functional indicators, on average, slightly increases to 5.5%; indicators of physical fitness more than double (up to 6.7%) reduce the pace of development; the highest growth rates are typical for body weight (14.7%), hand strength (20.0%) and endurance in a 6-minute run (11.8%), as well as for fat mass (14.7%); the smallest, in some cases negative, changes are characteristic of flexibility (-2.9%); indicators of heart rate and blood pressure (-2.9–0.1%). The limits of variability (V, %) of morphological and functional indicators increase at the age of 6 to 8 years, most of the physical fitness indicators decrease.

The relationship between indicators of morpho-functional status and physical fitness in groups of boys aged 6-8 was assessed based on the results of factor analysis (Table 2). In each of the groups, five factors were identified that describe 72.1-78.0% of the total variance. The first factors with the largest percentage of the total variance in the 6 and 7 year old groups reveal the priority of the variability of physical fitness, in the 8 year old group - the total body size; at the age of 6, the leading indicators are the manifestations of speed and strength readiness of the muscles of the trunk and the girdle of the upper extremities; at 7 years old - endurance, speed and strength training of leg muscles. The second factors, on the contrary, in groups of 6 and 7 years old combine indicators of total body size with a general priority of the significance of body weight; in the 8-year-old group - a set of indicators of physical fitness: speed-strength fitness of the muscles of the trunk and legs, endurance. The content of three to five factors in all age groups demonstrates relatively autonomous variability in hand strength and

flexibility; BP and heart rate.

The processes of growth, functional formation and development of the physical qualities of boys in the period from 6 to 8 years are characterized by age heterochrony due to endogenous and exogenous factors, including the passage of the first half-growth jump, age-related features of quantitative and differentiation changes, differences in the means and methods of physical education in preschool institutions and elementary grades of school institutions [7].

Conclusions. Indicators of morphofunctional status and physical fitness are statistically significantly different in boys aged 6, 7 and 8, they change heterochronously. Annual changes in morphological and functional indicators are relatively uniform in the period from 6 to 8 years, indicators of physical fitness increase most pronouncedly in the period from 6 to 7 years, with a decrease in the growth rate by half in the period from 7 to 8 years.

Age characteristics of indicators of morphofunctional status and physical qualities in boys in the period from 6 to 8 years are relatively independent. Hand strength, flexibility, blood pressure and heart rate are characterized by autonomous variability.

Physical fitness standards for boys of age groups of 6, 7 and 8 years, characterized by a normal course of physical development, should be developed for each age group, taking into account the greatest coverage of territorial variability.

The work was carried out within the framework of the state task of the Federal Scientific Center of Physical Culture and Sport (VNIIFK) No. 777-00005-21-00 (subject code No. 001-21/1).

References

1. Abramova T.F., Nikitina T.M., Kochetkov N.I. Labilnyye komponenty massy tela – kriterii obshchey fizicheskoy podgotovlennosti i kontrolya tekushchey i dolgovremennoy adaptatsii k trenirovochnym nagruzkam [Labile components of body mass - criteria for general physical fitness and control of current and long-term adaptation to training loads]. Guidelines. Moscow: Skayprint publ., 2013. 132 p.
2. Metodicheskiye rekomendatsii po provedeniyu monitoringa fizicheskoy podgo-tovlennosti obuchayushchikhsya v sfere obrazovaniya Rossiyskoy Federatsii FGBU «Federalnyy tsentr organizatsionno-metodicheskogo obespecheniya fizichesko-go vospitaniya» [Guidelines for monitoring the physical fitness of students in the field of education of the Russian Federation Federal State Budgetary Institution “Federal Center for Organizational and Methodological Support of Physical Education”] [Electronic resource]. Available at: http://fcomofv.ru/page351/page544/ (date of access: 03.02.2022).
3. Normativy GTO Vserossiyskogo fizkulturno-sportivnogo kompleksa «Gotov k trudu i oborone» (GTO) [Standards of the GTO of the All-Russian physical culture and sports complex “Ready for work and defense” (GTO)] [Electronic resource]. Available at: https://www.gto.ru/norms (date of access: 01.20.2022).
4. Serdyukovskaya G.N.[ed.] Organizatsiya meditsinskogo kontrolya za razvitiyem i zdorovyem doshkolnikov i shkolnikov na osnove massovykh skrining-testov i ikh ozdorovleniye v usloviyakh detskogo sada, shkoly [Organization of medical control over the development and health of preschoolers and schoolchildren based on mass screening tests and their health improvement in a kindergarten, school]. Moscow, 1995. 142 p.
5. Peterkova V.A., Nagaeva E.V., Shiryaev T.Yu. Otsenka fizicheskogo razvitiya detey i podrostkov [Assessment of the physical development of children and adolescents]. Guidelines. Moscow: FGBU “NMITs Endocrinology” of the Ministry of Health of Russia; Alfa-Endo publ., 2017. 94 p.
6. Strategiya razvitiya fizicheskoy kultury i sporta v Rossiyskoy Federatsii na period do 2030 goda [Strategy for the development of physical culture and sports in the Russian Federation for the period up to 2030]. Order of the Government of the Russian Federation dated November 24, 2020 No. 3081-r. Available at: http://static.government.ru/media/files/ (date of access: 02.02.2022).
7. Baranov A.A., Scheplyagina L.A.[ed.] Fiziologiya rosta i razvitiya detey i podrostkov (teoreticheskiye i klinicheskiye voprosy) [Physiology of growth and development of children and adolescents (theoretical and clinical issues)]. Practical guide. Moscow: GEOTAR-Media publ., 2006. 432 p.

Online calculator in diagnostics of functional state and body mass index

UDC 796.011.3

PhD, Associate Professor **T.N. Shutova**[1]
Dr. Hab., Professor **L.B. Andryushchenko**[1]
PhD, Associate Professor **N.Yu. Drayko**[2]
PhD, Associate Professor **S.N. Zvereva**[3]
[1]Plekhanov Russian University of Economics, Moscow
[2]Tchaikovsky State Academy of Physical Culture and Sports, Tchaikovsky
[3]Sevastopol State University, Sevastopol

Corresponding author: tany-156@rambler.ru

Abstract

Objective of the study was to develop a digital tool for the rapid implementation of functional diagnostics and further recommendations on physical culture.

Methods and structure of the study. A mobile application in the form of an online calculator made it possible to digitize the following existing formulas: the coefficient of endurance of the cardiovascular system, the level of regulation of the cardiovascular system, the vital index, the Skibinski circulatory-respiratory coefficient, the body mass index, the vegetative Kerdo index, the index of functional changes circulatory systems. And also to assess the level of motor activity of students of the Plekhanov Russian University of Economics (279 people, February 2022).

Results and conclusions. Diagnostics with the help of a digital tool revealed the optimal indicators of body mass index, physical activity of students below the physiological norm. At the same time, low values of VC, the level of regulation of the cardiovascular system, the vital index and the index of the functional capabilities of the circulatory system in young men were determined. Almost none of the index revealed high, above average and average values, except for the coefficient of endurance of the cardiovascular system in young men. In this regard, the importance of regular physical activity, "informal participation" in sports, organization of competitions "For all" (General physical training, billiards, tug of war), master classes using digital technologies are noted. Thanks to the developed application, efficiency, interactivity, personality-oriented orientation of teaching in physical culture and sports at the university was achieved. Undoubtedly, this digital service aroused high interest among the target student audience, it meets the requirements of the digital educational ecosystem for Physical Culture and Sports at the university.

Keywords: *online calculator, express assessment of the functional state, digital support of physical education, physical education of students.*

Introduction. The presentation of the concept of development in modern society is largely identified with digital transformation and global information challenges [6]. The strategy of working with the digital generation should be based on traditional educational processes that integrate modern technological capabilities of both the teacher himself and the student living in a perfect digital reality. In this regard, its significant transformation is in demand, the result of which is the formation of a new digital educational process [5].

Digital technologies in the new information society act as a mechanism for achieving educational goals and objectives. Such technologies in the educational process in physical culture and sports at the university are aimed at increasing the means of informatization and communication, developing educational platforms, new ways of independent physical education and sports, means of operational control of the physical and functional state, rethinking the type and presentation of information, creating a new system knowledge [2,7]. It is necessary to integrate information, both on conventional and modern media, computer technologies, information systems, work technologies and databases [3,4,8]. However, at present, there are not enough modern digital tools, services (mechanisms)

to solve educational, health-improving, organizational and managerial tasks according to physical culture and sports in a mobile, remote, operative, automated way.

Objective of the study was to develop a digital tool for the rapid implementation of functional diagnostics and further recommendations on physical culture.

Methods and structure of the study. The content of the mobile application "Online calculator of the functional state and body mass index" contains not only the revealed result for eight indicators and the norm values, but also methodological recommendations for each index, as well as the "Statistics" section for monitoring the dynamics of the functional state and body mass index . The Summary section displays all eight values, summarizing the diagnosis. The online calculator is distinguished by its complex nature, ease of use, concise interface and promptness of diagnostics (Figure 1, 2).

https://play.google.com/store/apps/details?id=com.vendetta.online_calculator

Main page of the online calculator functional status and body mass index
Section «Indices» and guidelines
Summary section (all 8 indicators)
Section «Statistics» (control of indicators)

Figure 1. *Structure of the online calculator*

Figure 2. *Interface, "icon" and QR code (Android, Apple) of the mobile application*

Resource support for assessing the functional state is minimal, in the form of a tonometer, scales, stadiometer and spirometer. To build an online calculator program, the Dart programming language, Android Studio computer programs, Flutter Framework, the program size is 19.9 MB. The mobile application is designed in such a way that all the results of the functional state, body mass index and level of physical activity are stored on the server, which will allow you to create a database of the studied indices, taking into account the gender and age of users.

With the help of the developed online calculator, the level of motor activity of students of the Russian University of Economics was assessed. G.V. Plekhanov (279 people, February 2022).

Results of the study and their discussion. The study showed (279 people, February 2022) that the body mass index for both boys (22.7 c.u.) and girls (20.9 c.u.) is within the normal range (Table 1).

The level of physical activity in boys was 9035 steps, in girls - 7542 - "a somewhat active lifestyle or a somewhat active work." The applied classification of the level of motor activity (E. Masi, James E. Peterman, Leonard A. Kaminsky, 2019) [8], where motor activity is <5 thousand steps per day - the so-called "Sedentary work"; 7.5-9.9 thousand steps per day - "Somewhat active work"; 10-12 thousand steps - "Active lifestyle"; over 12.5 thousand steps - "Very active lifestyle." At the same time, the physiological norm of 10 thousand steps is not realized by young men and especially girls.

The coefficient of endurance of the cardiovascular system (the norm is 16 c.u.), determined by the formula $CE \frac{(HR\ 10)}{PP}$, where HR - heart rate (bpm), PP - pulse pressure (mm Hg), showed an increase in the cardiovascular system in young men, the result was 13.8 conventional and the weakening of the activity of girls - 20.5 conventional units. The most common result (Mo) in girls was 24.1 conventional units, for young men - 9.5 conventional units. (Table 1). The revealed level of regulation of the cardiovascular system causes concern. So, in boys the result was 100.5 conventional units, for girls - 93.3 conventional units, while 81-90 is the "average" level of regulation, 91-100 is "below average", and 101 and above conventional units – "low" value. The value of the "double product" correlates with the value of the maximum oxygen consumption, so the lower the value, the higher the physical performance. The values for young men are on the border of the level of "below average" and "low", while a high standard deviation was revealed.

It should be noted that the most common result of blood pressure in young men is 134/66 mm Hg, the average heart rate is 80.2±17.5 beats/min. In girls, the level of CVS regulation is "below average", while the most common result of blood pressure is 115/74 mm Hg, the average heart rate is 84.2±13.7 beats/min (Table 2).

The norm of the vital index is 53-61 ml / kg, if the indicator is less, then this may indicate a lack of vital capacity of the lungs, or overweight. In the study, the life index in boys was 37.8±14.7 ml/kg, in girls it

Table 1. *Online calculator in the study of functional status and body mass index (February 2022)*

Indicators	Youths (n=136)		Girls (n=143)	
	(X±σ)	M_o (fashion)	(X±σ)	M_o (fashion)
Body mass index (norm 18.5-24.9 c.u.)	22,74,2	23,1	20,93,6	19,0
The level of physical activity (number of steps)	9035,25 2710	10 000	7542,52 2313	10 000
Endurance coefficient of the cardiovascular system (c.u.) (norm 16 c.u., less than 16 - strengthening, more than 16 - weakening of the cardiovascular system)	13,8 5,9	9,5	20,59,7	24,1
Level of CVS regulation (c.u., «double product») 81-90 - medium; 91-100 - below average; 101 and above - low value	100,533,0	132,0	93,321,7	83,9
Life index (ml/kg) (norm 53-61 ml/kg)	37,8 14,7	40,0	36,115,9	36,6
Circular-respiratory Skibinski coefficient (<5 c.u. - very bad, 5-10 - unsatisfactory, 10-30 - satisfactory, 30-60 - good, > 60 - very good)	25,213,0	26,0	16,98,3	23,5
Kerdo vegetative index (c.u.) (norm 0 conventional units, from -15 to +15 balance of sympathetic and parasympathetic influences)	- 10,542,6	15,7	7,3922,5	1,33
Index of functional capabilities of the circulatory system (c.u.) (2.6-3.09 - sufficient functional indicators, more than 3.09 - insufficient opportunities)	3,649,2	2,38	2,10,26	2,24

was 36.1±15.9 ml/kg. low values of the vital index are due to insufficient level of VC (Table 2), which in boys is only 3171.19± 594.5 ml, in girls - only 2370.8± 397.2 ml. The Stange's test of the male group of the studied - only 69.5 s., in the female group - only 53.8 s. In this regard, the importance of regular physical activity, including low-intensity physical activity, "informal participation" in sports, organization of "For All" competitions (general physical training, billiards, tug of war), master classes using digital technologies is noted.

Circular-respiratory coefficient Skibinski (c.u.), which determines the reserves and endurance of the respiratory and cardiovascular systems, was found to be at a satisfactory level in young men - 25.2 ± 13.0 conventional units, in girls - 16.9 ± 8 ,3 – "satisfactory". The result "excellent" was not revealed in any of the subjects.

Let us analyze the result of the index of functional capabilities of the circulatory system. With an indicator of 3.09 conventional units insufficient capabilities of the circulatory system are observed, the result indicates the presence of pronounced deviations in the adaptation processes. In the studied group of boys, the value was 3.64 conventional units, in girls the result was better - 2.1 conventional units– sufficient functionality of the circulatory system.

Diagnostics revealed optimal body mass index, physical activity below the physiological norm. At the same time, low values of VC, the level of regulation

Table 2. *Indicators of physical development and functional state of the cardiovascular system*

Indicators	Youths (n=136)		Girls (n=143)	
	(X±σ)	M_o (fashion)	(X±σ)	M_o (fashion)
Body length (cm)	181,42 6,6	180	167,345,3	165
Body weight (kg)	75,19 12,1	74,5	57,64 7,2	50,0
Vital capacity of the lungs (VC) (ml)	3171,19594,5	3000	2370,8397,2	2500
Stange test (s.)	69,52 25,1	90,0	53,81 15,2	45,0
Heart rate beats/min	80,24 17,5	81,0	84,27 13,7	83,0
BP (mm Hg)	124,9 18,1/ 70,2 9,9	134/66	111,6 14,3 / 72,7 8,6	115/74

of the cardiovascular system, the vital index and the index of the functional capabilities of the circulatory system in young men were determined. Virtually none of the index revealed high, above average and average values, except for the *CVS* endurance coefficient in young men.

Conclusions. All subjects were given individual recommendations, it was also recommended to increase physical activity up to 10-12.5 thousand steps, increase aerobic load, while monitoring heart rate and blood pressure, as well as training in the gym two to three times a week with low-intensity loads. Along with this, connect applications in the "fitness and health" category, online calculators for nutrition and water consumption.

Thanks to the developed mobile application in the form of an online calculator, efficiency, interactivity, and a personality-oriented orientation of training in physical culture and sports at the university were achieved.

References

1. Averyasova Yu.O., Eroshin M.D. Ispolzovaniye tsifrovykh tekhnologiy, kak metodov issledovaniya v trenirovochnom protsesse [Using digital technologies as research methods in the training process]. Sovremennyy trening i kouching: novyye vozmozhnosti v biznese i obrazovanii. [Modern training and coaching: new opportunities in business and education]. Proceedings conference. 2021. pp. 72-75.
2. Andryushchenko L.B., Akhmetov I.I., Aksenov M.O. et al. Gandbol: tsifrovyye i geneticheskiye tekhnologii v sisteme sportivnoy podgotovki [Handball: digital and genetic technologies in the system of sports training]. Moscow: Plekhanov Russian University of Economics publ., 2022. 367 p.
3. Andryushchenko O.N., Averyasova Yu.O., Kondrakov G.B. et al. Innovatsionnyye metody kontrolya spetsialnoy podgotovki basketbolistov [Innovative methods of control of special training of basketball players]. Aktualnyye problemy, sovremennyye tendentsii razvitiya fizicheskoy kultury i sporta s uchetom realizatsii natsionalnykh proyektov [Actual problems, modern trends in the development of physical culture and sports, taking into account the implementation of national projects]. Proceedings national scientific-practical conference with international participation. Moscow, 2021. pp. 909-918.
4. Bikmulina A.R., Fazleeva E.V. Primeneniye distantsionnykh obrazovatelnykh tekhnologiy po distsiplinam «Fizicheskaya kultura» i «Elektivnyye kursy po fizicheskoy kulture i sportu» [The use of distance learning technologies in the disciplines "Physical culture" and "Elective courses in physical culture and sports"]. Izvestiya Tulskogo gosudarstvennogo universiteta. Fizicheskaya kultura i sport. 2020. No. 3. pp. 12-20.
5. Weindorf-Sysoeva M.E., Fatkullin N.Yu., Shamshovich V.F. et al. Sovershenstvovaniye protsedury reytingovaniya vuzov po urovnyu razvitiya elektronnogo obucheniya [Improving the procedure for rating universities in terms of the development of e-learning]. Vestnik Tomskogo gosudarstvennogo universiteta. 2018. No. 437. pp. 165-170.
6. Matinyan A.O. Obrazovaniye v epokhu tsifrovizatsii [Education in the era of digitalization]. Vestnik Bishkekskogo gumanitarnogo universiteta. 2019. No. 3 (49). pp. 60-62.
7. Uvarov A.Yu., Gable E., Dvoretskaya I.V. et al. Trudnosti i perspektivy tsifrovoy transformatsii obrazovaniya [Difficulties and prospects of digital transformation of education]. Moscow: Vysshaya shkola ekonomiki publ., 2019. 343 p.
8. Shvab K. Chetvertaya promyshlennaya revolyutsiya [The fourth industrial revolution]. Shvab K. [transl]. Moscow: Eksmo publ., 2018. 285 p.
9. Shutova T.N., Yakuts E.I., Rybakova E.O. Osobennosti sozdaniya onlayn-kursov po fizicheskoy kulture i sportu [Features of creating online courses in physical culture and sports]. Uchenye zapiski universiteta im. P.F. Lesgafta. 2020. No. 12 (190). pp. 297-301.
10. Artamonov D.V., Osipova E.B., Averyasova Yu.O., Shutova T.N., Lubyshev E.A. Preimushchestva kiokushinkay karate dlya studentov biznes-shkol [Enefits of kyokushinkai karate for business school students]. Teoriya i praktika fizicheskoy kultury. 2019. No. 11. p. 14.
11. Masi E., James E. Peterman, Leonard A. Kaminsky. The Health Benefits of a Pedometer -Based 100,000 Steps. Journal of Science in Sport and Exercise. 2019. Vol. 1. No. 2. pp. 176-183.

Influence of physique on the physical fitness of pedagogical university students

UDC 796.011.3

PhD, Associate Professor **O.A. Bogdanov**[1]
Dr. Biol., Professor **E.N. Komissarova**[2]
Dr. Hab., Professor **L.L. Tsipin**[3]
Dr. Hab., Professor **A.V. Samsonova**[3]
[1]The Herzen State Pedagogical University of Russia, St. Petersburg
[2]St. Petersburg State Pediatric Medical University, St. Petersburg
[3]Lesgaft National State University of Physical Education, Sports and Health, St. Petersburg

Corresponding author: boafitness@mail.ru

Abstract

Objective of the study was to determine the dependence of the level of physical fitness of male students of a pedagogical university on the indicators of physique.

Methods and structure of the study. The experiment involved 43 first-year students of The Herzen State Pedagogical University of Russia at the age of 18-20 years, classified for health reasons to the main and preparatory medical groups. Body length and weight, body mass index, and percentage of body fat were measured as indicators of physique, which was calculated according to a standard method based on the thickness of skin-fat folds. The following tests were used to assess physical fitness: running 60 and 3000 m, pulling up on a high crossbar, lifting legs to the crossbar from a hanging position, long jump from a place, bending forward while standing on a gymnastic bench. Testing and measurement of physique indicators were carried out at the end of the second semester.

Results and conclusions. It was found that the body mass index of students is normal, and the percentage of fat in the body is above the norm (22.9±1.1%). It follows from this that when determining the compliance of body weight with the norm, the calculation of only the body mass index is insufficient - it is also necessary to take into account body composition. The test results showed the average level of students' physical fitness. Physique indicators significantly affect the results of tests that evaluate the speed and strength abilities of students. In this case, the correlation coefficient ranges from -0.61 to 0.52, with body fat having the greatest effect. However, the correlation of physique indicators with the results of tests for endurance, speed-strength abilities and flexibility turned out to be unreliable ($p>0.05$). The regularities obtained can serve as a basis for the development of physical culture programs for students, taking into account the need to correct the body composition of those involved.

Keywords: *students, physical fitness, physique, total body dimensions, body composition.*

Introduction. Specialists involved in research in the field of physical culture have recently noted a significant decrease in the level of physical fitness of students of higher educational institutions of the Russian Federation [4, 6]. One of the main components of a person's physical fitness is the degree of development of basic physical qualities, which are assessed by means of generally accepted tests. In the specialized literature there is evidence that there is a relationship between the level of physical fitness and the physique indicators of students of technical universities [7]. The same relationship was found for women of different ages during physical exercises [8]. It is appropriate to assume that such a relationship is also characteristic of other contingents of students, in particular, students of pedagogical universities. Identification of the factors that have the greatest impact on the level of physical fitness of students would make it possible to make adjustments to the curricula and programs on the subject "Physical Culture and Sports" for universities of various profiles.

Objective of the study was to determine the dependence of the level of physical fitness of male students of a pedagogical university on the indicators of physique.

Methods and structure of the study. The study involved 43 young men - first-year students of various faculties of the The Herzen State Pedagogical University of Russia. All of them, for health reasons, were assigned to the main and preparatory medical groups

and were engaged in physical culture in the group of general physical training. The age of the subjects at the time of the study was 18-20 years. Testing of physical fitness and measurement of physique indicators were carried out at the end of the second semester.

The level of physical fitness of students was determined on the basis of six tests widely used in practice: running 60 and 3000 m, pulling up on a high crossbar, raising legs to the crossbar from a hanging position, long jump from a place, bending forward while standing on a gymnastic bench with lowering hands below support level.

The students were tested under standard conditions after a warm-up. Running for 60 and 3000 meters was held at the stadium, the rest of the testing took place in the gym. In the long jump from a place, the best result of three attempts was counted.

Measurement of the total body dimensions of the subjects (body length and weight) was carried out using a medical stadiometer and scales. The percentage of body fat, which is an important characteristic of body composition, was determined from a nomogram based on measuring the thickness of two skin-fat folds: on the inner side of the lower leg and the outer side of the shoulder [10]. Measurements were made using a Lange caliper. This method, characterized by sufficient simplicity and accuracy, has become widespread with mandatory testing of students in a number of foreign countries. In addition to body fat content, body mass index (BMI) was calculated.

Experimental data were processed using the SPSS 24.0 statistical package.

Results of the study and their discussion. In Table 1 shows the average values of physique indicators and the results of testing students.

As can be seen from Table 1, the obtained values of the length and weight of the body of students are generally consistent with the data of other specialists [3,5]. The students' BMI is normal. At the same time, the percentage of fat in the body turned out to be above the norm, which, according to most researchers, ranges from 10 to 20% for young people of this age. The fact of excess fat content in the body of male students is also stated by other authors [7]. This allows us to conclude that, as we have already indicated [2], when determining whether the body weight is normal, the calculation of BMI is insufficient. It is necessary to take into account the composition of the body, that is, the ratio of fat and muscle tissue in the body.

The results of students' physical fitness tests on average correspond to 2.5 points on a five-point scale proposed by the Physical Education Program for universities [9], which can be assessed as an average level. The data obtained basically coincide with the results of similar studies conducted with the same contingent of students in other universities of the country. Although there are differences, due, in our opinion, to the different conditions in which testing was carried out [1].

To determine the relationship between the physique indicators and the test results of students, the correlation coefficients presented in Table 2 were calculated.

Analyzing the data in table 2, we can conclude that the body length of male students does not significantly affect the results shown in most tests that assess their physical fitness ($p>0.05$). A weak negative correlation is noted only with such an indicator as raising the legs to the crossbar in the hang, which is consistent with the data obtained by O.I. Ponomarev and P.P. Sivashchenko [7]. The body weight of the subjects affects the results in the 60 m run and in lifting the legs to the crossbar in the hang. The higher the body weight, the worse the results shown by those involved in these tests.

BMI significantly affects only the result in the 60-meter run. At the same time, there is an average correlation between the body fat content and the results in the 60-meter run, pull-ups on the bar and lifting the legs to the bar in the hang. Despite the fact that, as follows from the calculations, body weight and the percentage of body fat are interconnected

Table 1. *Total dimensions, body composition and test results of students,* **M±m** (n=43)

Body length, cm	Body weight, kg	BMI	% fat	60 m run, s	3000 m run, min, s	Pull-ups on the bar, number of times	Raising the legs to the crossbar, number of times	Standing long jump, cm	Standing forward bend, cm
178,2± 0,9	66,7± 1,0	21,0± 0,9	22,9± 1,1	8,5± 0,2	14.27,7± 18,3	9,3± 0,9	8,5± 0,5	233,9± 3,1	7,9± 0,7

Table 2. *Correlation coefficients between total sizes, body composition and test results of students (n=43)*

Indicators	60 m run, s	3000 m run, min, s	Pull-ups on the bar, number of times	Raising the legs to the crossbar, the number of times	Standing long jump, cm	Standing forward bend, cm
Body length, cm	0,16	- 0,07	- 0,27	- 0,34*	0,02	- 0,21
Body weight, kg	0,52**	0,21	- 0,25	- 0,37*	0,01	0,09
BMI	0,47**	0,25	- 0,11	- 0,22	0,01	0,22
% fat	0,52**	0,24	- 0,51**	- 0,61**	- 0,26	0,05

* p≤0,05; ** p≤0,01

(r=0.52), the results of tests characterizing the physical fitness of students are largely determined by the content of body fat.

It is noteworthy that all the considered indicators of the students' physique are not significantly related to the results in the 3000-meter run, standing long jump and standing forward bend. Standing long jump, unlike another test that characterizes speed and speed-strength abilities - 60-meter running, is largely determined by technique and possible performance errors (insufficient torso tilt during repulsion, premature lowering of the legs, etc.). This can explain the lack of connection between his result and physique indicators.

Conclusions. The results of the study allow us to conclude that when determining the compliance of body weight with the norm, the calculation of BMI is insufficient, it is also necessary to take into account the composition of the body, that is, the ratio of fat and muscle tissue in the body. The level of physical fitness of young students of the first year of a pedagogical university at the end of the second semester can be estimated as average. Physique indicators such as body length and weight, body mass index and body fat percentage affect to varying degrees the results of tests evaluating students' speed and strength abilities, but their relationship with the results of endurance tests, speed and strength abilities and flexibility is unreliable. The information obtained should be taken into account when developing physical education programs for students, and they should be focused, in particular, on reducing the percentage of body fat.

References

1. Aigubov N.M. Fizicheskaya podgotovka studentov nefizkulturnogo vuza sredstvami kikboksinga [Physical training of students of a non-physical education institution by means of kickboxing]. PhD diss. abstract. Shuya, 2010. 24 p.
2. Bogdanov O.A. Izmeneniye indeksa massy tela i soderzhaniya zhira v organizme studentov v protsesse zanyatiy fizicheskoy kulturoy [Changes in the body mass index and fat content in the body of students in the process of physical education]. Dvigatelnaya aktivnost i zdorovye uchashcheysya molodezhi [Motor activity and health of student youth]. Proceedings national scientific-practical conference "Herzen Readings". St. Petersburg: The Herzen State Pedagogical University of Russia publ., 2014. pp. 11-13.
3. Gorbatkova E.Yu., Zulkarnaev T.R., Akhmadullin U.Z. et al. Fizicheskoe razvitie studentov vysshih uchebnyh zavedeniy g. Ufy [Physical development of students of higher educational institutions in Ufa]. Gigiena i sanitariya. 2020. Vol. 99. No. 1. pp. 69-75.
4. G.N. Dronova et al. Uroven fizicheskoy podgotovlennosti studentov I kursa [The level of physical fitness of students of the 1st course]. Fizicheskaya kultura studentov [Physical culture of students]. Proceedings interuniversity scientific- method. conf.. St. Petersburg: SPbGMTU publ., 2008. 360 p.
5. Lumpova O.M., Kolokoltsev M.M. Kharakteristika fizicheskogo razvitiya yunoshey Pribaykalya [Characteristics of the physical development of young men of the Baikal region]. Fundamentalnyye issledovaniya. 2011. No. 11 (part 2). pp. 320-324.
6. Ponomarev G.N., Bogdanov O.A., Tsipin L.L. Vliyaniye totalnykh razmerov tela i soderzhaniye zhira v organizme na pokazateli fizicheskoy podgotovlennosti studentok [Influence of total body dimensions and body fat content on fe-

male students' physical readiness indicators]. Teoriya i praktika fizicheskoy kultury. 2014. No. 10. pp. 15-18.
7. Ponomarev O.I., Sivashchenko P.P. Vzaimosvyaz mezhdu intensivnostyu nagruzok i rezhimom pitaniya studentov pervogo kursa [The relationship between the intensity of the load and the diet of first-year students]. Izvestiya Rossiyskoy voyenno-meditsinskoy akademii. 2020. Vol. 39. No. 2. pp. 192-194.
8. Samsonova A.V., Komissarov E.N., Tsipin L.L. [Morphobiomechanical prerequisites for individualization of health-improving physical exercises]. Zdorovye, kak natsionalnoye dostoyaniye. St. Petersburg: NSU im. P.F. Lesgaft publ., 2010. pp. 385-442.
9. Ilyinich V.I., Evseev Yu.I. Fizicheskaya kultura [Physical culture]. Exemplary program for higher educational institutions. Moscow: GNII ITT «Informatika» publ., 2000. 72 p.
10. Slaughter M.H., Lohman T.G., Boileau R.A., Horswill C.A., Stillman R.J., Van Loan M.D., Bemben D.A. Skinfold equations for estimation of body fatness in children and youth. Hum. Biol. 1988. V. 60. No. 5. pp. 709-723.

Social and professional aspects of students forming competence in health-saving

UDC 378.172

Dr. Hab., Dr. Sc. Psychol., Professor **A.B. Serykh**[1]
Dr. Hab., Professor **E.I. Mychko**[1]
Ph.D., Associate Professor **A.E. Yakybovskaya**[1]
[1]Immanuel Kant Baltic Federal University, Kaliningrad

Corresponding author: annaserykh@rambler.ru

Abstract

Objective of the study was to reveal the features of the formation of students' health protection competence in the context of social and professional problems.

Methods and structure of the study. Empirical work was carried out on the basis of the Baltic Federal University. A diagnostic study was conducted with first and fourth year students using the questionnaire method, questionnaires "Index of attitudes towards health and a healthy lifestyle", "Attitudes towards health", which allow measuring the formation of structural components of the health saving competence.

Results and conclusions. The results of the diagnostics made it possible to note common features in the formation of the cognitive and emotional components. The indicators of the formation of the behavioral component reflected irregular activity in maintaining a healthy lifestyle in the majority of respondents. The peculiarities of the formation of students' health saving competence are determined by their attitude to health as a necessary condition for successful professional activity and unwillingness to make efforts in this direction.

Keywords: *educational space of the university, students, health, health saving competence.*

Introduction. The situation that has developed in education is due to the fact that as a result of mastering the educational program, a graduate of the university should be formed by a comprehensive set of competence. In relation to our study, special interest is the competence of the health of students.

With the essential characteristic of this competence, the student is the totality of value-semantic orientations, health-saving knowledge, skills that determine the emergence of experience of their own health-saving activities [4, p. 261]. One of the conditions ensuring the formation of this type of competence is considered by the health-saving space of the university. This space, in turn, has potential opportunities to increase students' satisfaction with training at the university [1, p. 28].

Studies by A.P. Lobanova, N.V. Drozdova, I.I. Kapalygina, A.B. Gray make it possible to distinguish the following components of the competence of health -saving: possession of knowledge of the content of competence; experience of competence; attitude to the content of competence; Emotional-first regulation of the manifestation of competence and readiness for the manifestation of competence [2, 3].

Objective of the study was to reveal the features of the formation of students' health protection competence in the context of social and professional problems.

Methods and structure of the study. The work was carried out on the basis of the Immanuel Kant Baltic Federal University. The respondents were 87 first-year students (16-18 years old) and 44 fourth-year students of humanitarian and pedagogical areas of training. The diagnostics was carried out using the author's questionnaire, focused on determining a person's competence in the field of health, and the questionnaires "Index of Attitude to Health and a Healthy

Lifestyle" (S. Deryabo, V. Yasin), "Attitude to Health (R.A. Berezovskaya).

Results of the study and their discussion. The results of the first stage of the pilot study showed that a healthy lifestyle was noted as an important life value by the majority of respondents - 91.9%, and almost all students (97.7%) believe that health is a key factor in successful professional activity.

The following reasons were indicated as the reasons for a healthy lifestyle: the desire to be beautiful - 80.4%; the need to lose weight - 57.4%; the need for physical activity - 82.7%; the desire to expand the circle of contacts - 45.9% and the requirements of modern fashion - 34.4%.

Some of the questions in the questionnaire reflected the attitude of first-year students to the state of their health. Interest in the problems of their health and a healthy lifestyle among the majority of students (81.6%) is manifested sporadically. When answering the question about assessing the state of their health, the results were as follows: 58.6% rated their state of health as "excellent", 28.7% - as "good", 12.6% - "satisfactory".

As regular classes, physical culture classes at the university (63.2%) and sports sections (36.7%) were noted. Walking with friends, going in for sports, going to the cinema, theater, and clubs were the most frequent types of leisure activities. 80.4% of the respondents answered that they do nothing specifically to maintain their health. The answer was unanimous about the need for a positive emotional mood in the classroom for any physical activity and in the issue of maintaining a healthy lifestyle (98.8%).

Diagnostics confirmed that a system of individual values is formed at the student stage. In the future, significant changes in the existing system of values occur only under the influence of significant changes (a change in the type of activity, illness, etc.).

At the next stage, the diagnostics of the formation of the components of health protection competence was carried out. Respondents were divided into two experimental groups: EG-1 included first-year students receiving humanitarian education, EG-2 - first-year students of pedagogical training.

The results of diagnosing the level of formation of the components of health protection competence allowed us to draw qualitative conclusions. Possession of knowledge of the content of competence in both groups was manifested in the following: the absence of bad habits, physical education and sports, rational nutrition, various procedures to maintain their health. Only among the respondents of EG-2 there were results close to the value understanding of health as success in various activities. The experience of manifestation of competence, as its structural component, is reflected through personality-oriented actions: physical training at the university, targeted visits to sports clubs, avoidance of situations that harm a healthy lifestyle, and the fight against bad habits. The scores in both groups did not differ significantly.

The results of the formation of attitudes towards the content of competence in the two groups showed that at the value level, health is next to material values, these types of values occupy the top positions. Indicators of the formation of emotional-volitional regulation reflected low values: weak activity in the organization of conscious work to preserve health, insufficient emotional response to actions to preserve health. The greatest differences in indicators were observed in the component of readiness to demonstrate competence, which we can explain by the peculiarities of preparing students for future professional activities.

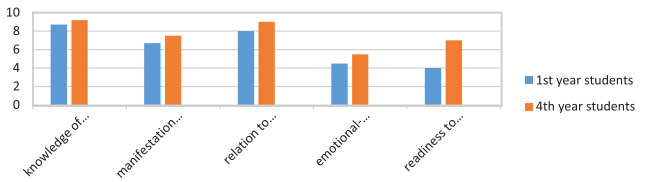
Summing up the results of this stage of the study, we can note the common features in the four formed components of health protection competence: students demonstrated knowledge of the main risk factors in the field of health, knowledge of the main ways to strengthen it. At the emotional level, health occupies a high position in the hierarchy of values, a healthy lifestyle is noted as the most important life value, but there are no stable positive emotions in relation to this value. At the behavioral level, most of the respondents

Comparative analysis of the results of the formation of components of health protection competence

Components	Formation indicators (EG-1)	Formation indicators (EG-2)
1. Possession of knowledge of the content of competence	7,9	8,7
2. Experience in the manifestation of competence	6,0	6,7
3. Attitude to the content of competence	7,1	8,0
4. Emotional-volitional regulation	4,1	4,5
5. Willingness to demonstrate competence	2,2	4,0

show activity irregularly. The specificity in the formation of components of health protection competence is due to a complex of professional competencies determined by labor actions and labor functions.

At the next stage of the research work, the diagnostics of the formation of the components of health protection competence in students of the 1st and 4th courses receiving pedagogical education was carried out. Since the greatest differences were observed in the level of formation of the readiness component, we assumed a connection between the result obtained and the target orientation of the training of future teachers. When considering the obtained indicators, it can be stated that, as in the case of diagnosing the formation of components of health protection competence in groups EG-1 and EG-2, differences are observed in the level of formation of the component of readiness for the manifestation of competence. The training of future teachers is based on the principle of health saving as the basis for the formation of key competencies. The pedagogical practice of future teachers allows students to demonstrate by the 4th year the normatively given competence of health preservation as professionally and personally significant in the performance of professional activities.



The results of the formation of components of health protection competence among students of pedagogical specialties

The conducted pilot study allows us to conclude that the peculiarities of the formation of health protection competence among students should be considered through the prism of its component composition. In this vein, health-saving competence is a component of general professional training of students outside the framework of a specific narrow specialty.

Conclusions. The results of the study indicate that the problem of forming students' health-saving competence is due to the contradiction existing in the student society: on the one hand, health and a healthy lifestyle are understood as necessary conditions for successful professional activity, and on the other hand, there are difficulties in positively transforming the internal position towards awareness values of health and readiness to make efforts in this direction.

References

1. Vakhnin N.A., Makhovikov A.B., Sharok V.V. Rol fizicheskoy kultury i sporta v udovletvorennosti studentov obucheniem v universitete [The role of physical culture and sports in student satisfaction with university education]. Teoriya i praktika fizicheskoy kultury. 2019. No. 4. pp. 28-30.
2. Drozdova N.V., Lobanov A.P. Kompetentnostnyy podhod kak novaya paradigma studentocentrirovannogo obrazovaniya [Competence-based approach as a new paradigm of student-centered education]. Minsk: RIVSH publ., 2007. 100 p.
3. Kapalygina I.I., Serykh A.B. Zdorovesberezhenie shkolnikov v informacionno-bezopasnom prostranstve: teoriya i praktika [Health saving of schoolchildren in the information-safe space: theory and practice]. Kaliningrad: BFU im. I. Kanta publ., 2018. 270 p.
4. Rybina I.R. Sushchnost ponyatiya «zdoroves-beregayushchaya kompetentnost» [The essence of the concept of "health-saving competence"]. Uchenye zapiski OGU. 2015. No. 3 (66). p. 2

Body as a factor of individualization of physical education lessons of university students

UDC 796

PhD, Associate Professor **T.V. Bushma**[1]
PhD, Associate Professor **O.V. Mironova**[2, 3]
PhD, Associate Professor **A.V. Sharonova**[4, 5]
I.L. Bondarchuk[1]
[1]Peter the Great St. Petersburg Polytechnic University, St. Petersburg
[2]Bobkov Saint Petersburg branch of Russian Customs Academy, St. Petersburg
[3]Saint Petersburg State University, St. Petersburg
[4]Russian State Hydrometeorological University, St. Petersburg
[5]The State Institute of Economics, Finance, Law, and Technology, Gatchina

Corresponding author: mironova.olga2014@gmail.com

Abstract

Objective of the study was to development and approbation of means of physical culture in the interests of increasing the level of physical fitness of students, depending on the type of physique.

Methods and structure of the study. The development was carried out on the basis of three universities in the period from 2020 to 2021 St. Petersburg and the Leningrad region. In the course of the work, indicators of physical development, physical fitness of the contingent and body types of students (230 people) were determined according to the traditional method. Constant monitoring of indicators of physical fitness, attendance and motivation for physical culture and sports was carried out.

Results and conclusions. As a result of the development, the method of individualization of physical culture classes of students based on their typological characteristics was substantiated and tested, which contributed to an increase in the level of physical fitness and had a positive effect on the effectiveness of the process. The result is a pronounced effect of the program on students of the hypersthenic type, which is reflected in a greater percentage of satisfactory results when passing control exercises compared to other typological groups.

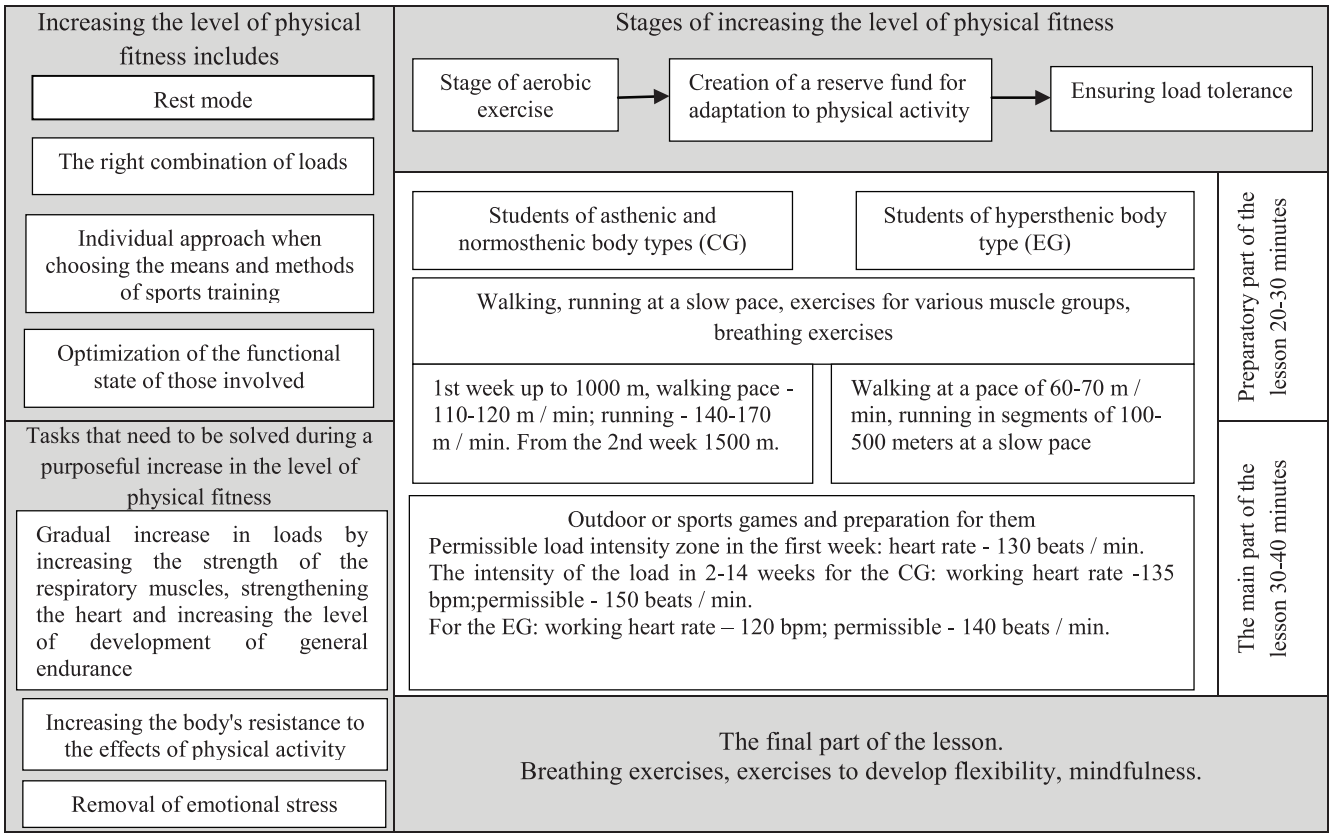
Keywords: *students, physical development, physical training, physical activity, body type, methodology.*

Introduction. The analysis of modern researches in the field of physical culture of students, presented in the scientific literature, is characterized to a large extent by the level of the functional state of those involved, anthropometric indicators and the development of mental qualities, motivational bases of the process, etc. [1,4]. As practice shows, in each educational institution there is a certain percentage of students who perform control exercises for a minimum score or even below the threshold established by the discipline program [5,6]. Insufficient level of physical fitness is a special state of the body, which is due to a weak systemic relationship between the components of physical fitness, as well as the "lag" of its individual elements [2,3,7,8]. Statistical data indicate that more than 80% of students with a low level of physical fitness have a hypersthenic body type, which makes it difficult to achieve the normative indicators of the physical education training process [7].

The creation of individual educational routes in the paradigm of modern education occupies a key place in increasing the effectiveness of training and achieving the maximum educational effect. Due to the prevailing nature of hypersthenic students who are lagging behind in physical culture, we see it relevant to substantiate special programs for accounting for the objective characteristics of this contingent in order to select physiologically and functionally justified individualized means of pedagogical influence.

Objective of the study was to development and approbation of means of physical culture in the interests of increasing the level of physical fitness of students, depending on the type of physique.

Methods and structure of the study. An analysis of the level of physical fitness of 230 students was carried out in 2020-2021. on the basis of Peter the Great St. Petersburg Polytechnic University, St. Petersburg State University and the State Institute of Economics,



Methodology for increasing the level of physical fitness of students

Finance, Law and Technology. Trainees with a satisfactory level of physical fitness were divided into control (CG) and experimental (EG) groups. The CG included students of asthenic and normosthenic body types, and the EG students of hypersthenic type.

To assess the effectiveness of the experimental program of the study, indicators of physical development, physical fitness, mode of physical activity, as well as the dynamics of these indicators were determined.

Results of the study and their discussion. Based on the analysis of scientific and methodological literature, a survey of teachers of St. Petersburg State University and the State Institute of Economics, Finance, Law and Technology in the framework of the use of means and methods of general physical training of students with a satisfactory level of physical fitness, an experimental methodology was developed using the principle of group individualization (see picture).

The basis of the experimental program was aerobic exercises, which favorably affect the formation of the necessary adaptive changes and reduce excess weight. No less important place was occupied by the issues of nutrition and maintaining a sufficient motor regime in the weekly cycle. The forms of self-control and counseling were updated. To reduce monotony and maintain motivation, aerobic activities included outdoor and sports games.

The use of aerobic exercise, especially at the initial stage of the experiment, contributed to the development of endurance, weight loss through the use of energy carbohydrate and fat sources, which created the necessary physiological basis for increasing physical activity in the future. At this stage, in planning the training of students of the hypersthenic type, exercises of moderate power and longer rest intervals were used, allowing students to fully restore their working capacity before performing the next exercise. A special place was occupied by exercises to strengthen the musculoskeletal system. In the course of theoretical classes, competencies in a healthy lifestyle (HLS) and the physiological foundations of training were formed.

At the second stage, due to the increase in the volume of physical activity and its direction, there was an increase in the functional capabilities of the trainees, which made it possible to improve the working capacity of the trainees through the formation of basic adaptive attitudes to physical loads close in magnitude to

Change in the studied indicators of students for the period of the experiment

Indicators	Group	Start experiment	End of experiment	$\bar{X}2\pm\bar{X}1$	Δ
		$\bar{X}1\pm m1$	$\bar{X}2\pm m2$		
100 m run, s	EG	13,66±0,40	13,21±0,25	-0,45	*
	CG	13,63±0,41	13,58±0,43	-0,05	
3000 m run, s	EG	778,60±33,04	715,23±37,16	-62,32	**
	CG	777,55±33,01	772,18±34,26	-5,37	
Pull-ups on the bar, times	EG	14,88±2,64	16,42±2,48	1,54	*
	CG	14,91±2,63	15,22±2,61	0,31	

*Note:*** – p<0,01; * – p<0,05.

the level of loads characteristic of students with good and excellent levels. physical fitness. In addition, all this together made it possible to apply more intense loads that contribute to the inclusion of fat sources in the energy regime to ensure physical work, which is important for the hypersthenic type. At this stage, special attention was paid to the observance of the rules of balanced and proper nutrition, observance of work and rest regimes.

The third stage was characterized by the provision of resistance to increased intensity of loads. During this period, strength exercises were also included in the classes, since if there is sufficient preparedness for hypersthenics, this type of exercise is no less important than aerobic exercise. In the process of strength training, the muscles use glucose, which they are able to extract from the blood circulation in a non-insulin way. In addition, the level of general exchange also increases. The program involved the use of strength exercises with their own weight or light weights, but using a large number of repetitions. In this part, the interval training method was used.

One of the important features of the proposed methodology of physical exercises was the use of various means that aroused interest among those involved, the creation of a positive emotional background. At the same time, the factor of accessibility of physical activity to the condition of those involved, control and self-control over the recovery process, excluding overwork, contributed to the achievement of a positive pedagogical effect. This is consistent with the provisions of the theory and practice of physical culture regarding the adequacy of the applied means and methods to the physical condition of those involved, not leading to their overwork, contributing to the normalization or improvement of body functions, and also taking into account individual typological features [1-5].

The dynamics of the level of physical fitness of students for the experimental period is presented in the table.

Changes in the level of physical fitness occurred only in the EG. In the 100 m run, the improvement was 0.45 s (at p<0.05), in the pull-ups on the crossbar - an improvement of 1.54 times (at p<0.05), in the 3000 m run - the improvement was 62, 32 s (at p<0.01).

Conclusions. The results of the conducted research indicate that in the classroom with students with a satisfactory level of physical fitness, related to the hypersthenic body type, it is advisable to rationally dose the load and smoothly increase it, especially at the initial stage of the predominantly uniform method. This made it possible to form the basis for the formation of a higher level of basic adaptive attitudes. The formation of persistent functional shifts that allow training without sharp responses from the body is an advantage of the experimental method of training with students of hypersthenic body type.

The use of physical culture means in the program, which increase the emotional background of classes, as well as the formation of competencies to maintain a healthy lifestyle, contributed to the depressing effect of monotony and increased motivation of those involved. The initial focus on the individualization of physical activity (individually optimal pace, sufficient duration of rest pauses between loads, special standardization of loads in a series) favored an increase in the level of development of students' physical fitness, including general endurance, and also allowed the body of those involved to quickly adapt to a stepwise increase loads.

According to the data of the students' survey after the end of the experiment, the individualization of the process of physical culture had a positive effect on their familiarization with the systematic physical culture and an increase in the volume of physical activity.

References

1. Baturin A.E., Kovalenko V.N., Katkov A.E. Uchet somatotipov studentov pri vybore sredstv i metodov fizicheskoy kultury [Consideration of students' somatotypes when choosing means and methods of physical culture]. Pedagogicheskiy zhurnal, 2019. Analitika Rodis. Vol. 9. No. 3-1. pp. 103-111.
2. Bakhtin T.N., Lesheva N.S. Monitoring fizicheskoy formy studentov pervogo kursa sankt-peterburgskogo gosudarstvennogo lesotekhnicheskogo universiteta imeni S.M. Kirova [Monitoring of the physical form of first-year students of St. Petersburg State Forest Engineering University named after S.M. Kirova]. Aktualnyye problemy, sovremennyye tendentsii razvitiya fizicheskoy kultury i sporta s uchetom realizatsii natsionalnykh proyektov [Actual problems, modern trends in the development of physical culture and sports, taking into account the implementation of national projects]. Proceedings national scientific-practical conference with international participation. Moscow, 2021. pp. 27-32.
3. Katkov A.E., Kovalenko V.N., Sklyarova I.V. et al. Metodika differentsirovannoy trenirovki studentov, imeyushchikh nizkiye pokazateli v bege na 3000 metrov [Methods of differentiated training of students with low performance in running 3000 meters]. Uchenye zapiski universiteta im. P.F. Lesgafta. 2019. No. 11 (177). pp. 155-160.
4. Lobanov Yu.Ya., Mironova O.V., Tokareva A.V. et al. Metodika podgotovki studentov s nizkim urovnem fizicheskoy podgotovlennosti k vypolneniyu normativov VFSK GTO [Methods of training students with a low level of physical fitness to fulfill the standards of the VFSK GTO]. Uchenye zapiski universiteta im. P.F. Lesgafta. 2017. No. 9 (151). pp. 170-174.
5. Lobanov Yu.Ya., Kovalenko V.N., Mironova O.V. et al. Metodika trenirovki studentov s nizkim urovnem fizicheskoy podgotovlennosti [Methods of training students with a low level of physical fitness]. Uchenye zapiski universiteta im. P.F. Lesgafta. 2018. No. 2 (156). pp. 126-130.
6. Lobanov Yu.Ya., Kovalenko V.N., Mironova O.V. et al. Kharakter proyavleniya fizicheskikh kachestv v zavisimosti ot tipologicheskikh osobennostey konstitutsii studentov [The nature of the manifestation of physical qualities depending on the typological features of the constitution of students]. Uchenye zapiski universiteta im. P. F. Lesgafta. 2018. No. 2 (156). pp. 122-126.
7. Fofanov A.M., Kovalenko V.N., Kotov P.A. Fizicheskaya podgotovka kursantov vuzov Sukhoputnykh voysk Vooruzhennykh Sil Rossiyskoy Federatsii v XXI veke [Physical training of cadets of universities of the Land Forces of the Armed Forces of the Russian Federation in the XXI century]. 2020. No. 1. St. Petersburg: VIFK publ., pp. 29-33.
8. Yarchikovskaya L.V., Sharonova A.V., Ustinova O.N. Upravleniye predekzamenatsionnym sostoyaniyem studentok sredstvami i metodami fizicheskogo vospitaniya [Management of the pre-examination state of female students by means and methods of physical education]. Teoriya i praktika fizicheskoy kultury. 2020. No. 6. pp. 29-31.

Satisfaction indicators of athletes with damage of the locomotor apparatus with the organization of competitions in cybattle

UDC 796.077-056.266

PhD, Associate Professor **A.V. Kornev**[1]
PhD, Associate Professor **A.V. Shvetsov**[2]
PhD, Associate Professor **D.M. Pravdov**[1]
N.E. Ereshko[1]
[1]Russian State Social University, Moscow
[2]Financial University under the Government of the Russian Federation, Moscow

Corresponding author: av-kornev@mail.ru

Abstract

Objective of the study was to analyze the degree of satisfaction of athletes with lesions of the musculoskeletal system with the organization of competitions in cybatletics.

Methods and structure of the study. To achieve the goal of the study, a survey was conducted of athletes with lesions of the musculoskeletal system as part of open competitions in cybatletics, which took place from March to May 2021 on the basis of the Russian State Social University. The survey involved 80 people (58 men and 22 women). Athletes had to answer questions in which they assessed their attitude to holding and organizing kibatletics competitions on a 10-point scale.

Results and conclusions. A survey of athletes who took part in kibatletics competitions made it possible to identify the degree of satisfaction with the organization and conduct of the competitions. The degree of satisfaction was studied according to the following parameters: the general level of organization and holding of competitions in cybatletics; competition schedule; favorable atmosphere during familiarization with the track and the competition; catering; the quality of work of the refereeing team and volunteers.

Keywords: *skibathletics, quality of competitions, degree of satisfaction, athletes with musculoskeletal disorders.*

Introduction. The study of the quality of competitions allows to identify the need and satisfaction of athletes in the field of physical culture and sports services [5]. In adaptive sports, such studies are relevant, since when organizing and holding sports events, it is necessary to take into account the peculiarities of the nosology of participants, the availability of technical means of rehabilitation (RTM), the accessible environment, etc. [2].

In the theory and methodology of adaptive sports, there are studies devoted to the analysis of the degree of satisfaction of persons with disabilities with the process of holding various competitions [3-5, 7]. Currently, new types of adaptive physical culture and sports are emerging that need a comprehensive analysis, including in the field of sports management and marketing.

One of the new directions in adaptive physical culture is kibatlon and kibatletics [1]. For the first time, the idea of holding such competitions was implemented in 2016 by Robert Reiner, a professor at the Swiss Higher Technical School in Zurich; the competitions were called cybathlon [8]. In Russia, this direction was called kibatletika, which has been implemented by the non-profit organization "Union of Developers and Suppliers of Technical Means of Rehabilitation "Kibatletika" (Union "Kibatletika") since 2016 [6].

The purpose of these competitions is that participants with disabilities and using technical means of rehabilitation (TMR) overcome specially prepared tracks with recreated various motor situations that a person with a disability encounters daily in everyday life. For example, overcoming road obstacles, barriers and steps for people with prosthetic legs or moving in an electric wheelchair; setting the table, screwing in an electric lamp and other manipulations with prosthetic hands. The task of the participants

(or kibatlets) is to accurately pass all the elements of the route in the minimum time. For each correctly performed element of the competitive course, the kibatlet is awarded points, the sum of which is taken into account in the final protocol. With the same amount of points, a higher place is awarded to the kibatlet, which spent less time on the route [1].

Objective of the study was to analyze the degree of satisfaction of athletes with lesions of the musculoskeletal system with the organization of competitions in cybatletics.

Methods and structure of the study. In order to analyze the degree of satisfaction of athletes with lesions of the musculoskeletal system with the organization of competitions, a survey was conducted as part of open competitions in cybatletics, which took place from March to May 2021 on the basis of the Russian State Social University. The organizers of the competition were the "Kibatletika" Union and the Faculty of Physical Education of the Russian State Social University [6]. The competition participants were surveyed using an online service for creating feedback forms, online testing "Google Forms". Answers to questions were evaluated on a 10-point scale depending on the degree of significance: 1-2 points - absolutely dissatisfied (by), 3-4 points - dissatisfied (by), 5-6 points - partially satisfied (by), 7-8 points - satisfied (at), 9-10 points - completely satisfied (at).

The survey involved 80 people (58 men and 22 women) from Moscow and St. Petersburg, Vladimir, Arkhangelsk, Belgorod, Kaliningrad, Kemerovo, Kirov, Leningrad, Nizhny Novgorod, Novgorod, Novosibirsk, Penza, Pskov, Rostov, Samara, Sverdlovsk, Smolensk, Tomsk, Yaroslavl regions, Republics of Bashkortostan and Tatarstan, Udmurt Republic, Krasnoyarsk and Krasnodar territories.

Results of the study and their discussion. An analysis of the general data of the survey participants revealed the following ratio by disability groups: with the 3rd disability group - 60%; with the 2nd disability group - 16.25% and with the 1st disability group - 23.75%. By belonging to the disciplines of cybatletics, the participants were represented approximately equally: prosthetic hands - 27.5%; hip prostheses - 28.75%; lower leg prostheses - 22.5%; electrified wheelchairs - 21.25%. The main results of the survey are presented in the table.

80% of kibatlets were completely satisfied with the overall level of organization and conduct of the competition, 16.25% were satisfied and only 3.75% noted that they were partially satisfied. The answers of the participants show that the organizers have made every effort to make the competition comfortable and have tried to take into account all possible nuances. Estimates of 1-2 points - absolutely dissatisfied (at) and 3-4 points - not satisfied (at) in this issue were absent.

Cybatletics competitions were held from March to May, which made it possible for athletes to choose convenient dates for participation. 92.5% of the respondents were completely satisfied with this option of holding the competition, 2.5% were satisfied and 5% of the athletes were partially satisfied.

Participation in the competition consisted of two parts. In the first part, the participants were given time to get acquainted with motor tasks on the track (at least 90 minutes). During this time, the volunteers conducted warm-up classes in adaptive physical culture, the judges gave safety instructions, the general passage of the track and its individual elements. As soon as they were ready, the kibatlets were invited by the judges to the starting line and completed the competitive passage of the track. The results of motor tasks (elements) fulfillment and the time of overcoming the route were recorded in the final protocol of the competition. All passages of the route were recorded on video, mounted in separate videos, where the passages of athletes were combined in accordance with the rating of a certain

Results (%) of the survey of participants on cybatletics (n=80)

Questions	Points				
	10-9	8-7	6-5	4-3	2-1
General level of competition organization	80	16,25	3,75	-	-
Competition schedule	92,5	2,5	5	-	-
Favorable atmosphere during training and competitions	96,25	3,75	-	-	-
Catering	95	2,5	2,5	-	-
The quality of the work of judges	97,5	2,5	-	-	-
The quality of volunteer work	92,5	7,5	-	-	-

federal district. All videos were made available to the athletes on the YouTube platform on the day the results were announced.

A favorable atmosphere during the training process and competitions is one of the important factors for the successful organization of events, which was confirmed by the results of a survey of participants. 96.25% of the respondents were completely satisfied, 3.75% of the athletes were satisfied, which indicates a favorable and comfortable psychological atmosphere during the competition. The data obtained during the survey proves the importance of preliminary seminars and conversations with the judging team and volunteers on the topic of ethics in the professional activities of specialists in adaptive physical culture, which were held before the competition.

During the competition, hot meals were organized for the kibatlets. This fact turned out to be very significant for the participants, which is confirmed by the results of the survey: for 95% of the participants, this moment in the competition caused complete satisfaction, and 2.5% were satisfied or partially satisfied.

The training of the referee team in the organization of sports events is the foundation for the effective conduct of competitions. The problematic issue is the interpretation of the rules for cybatletics in terms of passing a sports track, where there are many variations in the performance of individual elements of the task. The judging panel included teachers and senior students of the Faculty of Physical Education of the Russian State Social University. To train the referee team, two seminars were held, where the conditions for passing the route were considered in detail, taking into account nosology, trauma and the use of TMR.

During the training stage, before passing the track for the result, the refereeing team carried out consultations on each task of the track with a detailed analysis of the most common mistakes that were identified at the past competitions. All athletes received the same information, thanks to which they could independently draw up a scheme for passing the route through the elements, based on their own individual capabilities. During the passage of the route, especially in the category of electric wheelchairs, lower leg prostheses and hip prostheses, the referee team and volunteers carried out belaying the kibatlets on those elements of the route that could cause a risk of injury. Thanks to these actions of the judges, the risk of injury was reduced, and no injuries were recorded during the competition.

Analysis of the quality of work of the referee team by the participants of the competition revealed that: 97.5% of athletes are completely satisfied and 2.5% are satisfied. There were no ratings for 1-6 points in this question. An analysis of the answers to this question showed that the systematic training of judges and volunteers in terms of the ethics of behavior and a detailed analysis of the rules in kibatletics made it possible to conduct high-quality competitions.

The participants assessed the activity of volunteers in the process of holding a sporting event as follows: 92.5% are completely satisfied and 7.5% are satisfied with the work of volunteers.

The question “Participation in cybatletics gave me the opportunity to gain new knowledge and experience in using technical means of rehabilitation” was asked to answer with simple statements, where 82.5% of respondents answered in the affirmative, 2.5% answered “no” and 15% found it difficult to answer.

78 people (97.5%) expressed their desire to take part in kibatletics competitions again, and only two (2.5%) athletes answered negatively.

Expanding the possibilities of performing social and household operations is the main task of using TMR in everyday life by people with lesions of the musculoskeletal system (LMS). Through participation in cybatletics competitions, 75% of participants expanded their ability to use TMR in everyday life. 10% of athletes answered negatively to this question and 15% of respondents found this question difficult.

Conclusions. Analysis of the satisfaction of athletes with lesions of the musculoskeletal system with the organization and holding of competitions in kibatletics showed that the competitions were organized and held at a high level, the vast majority of respondents were completely satisfied with the competitions.

Additional surveys of respondents made it possible to identify shortcomings in the organization and conduct of competitions, they concerned the accessible environment and the need to consider the differentiation of disciplines by class of athletes (for example, an athlete with a prosthesis of one hand competes on an equal basis with an athlete who has prostheses of both hands). The use of medical and sports-functional classification (on the example of the Paralympic movement) will ensure fair competition between disabled athletes in kibatletics [2].

However, this issue also lies in the international plane, where these distinctions are not provided for in the official rules of the Cybathlon World Championship.

References

1. Davidyuk A.P., Lyubinsky A.V., Shvetsov A.V. Kibatletika – novyy proyekt v AFK [Kibatletika - a new project in Adaptive physical culture]. Adaptivnaya fizicheskaya kultura. 2020. No. 4. pp. 57-58.
2. Evseev S.P. Teoriya i organizatsiya adaptivnoy fizicheskoy kultury [Theory and organization of adaptive physical culture]. Textbook. 2nd ed., ster. Moscow: Sport-Chelovek publ., 2020. 616 p.
3. Kornev A.V., Karpova H.V., Bakai I.N. et al. Organizatsiya inklyuzivnykh sportivnykh sorevnovaniy v usloviyakh vuza [Organization of inclusive sports competitions in the conditions of the university]. Teoriya i praktika fizicheskoy kultury. 2021. No. 7. pp. 35-37.
4. Korneva M.A., Makhov A.S. Pokazateli udovletvorennosti sportsmenov-invalidov s porazheniyem oporno-dvigatelnogo apparata organizatsiyey sportivnykh sorevnovaniy po russkomu zhimu [Indicators of satisfaction of disabled athletes with lesions of the musculoskeletal system with the organization of sports competitions in the Russian bench press]. Adaptivnaya fizicheskaya kultura. 2014. No. 2 (58). pp. 32-35.
5. Makhov A.S. naliz udovletvorennosti sportsmenov-invalidov sorevnovaniyami v adaptivnom sporte (na primere Paraspartakiady Tsentralnogo federalnogo okruga) [Analysis of satisfaction of athletes with disabilities with competitions in adaptive sports (on the example of the Paraspartakiad of the Central Federal District)]. Omskiy nauchnyy vestnik. 2011. No. 3 (98). pp. 151-153.
6. Ofitsialnyy sayt Soyuza «Kibatletika» [Official website of the Cybathletics Union] [Electronic resource]. Available at: http://cybathletics.ru/ (date of access: 10.02.2022).
7. Rysakova A.S., Makhov O.G. Udovletvorennost uchebno-trenirovochnym protsessom vysokokvalifitsirovannykh snoubordistov s narusheniyem slukha [Satisfaction with the training process of highly qualified snowboarders with hearing impairment]. Adaptivnaya fizicheskaya kultura. 2015. No. 3 (63). pp. 39-41.

Teaching parents of children with disabilities exercises in adaptive physical culture

UDC 796.011.3

I.A. Lnenichka[1]
PhD, Associate Professor **I.N. Bakay**[2]
PhD, Associate Professor **N.V. Karpova**[2]
PhD, Associate Professor **V.P. Kartashev**[2]
[1]N.N. Blokhin Russian Cancer Research Center, Research Institute of Pediatric Oncology and Hematology, Moscow
[2]Russian State Social University, Moscow

Corresponding author: lnenichkaira@mail.ru

Abstract

Objective of the study was to experimentally substantiate the methodology for teaching parents of children with disabilities to adaptive physical education exercises.

Methods and structure of the study. The scientific work was carried out on the basis of the rehabilitation center LLC Center for Rehabilitation and Adaptive Physical Education "Together with mom" (Moscow) in the period from August 2020 to February 2021. The methodology of teaching parents contained the following means and methods of APC: correctional-directed exercises (Adaptive physical culture) APC; correctional and developmental mobile game; joint gymnastics; short seminars with parents; remote feedback method between parents and APC instructor.

Results and conclusions. A modified method of teaching parents, children with disabilities, exercises of adaptive physical culture, has shown its effectiveness during the rehabilitation course for children. This achievement is due to the use of combining the theoretical part with the practical, as well as the possibility of establishing high-quality feedback between the instructor and parents during training.

Keywords: *adaptive physical culture, children with disabilities, rehabilitation, physical rehabilitation.*

Introduction. The problem of rehabilitation treatment of children with disabilities takes place in the modern world, even despite the high degree of development and technological effectiveness of the rehabilitation process [3].

For children with disabilities, the family plays an important role in the restoration and formation of motor adaptation. The child spends all the remaining time from one rehabilitation course to another while at home.

This fact made it possible to identify the existing contradiction between the objective need for the implementation of the methodology for teaching parents the exercises of adaptive physical culture (APC) and the lack of scientific and methodological support for their content, the growing need to improve the process of rehabilitation of children with disabilities (limited health opportunities).

Objective of the study was to experimentally substantiate the methodology for teaching parents of children with disabilities to adaptive physical education exercises.

Methods and structure of the study. The scientific work was carried out on the basis of the rehabilitation center LLC "Center for Rehabilitation and Adaptive Physical Education "Together with Mom" (Moscow) from August 2020 to February 2021. An experimental group of parents and their children with disabilities was formed, which was differentiated into two subgroups, according to the functional capabilities of children. 16 parents and 16 children with disabilities took part in the pedagogical experiment. The first experimental group of parents and children with disabilities consisted of six parents and children who were determined in accordance with the diagnosis and the level of functional abili-

ties of children - functionally moving in a seated support. The second experimental group included 10 parents and children with disabilities, who were united on the basis of the diagnosis and the level of development of the motor sphere of children - functionally moving with support vertically.

The presented modified methodology pursues the main goal - improving and maintaining the rehabilitation potential of children with disabilities, by performing joint APC classes with parents, with feedback from an APC specialist who teaches the basics of APC.

Regardless of the correlation of the subjects to the subgroup, the duration of one lesson was 60 minutes, which was divided into 30 minutes - these are seminars, and the next 30 minutes - practical classes of APC for parents with children with disabilities. Classes were held twice a week, each experimental group had a schedule of days and times of visit. The definition of such a training schedule was drawn up taking into account the recommendations of specialists: a neurologist, a clinical neuropsychologist, a speech pathologist.

In total, the training course included eight sessions for each group, which were conducted at the time of the rehabilitation course for children with disabilities.

To control the implementation of APC exercises at home, an APC specialist was remotely in touch. This type of interaction involved the provision by parents to the APC instructor of video reporting material from joint APC home classes with children with disabilities.

The method of teaching parents contains the following means and methods of adaptive physical culture: corrective-directed APC exercises; correctional and developing outdoor game; articular gymnastics; short seminars with parents; remote feedback method between parents and APC instructor. Seminars with parents were held before practical joint classes with children with disabilities, which contributed to the implementation of the basis of didactics: the connection between theory and practice. For a better understanding and consolidation of the material being taught, parents were recommended to read methodological literature in addition to practice [1, 2, 4-6].

Having studied the clinical picture of the main diagnoses of children with disabilities, we have identified one of the problems of impaired functioning of the musculoskeletal system, which manifests itself in the following: curvature of the spine, contractures in the joints that limit the range of motion, low muscle tone, synkinesis.

Joint gymnastics, proposed for further joint activities of parents with children, included the following exercises:

In the supine position: performing flexion-extension in the shoulder joint of the arm, straightened in the elbow joint; performing flexion-extension of the leg in the hip and knee joints; performing a cross movement of a straight arm and flexion-extension of the leg in the hip and knee joints, body lifts (a roller is placed under the knees).

In the supine position: performing flexion-extension of the arm in the elbow and shoulder joints; performing flexion-extension of the leg in the knee joint; extension of the back, with the rise of the chest from the surface; abduction and adduction of the leg bent at the knee.

During the training in articular gymnastics exercises, the safest and most comfortable ways to perform movement and fixation of the limb were also explained to parents.

Results of the study and their discussion. The results of testing parents for knowledge of APC showed a positive trend in the development of theoretical material on the basic concepts of APC by the subjects, which was reflected in the comparison of the average values of the test results (the number of correct answers for each of the respondents), before training - 5.5 ± 1.0 and after training – 8.8±0.7.

In two experimental groups of the studied children with disabilities, the development of the functional state of the child's body and motor skills improved from the moment of the first day of the rehabilitation process until the 30th day of rehabilitation.

The percentage of the results of measurements in children with disabilities of the experimental group 1 on the 30th day of rehabilitation relative to the 1st day is presented as follows: sitting without support (s) - the average values of this exercise increased by 53%; plank through the ball on straight arms (c) - the average values of holding this body position increased by 29%; push-ups from a fitball with fixation of the pelvis (number) - the number of repetitions in compliance with the technical features increased by 60%; transition from a lying position to a sitting position (s) – the speed of this motor action performance improved by 3%.

The percentage of the results of measurements in children with disabilities of the experimental group 2 on the 30th day of rehabilitation relative to the 1st day is presented as follows: getting up from a chair without support (s) - the speed of this exercise improved by 20%; walking 5 minutes with support - the distance of the path in 5 minutes increased by 62%; standing facing the wall - 40% increase in the time of holding a static position; keeping oneself on an unstable support - the time for performing this exercise increased by 93%; walking for 5 minutes with support through obstacles - the distance of the path in 5 minutes increased by 42%.

To assess the assimilation and use by parents of the trained APC exercises at home, according to the method modified by us, the measurement indicators of the 30th day of homework were compared with the 30th day of the rehabilitation course. The difference in the average values of indicators is presented as a percentage. The percentage of the results of measurements in children with disabilities in the experimental group 1 on the 30th day of homework relative to the 30th day of the rehabilitation course are presented as follows: sitting without support (s) - holding this position in time increased by 13%; plank through the ball on straight arms (s) - the time of holding the position increased by 13%; push-ups from a fitball with fixation of the pelvis (number) - the number of repetitions of this exercise increased by 19%; transition from a lying position to a sitting position (s) - the speed of performing this action improved by 8%.

The percentage of the results of measurements in children with disabilities of the experimental group 2 on the 30th day of homework relative to the 30th day of the rehabilitation course are presented as follows: getting up from a chair without support (s) - the speed of this exercise improved by 15%; walking 5 minutes with support - the distance of the path for 5 minutes increased by 7%; standing facing the wall - the time of holding the position increased by 11%; holding yourself on an unstable support - the time of holding the position increased by 42%; walking 5 minutes with support through obstacles - the distance of the path for 5 minutes increased by 6%;

Despite the small dynamics of the percentage of functional testing indicators from the 30th day of APC homework relative to the 30th day of the rehabilitation course, the motor sphere of children with disabilities develops and maintains the achieved result of the functional state at the time of physical rehabilitation.

After completing training in APC exercises at the time of the rehabilitation course, parents worked APC with children at home, based on previously completed training.

To control the applied knowledge in home APC lessons, obtained in the classroom during rehabilitation and training, parents sent a preliminary video report via Watsapp remote connection on the exercise, after which a consultation was held by an APC specialist on the implementation of APC classes, the dynamics of the functional state of the child.

Theoretical and practical recommendations on APC lessons have been developed to provide parents and track the dynamics of the motor development of children with disabilities.

Exercises for each experimental group of trainees were outlined, and additional video material was filmed with training in the phased implementation of certain motor actions. The information served as methodological recommendations for parents, as well as the basis for tracking the dynamics of the motor development of children with disabilities.

Conclusions. The modified method of teaching the parents of children with disabilities to the exercises of adaptive physical culture has shown its effectiveness during the rehabilitation course by the children. This achievement is due to the use of combining the theoretical part with the practical, as well as the possibility of establishing high-quality feedback between the instructor and parents during training.

References

1. Koroleva I.V. Pomoshch detyam s narusheniyem slukha [Help for children with hearing impairments]. Guide for parents and professionals. St. Petersburg: KARO publ., 2016. 304 p.
2. Litvina G.A., Kulchitsky V.E., Ageev A.V. Adaptivnaya fizicheskaya kultura kak sredstvo fizicheskoy reabilitatsii i sotsialnoy adaptatsii [Adaptive physical culture as a means of physical rehabilitation and social adaptation]. Mir nauki, kultury, obrazovaniya. 2016. No. 3 (58). pp. 62-63.
3. Mikhailova V.P. Osobennosti organizatsii lechebno-ozdorovitelnoy deyatelnosti s detmi s porazheniyami oporno-dvigatelnogo apparata [Features of the organization of medical and

recreational activities with children with lesions of the musculoskeletal system]. Kulturologicheskiy podkhod v spetsialnom obrazovanii: psikhologo-pedagogicheskiy aspekt. 2017. pp. 176-181.
4. Plusheva N.S. Razvitiye dvigatelnykh navykov u detey mladshego doshkolnogo vozrasta s sindromom Dauna na zanyatiyakh po adaptivnomu fizicheskomu vospitaniyu [Development of motor skills in children of primary preschool age with Down's syndrome in the classroom for adaptive physical education]. Aktualnyye problemy sportivnoy podgotovki, ozdorovitelnoy fizicheskoy kultury, rekreatsii i turizma. Adaptivnaya fizicheskaya kultura i meditsinskaya reabilitatsiya: innovatsii i perspektivy razvitiya. 2020. pp. 356-359.
5. Apokin V.V. et al. Programma fizkulturno-ozdorovitelnoy napravlennosti sredstvami adaptivnoy fizicheskoy kultury [The program of physical culture and health improvement by means of adaptive physical culture]. Khanty-Mansiysk: Print-Klass publ., 2020. 256 p.
6. Chudnova O.A. Organizatsiya ozdorovitelnykh zanyatiy detey s OVZ v usloviyakh doshkolnykh uchrezhdeniy. [Organization of health-improving classes for children with disabilities in preschool institutions]. Uchenyye zapiski universiteta im. P.F. Lesgafta. 2019. No. 6 (172). pp. 181-185.

Health and rehabilitation games for children with disturbance of the functional state of the digestive system in the complex rehabilitation program

UDC 796.011.3

PhD, Associate Professor **I.N. Bakay**[1]
PhD, Associate Professor **N.P. Konstantinova**[1]
O.S. Ivanova[1]
M.S. Semiryazhko[1]
[1]Russian State Social University, Moscow

Corresponding author: irinasyazina@mail.ru

Abstract

Objective of the study was to experimentally substantiate the effectiveness of the use of health-improving and rehabilitation games for children aged 5-6 years with functional indigestion.

Methods and structure of the study. The developed comprehensive program of physical rehabilitation of children aged 5-6 years with a violation of the functional state of the digestive system was used, which consisted of adaptation, training and stabilization periods and included therapeutic exercises, hydrocolonotherapy, therapeutic massage, self-study.

Results and conclusions. The developed comprehensive program of physical rehabilitation allowed to achieve a more effective improvement in the functional state of the digestive system, the clinical picture of the disease, and had a positive effect on the health of children with biliary dyskinesia.

Keywords: *children, functional disorders of digestion, rehabilitation, physical rehabilitation, health, recreational and rehabilitation games.*

Introduction. Currently, many issues of treating children with digestive disorders are being successfully solved [3], but drug therapy often gives a temporary, unidirectional effect, in connection with this fact, the need arises for the contribution of non-drug therapy, in particular, based on the use of physical activity [2].

Game exercises occupy a special place both in the physical education of the child and in treatment, providing a complex effect on his body and high emotionality. The features of the use of games in childhood include their emotional saturation, against which the functional reserve capabilities of the body increase significantly, and scattered muscle load prevents fatigue, games are a specific type of children's activity [2].

Objective of the study was to experimentally substantiate the effectiveness of the use of health-improving and rehabilitation games for children aged 5-6 years with functional indigestion.

Methods and structure of the study. The pilot study was carried out during 2008-2012. on the bases of: Children's preschool institution of a combined type No. 809, Children's preschool institution of a compensating type No. 2185, Child Development Center No. 1678, Moscow. The studied contingent - 99 children, boys and girls, 5-6 years old. Within the framework of the study, the following were formed: the first experimental group - 27 children, the second experimental group - 24 children. The children of the experimental groups were diagnosed with biliary dyskinesia (disturbance of the functional state of the digestive system), mixed form, in the stage of incomplete remission. The control group included 48 children (main medical group).

In physical rehabilitation, there is no concept of "health-rehabilitation games". Games used in rehabilitation cannot have the same content as outdoor

games, since their main focus is to satisfy emotional needs, and in rehabilitation, the need to consolidate the acquired skills in difficult conditions of activity comes first. Thus, within the framework of this study, the concept of "health-rehabilitation games" has been clarified.

A game is a kind of unproductive activity, where the main motive lies in the pleasure associated not only with the result, but also with the very process of activity [1].

A mobile game is a kind of game activity, which is based on a variety of active movements, motor actions, motivated by the plot of the game, which contributes to the comprehensive improvement and consolidation of motor skills, vital motor qualities [1].

A health game is a kind of game activity aimed at improving, normalizing, a favorable state of the body [4].

Rehabilitation game is a kind of game activity aimed at restoring lost abilities or their correction after various diseases or injuries, using physical exercises [4].

"Health-rehabilitation games" is an integrative means of therapeutic physical culture, which optimally combines the general health-improving effect of physical exercises on the child's body and is aimed at improving the restored functions and their manifestation in a specially organized complicated game activity.

In the course of the study, a developed comprehensive program of physical rehabilitation was used for children aged 5-6 years with a violation of the functional state of the digestive system in a preschool educational institution.

The experiment involved two experimental groups: group 1 and 2, which were engaged in the developed program of physical rehabilitation. The control group of children did not study according to the developed program, they attended classes organized in a preschool educational institution.

The complex program consisted of three periods: adaptation, training and stabilization and included the following activities: therapeutic gymnastics (general developmental and special exercises with various sports and recreational equipment, recreational and rehabilitation games, breathing exercises, relaxation exercises, classes on fitballs, physiorola, exercises on simulators: exercise bike, treadmill, support bars), hydrocolonotherapy (physical exercises in water), therapeutic massage, self-study.

The program was implemented according to the scheme: classes for the children of the experimental groups were held three times a week, the 1st group had two sessions of therapeutic exercises with the inclusion of recreational and rehabilitation games and one session of hydrocolonotherapy, the 2nd group had three sessions of therapeutic exercises with the inclusion health and rehabilitation games.

Consider the features of the use of health-improving and rehabilitation games in a comprehensive program of physical rehabilitation.

Health-improving and rehabilitation games of a special orientation were included in the structure of the physical rehabilitation program during the training and stabilization periods, at the end of the main part of the therapeutic exercises. In the training period, games of medium intensity were used, the duration of the game was 2-3 minutes, in the stabilization period - 3-4 minutes.

When assigning health-improving and rehabilitation games to children with impaired functional state of the digestive system, the following data were taken into account: age, gender, individual characteristics of the child, the specifics of the disease (hypertonicity or hypotension). Health-improving and rehabilitation games were aimed at improving the outflow of bile and training the abdominal muscles, normalizing the psycho-emotional state of the child.

Approximate health-improving and rehabilitation games for biliary dyskinesia, used in a comprehensive program of physical rehabilitation (according to O.V. Kozyreva, S.V. Matveev):

1. "Funny turtles." Non-competitive game. Walk and run on all fours. Rules of the game: all participants, standing on all fours, have a shell on their back - an inflatable ring or a large soft toy. To the music, the turtles walk, walking forward, backward, with side steps to the right, to the left, turning in a circle at the same time and always keeping the ring on their backs. At the signal "high tide", all the turtles run to the indicated place. If the shell is lost, then the player must “crawl” to it, putting it on his back and return on all fours to the indicated place. The game is repeated several times.

2. "Shells". Cooperative game. The goal is to move the "pearl" handful. Rules of the game: all participants are lined up in a column of two. Each pair has gymnastic sticks in their hands, on which two balls with a diameter of 30-40 cm lie (you can use massage balls that are easier to hold between the sticks). At the signal of the teacher, the first pair of participants run around the turn and return to the next players. Having passed the baton, he drops the pearls into the "pool".

The game continues until all participants have passed their stage. The time of the whole team is taken into account.

3. "Jumps". Children stand straight, feet shoulder-width apart, lean in front and rest their hands on the floor. The arms and legs should be straight. The host announces the start of the race. Who is the fastest horse? For a warm-up, children are offered to walk first in a step in place for 15-20 s. The host thanks the children and notes that the horses are doing well in walking. Then he explains to the children that they will also jump in place. He defines the task: run as fast as possible, jump higher and more rhythmically. At the signal of the gong, the children depict races for 1 minute. At the end of the race, the leader and assistant call graceful "steeds", fast, frisky, etc., not forgetting to mark each child. In conclusion, thank all the children for participating in the game.

4. "Wheelbarrow". Children are divided into pairs. One gets on all fours and "turns" into a wheelbarrow. To do this, the partner takes him from behind by the legs and "lucky". The owner of the wheelbarrow must skillfully manage it and, at the signal of the leader, turn to the right, to the left, drive it either faster or slower. The wheelbarrow requires complete obedience to its "master". The facilitator evaluates how effective the interaction in pairs is. The exercise is carried out for 30 seconds, then the partners change places. Exercise strengthens the muscles of the hands and is very popular with children, excites them.

5. "Cat". The facilitator invites the children to kneel down and rest their palms on the floor. Now we will depict a cat. At first, the cat is unhappy. She arches her back as much as possible up. Now the cat is stretching. The back bends down. Movements should be energetic, but at the same time smooth and graceful. Movements alternate for 2 s. Then the children are asked to lie on their back, quickly and gracefully roll over to one side and then to the other, while simultaneously performing sipping movements with their arms and legs on one side and a curling movement on the other, as a cat does when it is very pleased. The exercise is performed within 2 seconds.

Results of the study and their discussion. During the implementation of the study, the effectiveness of the developed comprehensive program of physical rehabilitation with the inclusion of health-improving and rehabilitation games was proved: stable remission was observed in 18 (67%) children of experimental group 1 and 11 (46%) children of group 2. In nine (33%) children of group 1 and 13 (54%) children of group 2 experienced unstable remission. The change in the nature and frequency of attacks, they began to be episodic - once every six months - and proceeded in a smoother form.

The developed comprehensive program of physical rehabilitation allowed for a more effective improvement in the functional state of the digestive system, the clinical picture of the disease, and had a positive effect on the health of children with biliary dyskinesia.

Conclusions. For children with impaired functional state of the digestive system during the period of remission of the disease, it is advisable to apply a comprehensive program of physical rehabilitation in a preschool educational institution, with the inclusion of health-improving and rehabilitation games of a special orientation.

To improve the functional state of children, it is recommended to include in the physical rehabilitation program an individual complex of play activities at home (special play exercises for the abdominal muscles, breathing exercises with elements of games, play exercises for relaxation).

References

1. Avanesov R.I. Ozhegov S.I. Russkiy orfograficheskiy slovar: okolo 180 000 slov [Russian spelling dictionary: about 180,000 words]. Russian Academy of Sciences. V.V. Vinogradov Institute of the Russian Language. 2nd ed., rev., sup.. Moscow, 2004. 960 p.
2. Bakai I.N. Fizicheskaya reabilitatsiya pri diskinezii zhelchevyvodyashchikh putey u detey v usloviyakh doshkolnogo obrazovatelnogo uchrezhdeniya [Physical rehabilitation for biliary dyskinesia in children in a preschool educational institution]. Teaching aid. Moscow: Sputnik + publ., 2021. 48 p.
3. Kozlovsky A.A. Funktsionalnyye narusheniya pishchevareniya u detey rannego vozrasta [Functional disorders of digestion in children of early age]. Problemy zdorovya i ekologii. 2014. No. 4 (42).
4. Kozyreva O.V., Ivanov A.A. Fizicheskaya reabilitatsiya. Lechebnaya fizicheskaya kultura. Kineziterapiya [Physical rehabilitation. Healing Fitness. Kinesitherapy]. Educational dictionary-reference book: study guide. Moscow: Sovetskiy sport publ., 2010. 278 p.

To the problem of integration of educational, scientific and sports activity in higher education in the field of physical culture and sport

UDC 378

Dr. Hab., Professor **E.N. Medvedeva**1
Dr. Hab., Associate Professor N.G. Zakrevskaya1
PhD, Associate Professor V.S. Solovyov1
PhD, Associate Professor E.Ya. Mikhailova1
1Lesgaft National State University of Physical Education, Sports and Health, St. Petersburg

Corresponding author: e.medvedeva@lesgaft.spb.ru

Abstract

Objective of the study was to obtain objective data that allow developing evidence-based proposals for the normative, organizational, methodological support of the process of integrating educational, scientific and physical culture and sports activities in higher education in the field of physical culture and sports.

Methods and structure of the study. To solve the problems, a set of methods was used to comprehensively and comprehensively study the problem of integration: theoretical analysis and generalization of special literature; retrospective analysis of program and regulatory documents [1-3], retrospective analysis of the direction of dissertation research in the field of physical culture and sports; poll; expert review; testing; modeling; ascertaining experiment; methods of mathematical statistics.

Results and conclusions. In the process of analyzing the scientific literature, it was found that the implementation of the integration of education, science and physical culture and sports activities involves: correction of professional and sports training; improving the assessment of types of educational activities; creation of personnel, organizational, logistical and financial conditions; substantiation of normative documents regulating the implementation of this process, etc. Statistical data were obtained on the implementation of the main professional educational training programs, on the organizational, methodological support of the educational process, on the scientific and methodological support of sports teams of various levels. It has been established that at the moment there are integration processes in the system of higher education in the field of physical culture and sports, and the indicators characterizing the effectiveness of educational, scientific and physical culture and sports activities are interconnected.

Keywords: *Integration of educational, scientific and physical culture and sports activities, training of a sports reserve, educational and methodological support, scientific and methodological support.*

Introduction. A feature of higher education in the field of physical culture and sports is the possibility of training a sports reserve and testing in practice the effectiveness of the integration of educational, scientific and sports activities. In this regard, there is an urgent need to obtain objective data that allows developing scientifically based proposals for the normative, organizational, methodological support of the integration process, as a condition for the formation of a state order for sports training at a university. Based on the problems, the object of the study was the process of integrating educational, scientific, physical culture and sports activities in educational organizations subordinate to the Ministry of Sports of Russia, the subject is the content of the normative, organizational, methodological support for the integration of educational, scientific, physical culture and sports activities in these educational organizations.

Results of the study and their discussion. The activities of 14 universities in the field of physical culture and sports were analyzed. According to the survey data, it was found that the main professional educational programs for the training of sports teachers in 75 sports are being implemented in the universities of physical culture. At the same time, the coverage of sports specializations, depending on the status and

location of the university, is different (from 8 to 58).

In the total number of full-time students, the share of undergraduate students with sports categories was 80%. Almost half (47.3%) of them are highly qualified athletes (from CMS to HMS). However, based on the analysis of the general structure of the contingent among students, the majority are athletes who have the potential for further improvement in their chosen sport. The most priority sports for which training is carried out at universities are: athletics, martial arts (boxing, wrestling, judo, taekwondo), swimming, sports gymnastics (artistic gymnastics, rhythmic gymnastics, sports aerobics, acrobatics), dance sports, sports games (football, basketball, hockey, volleyball, handball, tennis), cross-country skiing.

Considering that the human resources of any higher educational institution and, in particular, in the field of physical culture and sports, determine the possibility of applying innovations and integrating educational, scientific, physical culture and sports activities, an analysis was made of the teaching staff of Russian universities of physical culture and its structure taking into account sports qualifications. It has been established that more than half of the teachers have a high sports qualification - CMS and above (55.7%). At the same time, the scientific qualifications of the teaching staff of all higher educational institutions, despite meeting the requirements, had a significant difference: from 60.1% to 84.1%.

Analysis of the diversity of scientific publications of the teaching staff of higher educational institutions of physical culture, taking into account the direction of physical culture and sports activities, testified that it is determined by the number of sports implemented at the university. Thus, the central universities were the leaders in this characteristic of publication activity, and this, in turn, was reflected in the degree of participation in the scientific and methodological support of sports teams of various levels. At the same time, the activity of scientific and pedagogical schools (SPS) of higher educational institutions of physical culture was of no small importance. It was revealed that their number is directly proportional to the variety of scientific researches carried out on the problems of physical culture and sports (Fig. 1).

In this aspect, the publication activity aimed at the scientific and methodological support of sports training is indicative. In total, higher education institutions of physical culture published more than 40,000 publications in the RSCI (Russian Science Citation Index); more than 1200 articles in journals indexed in Web of Science or Scopus; more than 8000 articles published in journals according to the list of HAC (Higher Attestation Commission).

An analysis was also made of the number of implemented areas for the training of scientific and pedagogical personnel and the availability of dissertation councils. At the moment, in the field of physical culture and sports, only half of the universities have dissertation councils in their respective scientific specialties (Fig. 2).

Analysis of the dynamics of the number of defended dissertations in the scientific specialty 13.00.04 - “Theory and methods of physical education, sports training, health and adaptive physical culture” testified that the general downward trend in Russia did not change the overall share of the scientific contribution of universities of physical culture. Thus, 56% of dissertations are defended in the universities of physical culture, which confirms the role of scientific and pedagogical schools of universities and the presence of favorable conditions for research.

Based on the results of the analysis of all the above indicators of integration activities, a structure for the

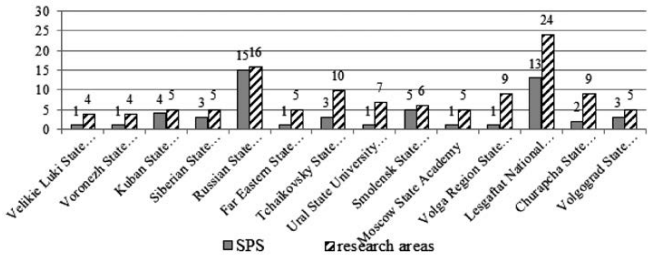


Figure 1. *Quantitative characteristics of scientific and pedagogical schools in higher educational institutions of physical culture in Russia (number)*

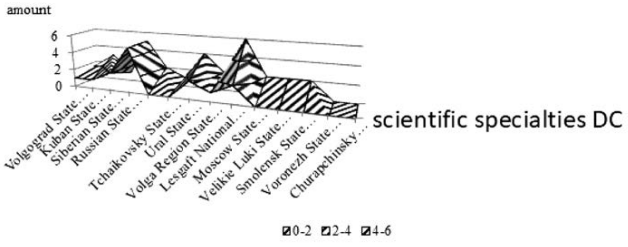


Figure 2. *The number of areas of postgraduate training and dissertation councils in higher education institutions of physical culture*

Generalized criteria for the integration of educational, scientific and physical culture and sports activities in higher education in the field of physical culture and sports

Type of integration	Criteria
Vertical	Availability and compliance with the Basic Professional Education Program (BPEP) and the program of sports training in the sport of various levels of education with the requirements of the Federal State Educational Standard (FSES), the program for the sport, the Federal Standard for Sports Training (FSSP); Continuity of BPEP levels of education and implementation of programs for various stages of sports training of students in accordance with the requirements of the FSSP for a sport; The presence of publications of students and faculty on the problems of the chosen sport in scientific publications of various levels of peer review; The presence of educational, scientific and sports achievements of students at all levels of education being implemented; The presence of performers of research work (RW) and research and development work on issues in the field of physical culture and sports from among the students
Horizontal	Availability of BPEP in the areas of training 49.00.00 in various sports specializations; Scientific research in a student scientific association according to the thematic plan of research with the involvement of the teaching staff of various departments and representatives of scientific and pedagogical schools (SPS) of the university; Interdisciplinary approach and the use of innovative technologies in various fields of science in the process of completing term papers and qualifying papers; Scientific research in the field of physical culture and sports with the involvement of various educational, sports and scientific structural units; Participation of the departments of the university in the scientific and methodological support of the training of national teams in sports
Organizational	Compliance with the local documents of the university that regulate the planning, organization and implementation of educational, scientific, sports activities that meet the unified requirements of the Federal State Educational Standards, Federal State Requirements (FGR), programs for sports (PS), Federal standards for sports training (FSST), the Higher Attestation Commission (HAC), orders of the Ministry of Science and Higher Education of the Russian Federation, etc. Interrelation and compliance of educational and methodical, personnel, logistical and scientific and methodological support of education, scientific and physical culture and sports activities with the requirements of the Federal State Educational Standard, FGR, PS «Trainer», FSST for sports; Compliance of the scientific work of students with the subject and plan of the research work of the university, the requirements of the regulatory documents of the Federal State Educational Standard, FGR and HAC; Compliance of the educational, research, physical culture and sports infrastructure and the material and technical base of the university with the Federal State Educational Standards, FGR, FSST and the stages of training in the chosen sport

integration of educational, scientific, physical culture and sports activities was developed, which is a holistic education, the basic basis of which are unified regulatory documents.

In the course of the study, the criteria for each individual type of activity were first identified and systematized, taking into account the direction of integration (vertical, horizontal and organizational), which made it possible to objectively assess the possibility of its implementation. Comparison of the criteria for each type of activity made it possible to systematize and combine them according to common features in each of the areas of integration. As a result of the generalization, the main criteria for the integration of educational, scientific and physical culture and sports activities in higher education in the field of physical culture and sports were specified (see table).

Conclusions. In the process of analyzing the educational and methodological support, it was found that all educational programs implemented in the universi-

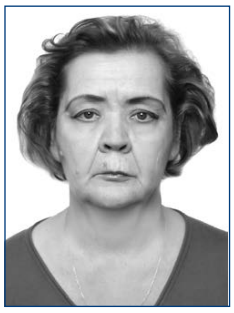
ties of physical culture comply with the requirements of documents regulating educational, scientific and physical culture and sports activities in the field of physical culture and sports, which confirms the possibility of integrating these types of activities in universities. It was found that in the system of higher education in the field of physical culture and sports there are integration processes due to interrelated indicators that characterize the effectiveness of educational, scientific and physical culture and sports activities.

References

1. «Ob utverzhdenii Koncepcii podgotovki sportivnogo rezerva v RF do 2025 goda» (vmeste s «Planom meropriyatij po realizacii Koncepcii podgotovki sportivnogo rezerva v Rossijskoj Federacii do 2025 goda») [“On Approval of the Concept for the Preparation of a Sports Reserve in the Russian Federation until 2025” (together with the “Action Plan for the Implementation of the Concept for the Preparation of a Sports Reserve in the Russian Federation until 2025”)]. Decree of the Government of the Russian Federation dated 10.17.2018 No. 2245-r (as amended on 29.04.2021). Available at: https://rulaws.ru.
2. «O fizicheskoy kulture i sporte v Rossiyskoy Federatsii» (s izm. i dop., vstup. v silu s 01.09.2021) [“On Physical Culture and Sports in the Russian Federation” (as amended and supplemented, entered into force on September 1, 2021)]. Federal Law of December 4, 2007. No. 329-FZ (as amended on July 2, 2021). Available at: https:/ www.consultant.ru.
3. Professionalnyy standart 05.003. Trener. Utverzhden prikazom Ministerstva truda i sotsialnoy zashchity Rossiyskoy Federatsii ot 28 marta 2019 goda. N 191n. [Professional standard 05.003. Trainer. Approved by order of the Ministry of Labor and Social Protection of the Russian Federation of March 28, 2019. No. 191n]. Available at: http: // www.consultant.ru.

Diagnostics of the quality of vocational education in the field of physical culture and sport using tasks developed with requirements of the national qualification system

UDC 796.077.5



Dr. Med. **N.A. Zadorozhnaya**[1]
PhD, Associate Professor **N.V. Dubkova**[1]
I.A. Bolotova[1]
PhD, Associate Professor **A.A. Domozhilova**[1]
[1]Lesgaft National State University of Physical Education, Sports and Health, St. Petersburg

Corresponding author: zadorozhnaya_10@mail.ru

Abstract

Objective of the study was to develop and evaluate the effectiveness of applying a bank of test tasks in the discipline "Hygienic bases of physical culture and sports activities" for diagnosing the quality of vocational education.

Methods and structure of the study. A bank of test tasks has been developed and tested for conducting knowledge control in the discipline "Hygienic foundations of physical culture and sports activities" taking into account the requirements for three main professional qualifications in the 2nd year of the bachelor's degree program at the Lesgaft National State University of Physical Education, Sports and Health.

Results and conclusions. It is shown that the proposed diagnostic criteria for assessing the quality of vocational education make it possible to take into account the modern requirements of the development of society and contribute to improving the level of training in the field of physical culture and sports in accordance with the requirements of the national qualifications system.

Keywords: *quality of education, bank of test items, ranking test, qualification.*

Introduction. Improving the quality of higher education in our country is very relevant in the light of the ever-increasing requirements for the professional competencies of future specialists. Undoubtedly, considering the sphere of physical culture and sports, this is especially noticeable, since in the conditions of high competition among athletes, coaches and specialists who provide training are currently required not only to possess the most advanced knowledge from various scientific fields, but also the ability to integrate them in the process of developing and timely correction of training programs [1, 2].

Thus, it is obvious that the coach of the "present" and, moreover, of the "future" in the course of his professional training must master a wide range of knowledge, skills and labor actions in order to successfully solve the identified tasks.

Objective of the study was to evaluate the effectiveness of the application of test tasks for diagnosing the quality of vocational education in the discipline "Hygienic foundations of physical culture and sports activities" for students of the training direction 49.03.01 "Physical culture".

Methods and structure of the study. The work was carried out at the Department of Preventive Medicine and Fundamentals of Health Lesgaft National State University, St. Petersburg with the participation of 2nd-year undergraduate students (n=120), who are enrolled in the full-time department in the profile (direction) of training 03.49.01 - "Physical Education".

For a long time in our country, the main form of knowledge control was the oral response of students to questions. However, the transition to a point-rating system [3] and the need for remote assessment of knowledge in the current epidemiological conditions caused by the coronavirus infection pandemic actualizes knowledge control in the form of performing various types of test tasks.

In view of the foregoing, a team of authors developed a bank of test tasks for conducting knowledge control in the discipline "Hygienic foundations of physical culture and sports activities" taking into ac-

count the requirements for the three main professional qualifications, which are presented in Table 1.

The final layout reflects labor functions, labor actions, test and practical tasks for the 6th and 7th levels of qualifications with reference to regulatory documentation and educational and methodological literature (Sanitary rules and norms (SanRN), Order of the Ministry of Sports of the Russian Federation dated October 30, 2015 No. 999, textbooks on the discipline).

Questions of choice, ranking, and conformity were included in the test trials (Table 2). In practical tasks, situational tasks were presented, in solving which students were asked to analyze a specific situation in the practice of physical culture and sports related to hygienic provision, a comprehensive assessment of the health and development of children and adolescents, nutrition, etc.

In each option, all blocks of questions were presented. The scoring of tasks was carried out and the final result was translated into an assessment - "excellent", "good", "satisfactory" and "unsatisfactory ". Then a comparison was made with the oral answer in the exam.

Results of the study and their discussion. According to the results of the testing, it was revealed that the best results were observed when answering such types of questions as the "choice test" and "match test", in which 86% and 84% of students, respectively, gave the correct answers. In turn, tasks of the "open question" type caused difficulties for 23% of the tested, "ranking test" - for 25% of students, and when solving practice-oriented tasks, errors were noted in 33% of students. Obviously, this was due to the fact that students are worse oriented in tasks related to labor activities.

In general, 47% of students scored a total score corresponding to the mark "excellent"; 16% of students demonstrated a level of knowledge rated as "good", and the rest of the students (27%) received a "satisfactory" rating. The sum of points according to the results of testing in the group of students averaged 26.60±2.11 points, however, it should be emphasized that 10% of students did not pass the certification. Mostly they did not cope with practical tasks, which indicates that these students at the time of testing were not ready to address issues related to practical activities.

Comparison of the results of performing test tasks with oral answers in the exam indicates that the scores for the two types of control coincide by 75%. However, the exam scores were slightly higher compared to the data obtained during the testing. The sum of points for the exam in the form of an oral answer varied from 24 to 30 points and averaged 27.02±1.09 points for the group.

It is also important that when comparing the results of approbation of a bank of test items that take into account indicators of achieving a professional standard and corresponding to general professional competencies (first stage, 2018-2019 academic year), which were prepared earlier [4] and approbation of a set of tasks developed taking into account labor actions, knowledge and skills for three professional qualifications (second stage, 2019-2020 academic year), it was found that, according to the test results, the best results were shown by bachelors in the second stage (Table 3). Thus, according to the results of the first stage, the average score was 23.60±2.25, and accord-

Table 1. *Professional qualifications*

Name of qualification	Qualification level
Trainer	6 skill level
Specialist in instructor and methodological work in the field of physical culture and sports	6, 7 skill level
Head of an organization (subdivision of an organization) carrying out activities in the field of physical culture and sports	6, 7 skill level

Table 2. *Test tests*

Labor action	Knowledge	Skill
1. One practice-oriented task/case is formed	1. Choice test (4 possible answers, one correct)	1. Ranking test (establishing the order of options)
	2. Open question (the answer is entered by the certified person)	2. Conformity test (matching options)

Table 3. *Summary table of a comprehensive assessment of knowledge based on the results of the 1st and 2nd stages of testing and intermediate control (exam),* M±m

Stages	Test scores	Points based on the results of intermediate control (exam)
1st stage of testing, 2018-2019 academic year, (n=100)	23,60±2,25	27,50±1,39
2nd stage of testing, 2019-2020 academic year, (n=120)	26,60±2,11	27,02±1,09

ing to the results of the second stage - 26.60±2.11. At the same time, it should be noted that when comparing the results of oral answers in the exam, comparable values of marks of bachelors of different years were noted.

In conclusion, it should be emphasized that the bank of tasks, developed taking into account the requirements of the national qualifications system, was integrated into the discipline course on the Moodle platform in order to be used when conducting boundary control in a remote format (2020-2021 academic year) during a difficult epidemic situation due to the spread of coronavirus infection, and has shown its effectiveness to control students' knowledge.

At the same time, conducting an exam remotely in the form of answering exam questions in essay format, in our opinion, does not allow obtaining an objective assessment of students' knowledge and oral answer to exam questions remains the preferred form of intermediate control.

Conclusions. Thus, the proposed diagnostic criteria for assessing the quality of vocational education make it possible to take into account the modern requirements of the development of society and help improve the level of training in the field of physical culture and sports, taking into account the requirements of the national qualifications system.

References

1. Kostyuchenko V.F., Zverev V.D., Vasiliev D.A. Transformatsiya podgotovki fizkulturnykh kadrov v rossiyskoy sisteme obrazovaniya [Transformation of training of physical culture personnel in the Russian education system]. Teoriya i praktika fizicheskoy kultury. 2021. No. 4. pp. 50-52.
2. Lubysheva L.I. Sovremennaya sportivnaya nauka: ot stagnatsii k novoy paradigme razvitiya [Modern sports science: from stagnation to a new paradigm of development]. Teoriya i praktika fizicheskoy kultury. 2017. No. 5. pp. 3-5.
3. Lubysheva L.I. Aktualizatsiya tekhnologiy kontrolya v sisteme podgotovki fizkulturno-sportivnykh kadrov [Actualization of control technologies in the system of physical culture and sports personnel training]. Teoriya i praktika fizicheskoy kultury. 2019. No. 11. p. 95.
4. Kiergaard A.V., Tsallagova R.B., Dubkova N.V., Zadorozhnaya N.A. Osobennosti formirovaniya testovykh zadaniy dlya otsenki kachestva professionalnogo obrazovaniya v oblasti fizicheskoy kultury i sporta [Features of the formation of test tasks for assessing the quality of vocational education in the field of physical culture and sports]. Teoriya i praktika fizicheskoy kultury. 2019. No. 11. pp. 96-98.