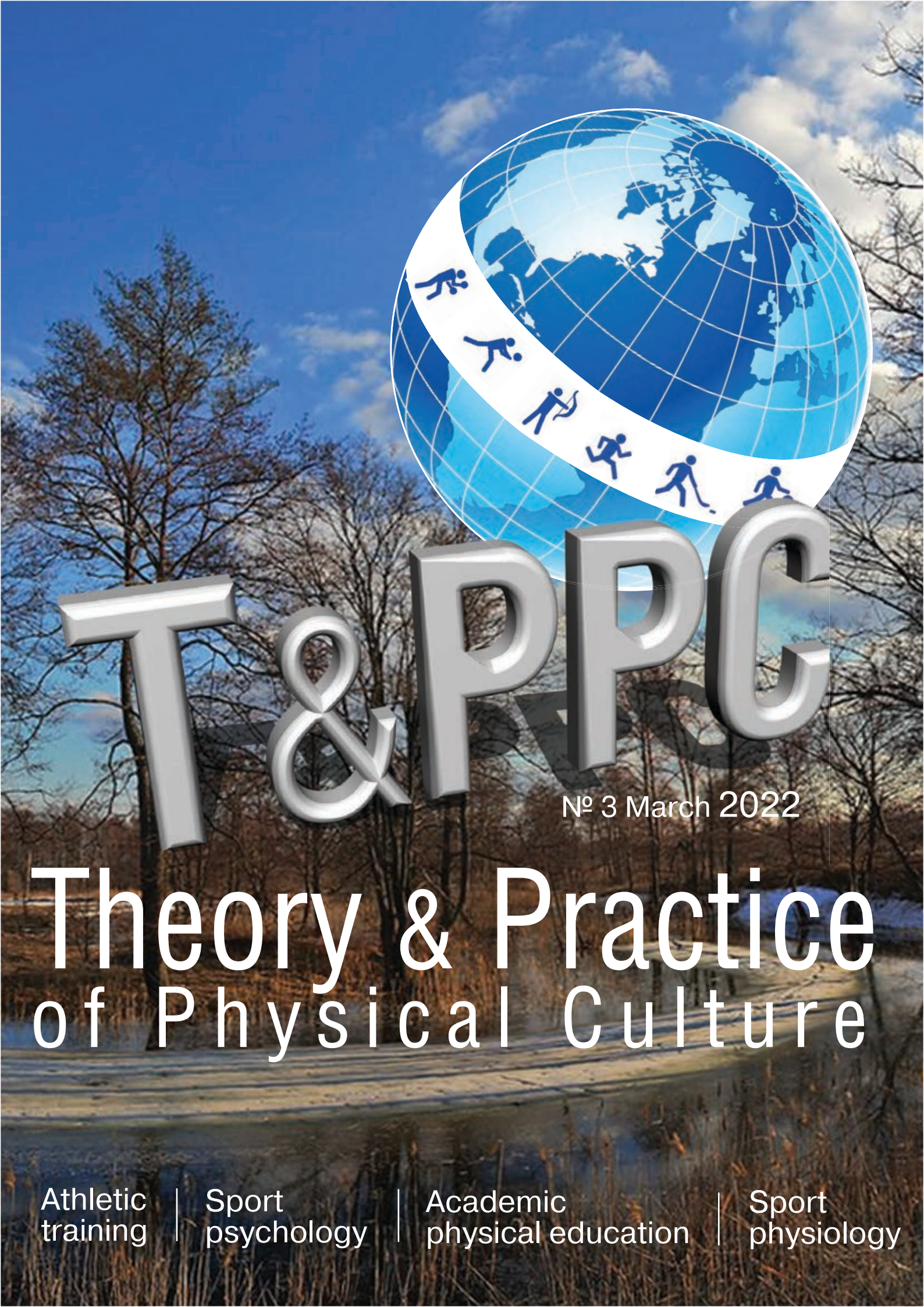


T&PPC

№ 3 March 2022

Theory & Practice of Physical Culture

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

Key issues of the modern sports science for discussion

Physical fitness of sports students as a factor in the formation of professional competencies

Professional pedagogical activity is a special form of art that requires from a person not only high erudition, but also good health, good physical shape.

This is especially true of a physical education and sports teacher. However, it is known that every year the state of health, functional and physical fitness of schoolchildren and students is getting lower. Attention is also drawn to the fact that the problem of reducing the physical condition of students is also observed in physical education universities. It is obvious that physical fitness is the most important factor determining the health and performance of the future sports teacher, his success in mastering professional competencies. Physical fitness is usually characterized by the level of functionality of various systems of the human body (cardiovascular, respiratory, muscular) and the development of physical qualities (strength, endurance, speed, agility, flexibility).

The process of physical preparation of a student throughout all years of study should be directed in accordance with the peculiarities of the sports and pedagogical disciplines taught with constantly increasing technical complexity and represent a continuous character in the system of long-term training.

The analysis of the content of the programs of academic disciplines of universities of physical culture shows that the main time of training sessions is aimed at mastering the techniques of various sports. At the same time, the successful development of the technical elements of sports is based on the foundation of general physical fitness. The weak level of physical fitness of students does not allow solving the problem of effective mastering of technical techniques. But the curricula and programs do not provide for the purposeful development of physical fitness of students.

Apparently, in order to solve the physical training of students, various exercises for the development of physical qualities, their specific manifestation and interaction should be included during training sessions in sports. Along with this, to activate the process of education and upbringing, to constantly maintain interest in one's own state of health and physical fitness.

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.

Editor-in-Chief, Honored Worker of Physical Culture of the Russian Federation, Ph.D., Professor L.I. Lubysheva

Theory and Practice of Physical Culture

3'2022

Monthly Scientific-theoretical Journal, founded in 2013

ISSN 2409-4234

©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

Hardware-software complex for sports orientation, selection and stage control: potential for judo and sambo

UDC 612.6:796.8

Dr.Biol., Professor **Y.V. Koryagina**[1]
PhD **S.V. Nopin**[1]
PhD **G.N. Ter-Akopov**[1]
S.M. Abutalimova[1]
[1]North Caucasian Federal Research and Clinical Center
of the Federal Medical and Biological Agency of Russia, Essentuki

Corresponding author: fizkult@teoriya.ru

Abstract

Objective of the study was to develop and implement an information system – hardware-software complex for sports orientation, selection and stage control in judo and sambo.

Methods and structure of the study. The following methods were applied during the study: information technology based methods; spirometry; anthropometry, dynamometry, psychophysiological test methods; sports educational methods; non-parametric mathematical statistics methods. 240 children and junior athletes took part in testing the developed hardware-software complex.

Results and conclusion. Using the data from the theoretical analysis and author's research [3], an information testing system - hardware-software complex for sports orientation, selection and control in judo and sambo was developed. The hardware-software complex consists of the hardware facilities and software. The developed hardware-software complex includes four test blocks: morphological, functional, psychophysiological and physical fitness.

The hardware-software complex for sports orientation includes four test blocks to determine the morphological, functional, psychophysiological, and physical fitness rates. The testing of thhardware-software complex for sports orientation, selection and stage control in judo and sambo showed its effectiveness in determining the psycho-functional readiness of children for judo and sports orientation, selection and control in judo and sambo.

Keywords: *sports orientation, selection, stage control, functional diagnostics, fitness tests, psychophysiological testing, working capacity, judo, sambo.*

Background. According to the physiological classification, judo and sambo are related to martial arts which require athletes to solve complex motor tasks in a compressed time frame. At the same time, these are speed-strength and complex coordination sports that place high demands on such qualities of flexibility and dexterity. Currently, a large number of scientific studies have been carried out, mainly by foreign scientists, devoted to the most significant performance factors [2, 5, 6]. Factors or predictors of athletic performance are the most significant characteristics of the psychophysiological state of the body systems or motor skills, the determination of which can be used to address the problems of sports orientation, selection and control of the body condition of athletes in judo and sambo.

Objective of the study was to develop and implement an information system – hardware-software complex for sports orientation, selection and stage control in judo and sambo.

Methods and structure of the study. The following methods were applied during the study: information technology based methods; spirometry; anthropometry, dynamometry, psychophysiological test methods; sports educational methods; non-parametric mathematical statistics methods. 240 children and junior athletes took part in testing the developed hardware-software complex.

Results and discussion. Using the data from the theoretical analysis and author's research [3], an information testing system - hardware-software complex for sports orientation, selection and control in judo and sambo [4] was developed. The hardware-software complex consists of the hardware facilities and software. The developed hardware-software complex

includes four test blocks: morphological, functional, psychophysiological and physical fitness. Figure 1 illustrates the main window of the software part of the hardware-software complex.

Fig. 1. *Main window of the hardware-software complex for sports orientation, selection and control in judo and sambo.*

The psychophysiological test block includes the Schulte test, simple visual and auditory sensorimotor reaction time test, complex sensorimotor reaction time test - choice reaction time and determination of the type of temperament and properties of the nervous system by a person-time unit. The morphofunctional test block includes measurement of body length, body mass, arm length, leg length, chest circumference, wrist circumference, vital capacity (VC), wrist dynamometry, deadlift dynamometry, duration of static tension of 50% of maximum using the wrist dynamometer.

Figure 2 illustrates the window of the hardware-software complex for sports orientation, selection and control in judo and sambo including the morphofunctional test block.

Fig. 2. *Window of the hardware-software complex for sports orientation, selection and control in judo and sambo including morphofunctional test block.*

The physical fitness test block includes a modified Boyko test to determine physical working capacity level [1], beep test, as well as tests to rate dexterity (3 10m shuttle run), flexibility (standing bends forward), speed-strength abilities (standing long jump), strength endurance (push-ups). Figure 3 illustrates the window of the hardware-software complex for sports orientation, selection and control in judo and sambo including the physical fitness test block.

The test rates were used to develop a special scale for evaluating the results of 5-6 year-old children involved in physical education with the elements of judo and young athletes (9-10, 11-12 and 13-14 years old) practicing judo and sambo. The hardware-software complex was tested as part of the pilot project of the Russian Judo Federation “Children’s Judo”, Sochi, in the Municipal Budgetary Institution “Sports School of the Olympic Reserve in Martial Arts Discipline” in Essentuki, sports complex “Gymsportpremium” in Pyatigorsk, Municipal Budgetary Institution for Supplementary Education “Children’s and Youth Sports School No. 1” in Kislovodsk, Municipal Public Institution “Fitness and recreation complex “Pobeda” of the Zolsky municipal district of the KBR. The psychophysiological, morphological, physical fitness, and working capacity rates were obtained, which made it possible to study and analyze the age-specific differences in children and adolescents engaged in judo and sambo.

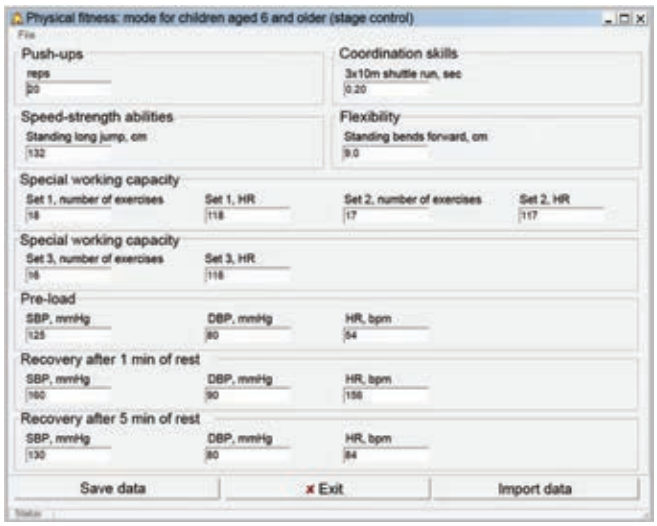


Fig. 3. *Window of the hardware-software complex for sports orientation, selection and control in judo and sambo including physical fitness test block.*

The greatest differences in the physical development rates were detected in terms of body length, body mass, and leg length (see Table). Among the functional indicators, it was VC, wrist and deadlift dynamometry rates that underwent the greatest age-specific changes. The psychophysiological indicators improved to a greater extent in the preschoolers under 7 years old. At the same time, the complex sensorimo-

Morphofunctional, psychophysiological and physical fitness rates in 5-14 year-old boys practicing judo

Indicators	5-6 y.o. 1	7-8 y.o. 2	9-10 y.o. 3	11-12 y.o. 4	13-14 y.o. 5
Body length, cm	120,6±5,0 P1-2,3,4,5 <0,001	129,3±8,0 P2-3,4,5 <0,001	140,1±7,2 P3-4,5 <0,001	150,3±8,0 P4-5 <0,001	162,3±8,3
Body mass, kg	24,0±5,2 P1-2,3,4,5 <0,001	29,0±10,1 P2-3,4,5 <0,001	37,1±9,3 P3-4,5 <0,001	43,5±9,2 P4-5 <0,001	53,3±17,6
Leg length, cm	64,3±3,2 P1-2,3,4,5 <0,001	71,3±6,5 P2-5 <0,05	78,5±5,4	84,8±5,4	91,6±5,5
Arm length, cm	50,3±2,7 P1-2,3,4,5 <0,001	55,9±5,0 P2-5 <0,05	60,9±3,4 P3-5 <0,05	65,8±4,2	71,5±4,3
Wrist circumference, cm	12,7±0,9 P1-3,4,5 <0,05	13,2±1,1	14,2±1,1	15,3±1,1	16,0±1,3
Body-mass index, %	94,0±11,9	84,6±15,2	82,6±13,9	81,2±12,5	86,2±23,5
VC, ml	1462,2± 209,5 P1-3,4,5 <0,05	1721,9± 339,8 P2-3,4,5 <0,05	2179,7± 397,9 P3-4,5 <0,05	2632,3± 482,3	3276,1± 746,3
Deadlift dynamometry, kg	27,5±8,1 P1-5<0,05	39,2±12,0	51,5±14,3	58,8±15,0	75,3±20,7
Right hand dynamometry, kg	9,1±3,0 P1-5 <0,05	14,4±8,7	16,3±4,4	19,0±4,6	24,5±4,6
Left hand dynamometry, kg	8,8±3,0 P1-5 <0,05	13,1±7,4	15,5±4,5	18,5±4,7	24,1±4,8
Light response time, sec	0,41±0,02 P1-2,3,4,5 <0,05	0,35±0,01	0,33±0,06	0,31±0,08	0,30±0,07
Choice reaction time, sec	0,64±0,02 P1-2,3,4,5 <0,05	0,53±0,02 P2-4,5 <0,001	0,50±0,01	0,42±0,07	0,38±0,08
Efficiency (Schulte test), sec	181±21 P1-2,3,4,5 <0,001	90±28 P2-4,5 <0,001	78±22 P3-5 <0,001	54±15	45±9
Strength endurance (push-ups), reps	22,6±11,6 P1-2,3,4,5 <0,05	24,4±10,8	25,0±10,2	27,5±9,8	36,2±9,9
Speed-strength abilities (standing long jump), cm	122,1±15,0 P1-2,3,4,5 <0,05	136,3±10,9 P2-3,4,5 <0,05	150,8±10,2 P3-4,5 <0,05	167,0±16,5	197,0±18,0

tor reaction time, choice reaction time, and the effectiveness of mental work continued to improve up to 14 years. The dynamics of changes in the physical fitness rates in the boys and girls were very different. In the boys, there was an annual improvement in strength endurance and speed-strength abilities, special working capacity and a more significant increase in the functional indicators of the cardiovascular system during the stress tests. In the girls, there was an increase only in the speed-strength rates, as well as an increase in the reactions of the cardiovascular system to loading.

Conclusion. The hardware-software complex for sports orientation includes four test blocks to determine the morphological, functional, psychophysi-

ological, and physical fitness rates. The testing of the hardware-software complex for sports orientation, selection and stage control in judo and sambo showed its effectiveness in determining the psycho-functional fitness of children for judo and sports orientation, selection and control in judo and sambo.

The study was performed at the Federal State Budgetary Institution North Caucasian Federal Research and Clinical Center of the Federal Medical and Biological Agency of Russia under the State Contract for the performance of research work No. 129.001.20.14 of July 21, 2020, code: "Judo 20".

References

1. Boyko V.F., Danko G.V. Physical training of wrestlers. Study guide. Kiev: Olimpiyskaya literatura, USUPES publ.,2004. 223 p.
2. Issurin V.B. Sports talent: forecast and implementation. Transl. From Engl. I.V. Sharobayko. M.: Sport publ., 2017. 240 p.
3. Nopin S.V., Koryagina Yu.V., Ter-Akopov G.N. HSC Sports orientation of children to judo classes. Certificate of registration of the computer program 2020662507, 10/14/2020. Application No. 2020661852 dated 06.10.2020.
4. Nopin S.V., Koryagina Y.V., Ter-Akopov G.N. HSC Sports orientation, selection and control in judo and sambo. Certificate of registration of the computer program 2021619474, 06/10/2021. Application No. 2021618723 dated 09.06.2021.
5. Pogrebnoy A.I., Komlev I.O. Modern world trends in sports training of judokas (foreign literature review). Fizicheskaya kultura, sport-nauka i praktika. 2018. No. 3. pp. 107–113.
6. Kuvačić G., Krstulović S., Đapić P. Factors Determining Success in Youth Judokas. Journal of Human Kinetics. 2017. Vol. 56. pp. 207-217.

Digital transformation of professions in physical education and sport sector

UDC 796.011.3

PhD **A.V. Ermakov**[1]
PhD **E.N. Skarzhynska**[1, 2]
PhD, Associate Professor **M.A. Novoselov**[2]
[1]Federal Scientific Center for Physical Culture and Sport (VNIIFK), Moscow
[2]Russian State University of Physical Culture, Sports, Youth and Tourism (SCOLIPE), Moscow

Corresponding author: bigbr@mail.ru, skar_e@mail.ru

Abstract

Objective of the study was to reveal the trends of transformation of tracks of the professional physical education and sports specialist training system in the context of the ongoing economic digitalization process and data-driven management approach of the physical education and sports experts.

Methods and structure of the study. We made a content analysis of 135,000 documents (including study reports and corporate sports management vacancies in Europe, North and South America) to rank requirements to the competences and job responsibilities in special digital services of the modern physical education and sport sector service personnel.

Results and conclusion. On the whole, the global physical education and sport sectors show a special demand for personnel having digital competences and, therefore, we recommend the national physical education and sport sector decision-makers to give a special priority to the following education disciplines: “SMM in sports", "Customer Relationship Management incorporate sports", "Digital Marketing in Sports", "Artificial Intelligence in physical education and sports", "Digital technologies in sports"; ; plus the following special modules: "Data analysis in sports", "Artificial Intelligence and machine learning in sports", "Digital project management in sports", "Big Data with artificial Intelligence technologies", etc.

Keywords: *digitalization, digital economic competences, sports, physical education, digital trail, referee, coach, sports agent, corporate sports manager.*

Background. The physical education and sport sector digitalization ideas were advanced by the leading researchers since the mid-XX century [4]. Modern research community analyzes the ongoing physical education and sport sector transformations in the context of the digital economy growth trends [1,2, 3, 5-7]; although the physical education and sport specialist training system transformations are still largely underexplored.

Objective of the study was to analyze the professional physical education and sport specialist training system and its transformation tracks in the context of the ongoing economic digitalization process and growing management data-driven styles in the physical education and sport sector progress policies and practices.

Methods and structure of the study. We run the study in 2019-2021 in three stages:

– Contribution to the development of the physical education and sport specialist professional competency qualification toolkit;

– Analysis of the physical education and sport specialist labor markets and demand formation logics with a special attention to the data-driven operation competences; and

– Contribution to three professional physical education and sport specialist training curricula digitalization project development, implementation and progress analyses under the “Digital economy Personnel Training for the National digital economy” Federal Program.

Results and discussion. Having analyzed the physical education and sports labor market demands in many countries, we found the key professional physical education and sport specialist training service progress trends to make recommendations for

Table 1. *Digital transformations in competencies of the* physical education and sport specialists

Specialty	Digital competencies
Sports referee	Sports ref's responsibilities are to: ensure compliance of the rules, fix sports results, violations of the rules, accept appeals, etc.; with the ongoing digitalization of the service requiring proficiency in special software and technical tools. Modern ref's services are classified into the offline and online ones. The offline service may require the relevant equipment test, setup and operation competences and potential assistance including the modern communication tools operation ones to deal with the competitors and supporters. The online ref service requires a high proficiency in special technologies and excellent communication toolkit operation skills. Modern digital technologies (including those with the artificial Intelligence elements) may require a ref being reasonably proficient in the operational software administration domain critical for the sports refereeing service quality.
Coach	Modern coaches are increasingly expected to demonstrate proficiency in the data processing on the whole and big data processing formats in particular – starting from the input data collection and processing digital technologies. The digital technologies-competencies are critical for a modern coach to efficiently design and manage the training and competitive service in the offline and online formats. The offline training and competitive service requires the coach to freely use special technical tools and technologies to monitor and test the individual performances and teamwork in every technical and tactical aspect. The online coaching service requires the coach being proficient in the performance data collection, processing and management, and in the trainees training in the own performance self-test basics; plus competent in the modern safety standards secured by efficient digital visualization and communication tools. A digital-technologies-competent coach, therefore, should have due analytical skills, due to separation of the analytical and coaching responsibilities being often counterproductive. A sports analyst must have some coaching competencies and vice versa otherwise the information on athletes and team and their training/ competitive performance data flow may be fragmented.
Professional athlete	A digital-technologies-proficient athlete is able to freely communicate with their coaches in offline and online formats, particularly in professional sports where they need to timely test and manage the physical fitness and performance in combined/ hybrid competitive formats – for the best competitive progress, since such progress in professional sports is acknowledged in many aspects including the financial one. This is the reason why the modern digital technologies -competent athlete should give time to his/ her media indexing, social networking, media covering and other commercial aspects. This means that a modern professional athlete should have good digital imaging competencies and skills; although they are often detrimental for high intensive trainings and, hence, may sometimes be outsourced. Still every top athlete is expected to contribute to the digital content building efforts by photos, videos, etc.
Corporate sports manager	Corporate sports manager should be proficient in the management and marketing responsibilities in contact with the relevant government agencies – within the Government Relations domain. Modern digital technologies competences are known to help a corporate sports manager control and optimize the inside service system and build up relations with the outside parties including the potential and current clientele. Of special benefits for the corporate sports manager, therefore, in addition to the general digital economy / cultural ones, are the Customer Relationship Management and other relevant system management skills. The corporate sports management service should give a due priority to social networking. Thus in b2b segment we would prioritize the following digital tools: partner programs, websites, social networks; and in the b2g segment: professional sports advertising in communities and core agencies; website management, radio/ TV advertising. Highly ranked in the b2c segment are the social networking, website management, blogging and thematic communities building elements. (Note: b2g segment is the e-advertizing of professional sports communities and agencies, website management, radio/ TV advertizing; b2c segment is the social networking, website management, blogging and thematic communities building elements. On the whole, modern digital technologies competences help the corporate sports management excel the service by the electronic infrastructure coordination, moderation and networking skills.
Sports agent	The valid legislation allows a sports agent form agency contracts with individual athletes, coaches and professional sports clubs. Modern sports agent may be classified into (1) personal assistants in accommodation, booking and other services; and (2) commercial project managers that advance, among other things, the athletes' media indices. Modern professional sports agents need to be highly proficient in the digital technologies including the smart contracting ones. They increasingly operate as the community managers, with their responsibilities including contacts with the employers, commercial partners, sponsors and advertisers.

the national physical education and sport specialist training system transformations initiatives. Making our contribution to the "Digital economy Personnel Training for the National digital economy" Federal Program in 2020, we developed the following four Digital Professional Training curricula (three of which are implemented as of now): "Digital Marketing in Sports"; "Event Producer (esports)" and "SMM in esports" [8-10]. Our subsequent analysis of the digital progress tracks of the trainees of the above Digital Professional

Training courses found the physical education and sport specialties and Digital technologies competences of highest demand on the labor markets: see Table hereunder.

Conclusion. Our analysis of the professional physical education and sport specialist training system and its transformation tracks in the context of the ongoing economic digitalization process and growing management data-driven styles found the following modern high-demand digital technologies competences in every physical education and sport specialty: service software administration and operation skills (in the sports refereeing, training service, etc.); test digital technologies operation and data processing skills to efficiently manage fitness and performance; and media coverage related digital technologies operation and control skills. Therefore, we would recommend the physical education and sport specialist training curricula being complemented by the following modules/disciplines: "SMM in Sports", "Customer Relationship Management in sports organization", "Digital Marketing in Sports", "Artificial Intelligence in physical education and sports", "Digital technologies in Sports"; plus the following special modules: "Data analysis in sports", "Artificial Intelligence and machine learning in sports", "Digital project management in sports", "Big Data with artificial Intelligence technologies", etc.

References

1. Gorbachenko A.F., Skarzhinskaya E.N. Professions of future: computer sports as industry of information society. Management in the field of science, education and technological development. Proc. research- practical conferences with international participation. 2016. pp. 115–119.
2. Ermakov A.V., Skarzhinskaya E.N. Digital technologies in sports as educational tool. Physical education and sports in the XXI century: Actual problems and their solutions. 2020. pp. 189–193.
3. Ermakov A.V., Skarzhinskaya E.N., Sarafanova E.A. Sports education - big data based pedagogy. Big data in education: data analysis as a basis for making managerial decisions]. Proc. I International Conference. 2020. pp. 313–323.
4. Zatsiorskiy V.M. Cybernetics, mathematics, sports. M.: Fizkultura i sport publ., 1969. 200 p.
5. Iordanskaya F.A. Digital technologies in monitoring of training and distance training processes for athletes and people involved in physical education. Vestnik sportivnoy nauki. 2020. No. 3. pp. 31–44.
6. Kukushkin A.A., Novoselov M.A. Sensory visualizers-applied model of physical fitness rating system for primary school students. Sbornik trudov studentov i molodykh uchenykh RGUFKSMiT. 2014. pp. 70–71.
7. Novoselov M., Filatov S. Specialized software for psychodiagnostics and correction of athletes' functional state. Sportivny psikholog. 2004. No. 1. pp. 87–90.
8. "Event-producer (e-sports)" Program. Available at: https://cat.2035.university/rall/course/6408/?project_id=27&keywords=event menedzher (date of access: 10.06.2021)
9. "SMM in eSports" Program. Available at: https://cat.2035.university/rall/course/6406/?project_id=27&keywords=smm kibersport (date of access: 10.06.2021).
10. "Digital Marketing in Sports" Program. Available at: https://cat.2035.university/rall/course/6492/?project_id=27&keywords=%D1%86%D0%B8%D1%84%D1%80%D0%BE%D0%B2%D0%BE%D0%B9%20%D0%BC%D0%B0%D1%80%D0%BA%D0%B5%D1%82%D0%B8%D0%BD%D0%B3%20%D0%B2%20%D1%81%D0%BF%D0%BE%D1%80%D1%82%D0%B5 (date of access: 10.06.2021).
11. Bachelor of Arts (BA) Degree with a Major in Sport Management and a Major Concentration in Sport Analytics. Available at: https://ga.rice.edu/programs-study/departments-programs/social-sciences/sport-management/sportmanagement-ba-analytics-concentration/ (date of access: 23.05.2021).
12. Careers in esports: advice and information. Available at: https://britishesports.org/careers (date of access 10.06.2021)
13. Masters Degrees (Sports Analytics) Available at: https://www.findamasters.com/masters-degrees/?Keywords=sports+analytics (date of access: 23.05.2021).
14. Sport Analytics Available at: https://www.syracuse.edu/academics/undergraduate-majors-minors/sportanalytics/ (date of access: 23.05.2021).

Peculiarities of manifestation of peak special strength in beginner armwrestlers of various weight categories

UDC 796.015

PhD student **I.A. Matyushenko**[2]
PhD, Associate Professor **I.N. Nikulin**[1]
PhD, Associate Professor **A.V. Possokhov**[1]
PhD, Associate Professor **Y.P. Gladkikh**[1]
[1]Belgorod State National Research University, Belgorod
[2]Bauman Moscow State Technical University, N.E. Bauman, Moscow

Corresponding author: nikulin_i@bsu.edu.ru

Abstract

Objective of the study was to identify differences between the peak special strength rates in beginner armwrestlers of various weight categories.

Methods and structure of the study. Sampled for the study were 24 athletes aged 18-25 years, with up to one year into armwrestling sport and having no sports title. All subjects were divided into three groups depending on their body weight: Group A (n=8) – 53-65 kg – light weight category, Group B (n=8) – 78-85 kg – middle weight category, Group C (n=8) – 105 kg and over – heavy weight category.

The subjects' special strength abilities were assessed using a tensodynamometry method [4, 6]. After the warm-up, the subjects were given two attempts for every test, where only the best attempt was recorded.

Results and conclusions. The comparison of the test rates of armwrestlers of the middle and heavy weight categories showed that the greatest difference between the mean strength values, above 100%, was found in the forearm pronators, above 90% - in the forearm supinators ($p<0.01$), above 38% – in the shoulder extensors ($p<0.01$); the smallest - in the finger flexors (5.1%), supine forearm flexors (16.6%), and hand flexors (17.6%). There were no statistically significant differences between the beginner armwrestlers of the middle and heavy weight categories in the following tests: supine forearm flexion and finger flexion. The findings indicate that the difference in the special strength fitness rates in beginner armwrestlers of various weight categories is less significant than that of qualified athletes.

Keywords: *armwrestling, special strength fitness, peak strength, weight categories, tensodynamometry.*

Background. In many sports, including armwrestling, the improvement of athletic performance largely depends on the special fitness level of athletes. In terms of the direction in the development of motor skills, armwrestling refers to speed-strength sports. Special aspects of competitive activity in armwrestling include increased demands on the level of development of the arm muscles, forearm and hand in particular [2, 8]. The main motor task for an armwrestler is to develop the maximum capacity of the competitive movement, that is, to develop maximal strength in the shortest time [7].

Researchers note that there is no statistically significant difference between the maximal strength rates measured in a static mode and the maximum weight that can be lifted with the same movement [3].

When characterizing maximal strength, specialists identify peak strength as the highest level of strength displayed at a specific point in the motion range [5, 9].

There is a view that in people of the same training level, maximal strength increases with the body weight gain [1]; however, the body mass of an armwrestler is not a leading indicator of the effectiveness of competitive activity in the given sport [6].

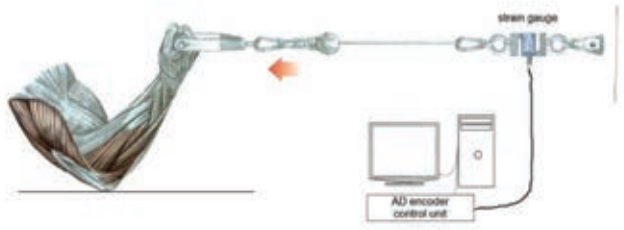
Objective of the study was to identify differences between the peak special strength rates in beginner armwrestlers of various weight categories.

Methods and structure of the study. Sampled for the study were 24 athletes aged 18-25 years, with up to one year into armwrestling sport and having no sports title. All subjects were divided into three groups depending on their body weight: Group A (n=8) – 53-

65 kg – light weight category, Group B (n=8) – 78-85 kg – middle weight category, Group C (n=8) – 105 kg and over – heavy weight category.

The subjects' special strength abilities were assessed using a tensodynamometry method [4, 6]. After the warm-up, the subjects were given two attempts for every test, where only the best attempt was recorded.

For this study purposes, we have developed a comprehensive computer-controlled methodology for measuring strength indices in armwrestling (see Figure).



Special strength abilities measuring system scheme

The measuring system consists of the following elements: force sensory system; professional arm wrestling table; tensoresistive pressure sensor; analog-to-digital (AD) encoder; personal computer.

The study was conducted on the basis of the armwrestling section of the Bauman Moscow State Technical University.

Results and discussion. Given in Table 1 are the comparative characteristics of the peak special strength rates in the beginner armwrestlers of the middle and heavy categories. These data confirm that there are no significant differences between the following indicators: supine forearm flexion and finger flexion.

The greatest difference between the mean strength values, above 100%, was found in the forearm pronators, above 90% - in the forearm supinators ($p<0.01$), above 38% – in the shoulder extensors ($p<0.01$); the smallest - in the finger flexors (5.1%), supine forearm flexors (16.6%), and hand flexors (17.6%). There were no statistically significant differences between the beginner armwrestlers of the middle and heavy weight categories in the following tests: supine forearm flexion and finger flexion.

Given in Table 1 are the comparative characteristics of the peak special strength rates in the beginner armwrestlers of the light and middle categories.

There were significant differences in terms of all peak strength indicators, except for hand abduction, forearm supination, and shoulder extension. The most significant differences were found in the following tests: hand flexion, neutral-point forearm flexion, and supine forearm flexion ($p<0.01$).

The earlier studies of special strength fitness of armwrestlers of the middle and heavy weight categories with the 1st senior category (CMS) and titles of MS and WCMS revealed significant differences in terms of all test rates [6]. This leads to the conclusion that the difference in the peak special strength rates in beginner armwrestlers of various weight categories is less significant than that of qualified athletes.

Conclusion. The control test rates in the beginner armwrestlers (up to one year of sports experi-

Table 1. *Comparative characteristics of peak special strength rates in beginner armwrestlers of middle and heavy categories*

Control test	Group B 78-85 kg, M±m	Group C 105+ kg, M±m	Difference, kg	Difference, %	t	p
SP	26.60±1.30	34.01±1.81	7.41	27.7	3.33	<0.01
HF	44.45±2.04	52.28±2.40	7.83	17.6	2.49	<0.05
HA	17.44±0.82	23.76±2.03	6.32	36.2	2.89	<0.05
FS	23.71±2.01	45.26±5.04	21.55	90.9	3.97	<0.01
NFF	31.15±0.83	37.75±2.43	6.6	21.2	2.57	<0.05
SE	65.78±2.09	91.01±4.76	25.23	38.4	4.85	<0.01
SFF	31.18±0.60	36.34±4.43	5.16	16.6	1.15	>0.05
FP	26.09±1.76	53.82±6.44	27.73	106.3	4.15	<0.01
FF	63.96±2.59	67.21±5.32	3.25	5.1	0.55	>0.05

Legend. SP – shoulder pronation, HF – hand flexion, HA – hand abduction, FS – forearm supination, NFF – neutral-point forearm flexion, SE – shoulder extension, SFF – supine forearm flexion, FP – forearm pronation, FF – finger flexion.

Table 2. *Comparative characteristics of peak special strength rates in beginner armwrestlers of light and middle categories*

Control test	Group A 55-65 kg, M±m	Group B 78-85 kg, M±m	Difference, kg	Difference, %	T	p
SP	22.19±1.21	26.60±1.30	4.41	19.87	2.48	<0.05
HF	35.11±1.78	44.45±2.04	9.34	26.60	3.45	<0.01
HA	15.34±0.89	17.44±0.82	2.1	13.69	1.74	>0.05
FS	20.21±1.86	23.71±2.01	3.5	17.32	1.28	>0.05
NFF	24.02±1.61	31.15±0.83	7.13	29.68	3.94	<0.01
SE	59.37±2.88	65.78±2.09	6.41	10.80	1.8	>0.05
SFF	26.68±1.30	31.18±0.60	4.5	16.87	3.14	<0.01
FP	20.40±1.31	26.09±1.76	5.69	27.89	2.59	<0.05
FF	55.65±2.32	63.96±2.59	8.31	14.93	2.39	<0.05

ence) confirm that there were significant changes between the athletes of the middle and heavy weight categories in 7 out of 9 special control tests: shoulder pronation, hand flexion, hand abduction, forearm supination, neutral-point forearm flexion, shoulder extension, forearm pronation. There were no statistically significant differences between the following indicators: supine forearm flexion and finger flexion.

The most significant differences between VC and VC are found in «Hand Flexing», «Forearm Flexion in Neutral Position» and «Forearm Flexion in SMP» ($p<0.01$). The most significant differences between the beginner armwrestlers of the light and middle weight categories were found in the following tests: hand flexion, neutral-point forearm flexion and supine forearm flexion ($p<0.01$).

References

1. Belskiy I.V. Effective training systems: Arm wrestling. Body-building. Benchpress. Powerlifting. 2nd ed., rev., sup.. Minsk: VidaN publ., 2002. 352 p.
2. Voronkov A.V., Nikulin I.N., Sobyanin F.I. Control over excelling strength fitness of students practicing armwrestling. Fizicheskoe vospitanie studentov. 2014. No. 2. pp. 3–7.
3. Zatsiorskiy V.M. Athlete's physical qualities: fundamentals of theory and methods of education. 4th ed.. M.: Sport publ., 2019. 200 p.
4. Matyushenko I.A., Nikulin I.N., Antonov A.V. et al. Model characteristics of strength of individual muscle groups of armwrestlers of different skill levels. Teoriya i praktika fiz. kultury. 2020. No. 8. pp. 19–21.
5. Platonov V.N. Athletes' motor qualities and physical training of athletes. M.: Sport publ., 2019. 656 p.
6. Nikulin I.N., Matyushenko I.A., Antonov A.V. et al. Comparative characteristics of special strength fitness rates in armwrestlers of different weight categories and skill levels. Teoriya i praktika fiz. kultury. 2021. No. 5. pp. 9–11.
7. Usanov E.I., Chugina L.V. Arm wrestling with arms. Study guide. M.: RUDN publ., 2010. 298 p.
8. Podrihalo O.O., Podrigalo L.V., Bezkorovainyi D.O., Halashko O.I., Nikulin I.N., Kadutskaya L.A. The analysis of handgrip strength and somatotype features in arm wrestling athletes with different skill levels. Physical education of students, 2020. No 24 (2). pp. 64–70.
9. Stone M.H., Stone M., Sands W.A. Principles and practice of resistance training. Human Kinetics, 2007. P. 376.

Maximal and repeated muscular efforts: ergometric and physiological evaluation criteria

UDC 796.012

PhD, Associate Professor **A.G. Samborskiy**[1]
PhD, Associate Professor **L.E. Pakhomova**[1]
PhD, Associate Professor **G.Y. Shipulin**[1]
L.T. Pokazannikova[1]
[1]Belgorod State National Research University, Belgorod

Corresponding author: samborskyag@mail.ru

Abstract

Objective of the study was to analyze strength control patterns for isometric contractions of the rectus femoris in a weightlifting model testing experiment by repeated 5-second maximal strength tests and 1-minute maximal strength keeping tests.

Methods and structure of the study. We sampled for the strength training system testing experiment the 18-20 years old elite sambo fighters (n=8, Candidate Masters of Sports and Masters of Sports) 174-182cm tall and 66-82 kg heavy. The tests were run in laboratory using a pressure platform.

Results and conclusion. The pre- versus post-experimental 5s maximal strength tests of the isometric contractions of rectus femoris found significant progress in the following test rates: peak force by 10.4%; maximal strength by 13.3% and force impulse by 15.5%. The pre- versus post-experimental 1min maximal strength keeping tests found significant progress in the following test rates: peak force by 11.2%; maximal strength by 15.2%; maximal strength reaching time by 14.6%; and the 97% maximal strength reaching time by 15.8%. The strength variation analysis found significant progress in the maximal strength, maximal strength reaching and keeping times with the maximal strength control and fall patterns.

Keywords: *muscular strength, isometric contractions, maximal strength reaching time, maximal strength keeping time, lactic acid, acid-base balance.*

Background. Muscular strength is largely determined by the muscular control and operation mode among the other key factors. Since muscular responses to triggers may be classified into contractions, flections (with length reductions and growths, respectively) and isometric contraction, actual performance in every of these modes depends on the operational setting [1, 3]. Modern sports give multiple examples of dynamic and isometric contractions or both at a time. It is not unusual for many sports (weightlifting, gymnastics, wrestling, etc.) that strength is applied with little or no changes in lengths of the key muscles; although such isometric tensions are commonly considered unhealthy due to the excitation in the relevant nervous centers under stress being soon responded by protective inhibition as the tense muscles squeeze blood vessels to hamper circulation and, hence, performance [1-3].

Objective of the study was to analyze strength control patterns for isometric contractions of the rectus femoris in a weightlifting model testing experiment by repeated 5-second maximal strength tests and 1-minute maximal strength keeping tests.

Methods and structure of the study. The study was designed to analyze strength control patterns for isometric contractions of the rectus femoris by the repeated 5-second maximal strength tests till meaningful strength falls with 30-second rest breaks, and the 1-minute maximal strength keeping tests. The strength variations in the tests were profiled by special software: see Fig. 1 for example. The test data were processed for analysis by the standard Statistica и Excel toolkits.

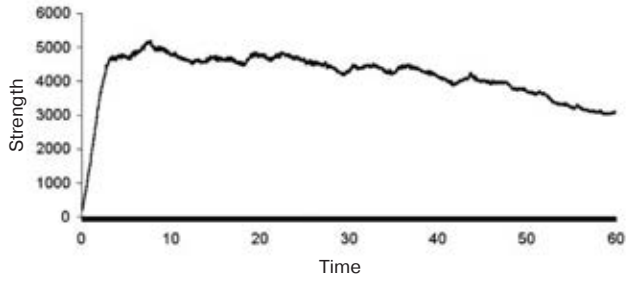
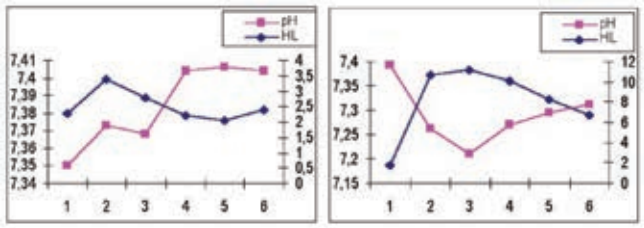


Figure 1. *Strength variation curve in one of the 1-min maximal strength keeping test*

Strength Time

We also tested the acid-base balance and lactic acid variations in the pre- and post-test blood samples on minutes 3, 5, 10, 15 and 20 after the start. The blood acid-base balance (pH) was tested by BMS-2M Microanalyzer (made by Radiometer Co., Denmark); and lactate variations (HL) were tested by Lactate-Plus Photometer (made by Nova Biomedical, USA). Blood biochemistry tracking data are given in Fig. 2. The strength variation curves were computed by a graphoanalytical method using a bi-exponential equation [4].



a **b**

Figure 2. *pH and HL variations for the isometric contractions of the rectus femoris in (a) repeated 5s maximal strength tests till meaningful stress falls with 30s rest breaks; and (b) 1min maximal strength keeping tests*

The strength training model included power snatches till the legs-apart squat phase for five weeks, with two trainings a week. The sample was tested by the maximal weights in training sessions 1-3, 90% maximums in trainings 4-6 and 80% maximums in trainings 7-9. In every training the athletes were tested by maximal repetitions, with the rest breaks in between the repetitions of 3min, 1min and 30s in training sessions 1, 2 and 3, respectively (9 trainings in total).

Results and discussion. Given in Table 1 hereunder are the strength variations in the repeated 5-s maximal strength pre- versus post experimental tests.

The training experiment was found to meaningfully improve the following test rates: peak force (Fpeak) by 10.4%; maximal strength (Fmax) by 13.3% and force impulse (ΣF) by 15.5%. Given in Table 2 hereunder are the strength variations in the repeated 1-min maximal strength keeping pre- versus post experimental tests.

The above data demonstrate significant progress in the following test rates: F_0 by 15.9%; peak force (Fpeak) by 11.2%; 97% maximal strength (F97%) by 15.2%; maximal strength keeping time (Tmax) by 14.6%; and 97% maximal strength reaching time maximal strength (T1) by 15.8%. We found growth in the maximal strength keeping time (Tud) by 2.2%; 97% maximal strength keeping time 2 (T2) by 7.3%; and force impulse index (ΣF) by 14.9%. Even higher improvements were found in the following test rates: pH to 7.22 from 7.37 mEq*l-1 in the 1min maximal strength keeping test; and lactate to 11.40 Mmol * l-1 from 3.45 Mmol • l-1 in the 1min maximal strength keeping and repeated 5s maximal strength tests, respectively.

Conclusion. As demonstrated by the strength variation analysis, the sample made significant progress in the maximal strength, maximal strength reaching and maximal strength keeping times with the maximal strength control and fall patterns. The experimental training system was found beneficial as verified by the significant progress in the repeated 5s maximal strength and 1min maximal strength keeping tests. The pH and HL rates were found to come back to the pretest levels in the repeated 5s maximal strength tests upon the 20min rest breaks. In the 1min maximal strength keeping tests, the pH and HL rates upon the 20min rest breaks, however, were tested still far from the pretest levels at 7.29 mEq •l–1 and 6.20 Mmol •l–1, respectively.

Table 1. *Strength variations in the repeated 5-s maximal strength pre- versus post experimental tests*

Test rates	Pre-exp.		Post-exp.		Growth, %	p
	x	σ	x	σ		
F_{peak}, H	5169,7	963,5	5710,4	941,0	10,4	< 0,05
F_{max}, H	4516,5	842,5	5119,8	932,6	13,3	< 0,05
K_1, c^{-1}	0,056	0,008	0,047	0,005	-	> 0,05
ΣF, кН	20,6	2,6	23,8	3,3	15,5	< 0,05

Table 2. *Strength variations in the repeated 1-min maximal strength keeping pre- versus post experimental tests*

Test rates	Pre-exp.		Post-exp.		Growth, %	p
	x	σ	x	σ		
F_0, H	4923,7	1070,3	5710,5	1206,7	15,9	< 0,05
F_{peak}, H	5275,4	933,6	5865,6	1049,6	11,2	< 0,05
F_{max}, H	4619,2	1081,3	5319,2	985,5	15,2	< 0,05
$F_{97\%}$, H	4480,7	1048,9	5159,7	955,9	15,2	< 0,05
T_{max}, c	6,56	2,37	5,60	2,15	14,6	< 0,05
T_1, c	4,18	1,73	3,52	1,59	15,8	< 0,05
T_2, c	11,75	1,08	12,61	1,13	7,3	< 0,05
$T_{уд}$, c	8,25	0,65	8,43	0,83	2,2	< 0,05
K_1, c^{-1}	0,008	0,002	0,007	0,002	-	> 0,05
K_2, c^{-1}	1,106	0,409	0,902	0,551	-	> 0,05
ΣF, кН	230,4	42,4	264,9	38,3	14,9	< 0,05

References

1. Verkhoshanskiy Y.V. Fundamentals of special strength training in sports. 2nd ed., rev, sup.. M.: Fizkultura i sport publ.. 1977. 215 p.
2. Volkov N.I. Bioenergetics of human strenuous muscular activity and ways to improve athletes' performance. Doct.diss. (Biol.). M., 1990. 101 p.
3. Zatsiorskiy V.M. Athletes' motor qualities: (research on theory and methodology of education). Doct. diss. abstract (Hab.).. M., 1969. 71 p.
4. Henry F.M., Trafton J.R. The velocity curce of sprint running with some observations on the muscle viscosity factor. Res. Quart. Amer. Ass. Health Phys. Educ. 1951. P. 409–422.

Modern trends in development of elite and youth ski jumping take-off technique

UDC 796.925

G.G. Zakharov[1]
A.N. Belyova[1]
PhD **N.B. Novikova**[1]
N.V. Adodin[2]
[1]Saint-Petersburg scientific-research institute for physical culture, Moscow
2Federal Science Center of Physical Culture and Sport (VNIIFK), Moscow

Corresponding author: zaharov-grigori@mail.ru

Abstract

Objective of the study was to reveal the dynamics of angular characteristics of take-off variations in the ski jumping of the leaders of international competitions versus the Russian elite and junior ski jumpers in the major events of 2015 through 2020.

Methods and structure of the stud. The take-off techniques were side-captured at 50 fps by video camera fixed perpendicular to the jumping line opposite the take-off table edge, with the take-off technique sequence processed by StatPlusPro 7 and analyzed by DartFish Pro 10.0 software tools.

Results and conclusion. The study found statistically significant ($p<0.05$) changes in the world bests' take-off techniques in 2015 to 2019, particularly in the trunk angle and take-off angle; whilst the Russian elite was tested with no statistically significant progress in any of the test rates. The Russian junior ski jumpers were found to make even statistically significant regresses in the take-off angle and knee angle ($p<0.05$). The national ski jumping training systems, therefore, are recommended to be revised to as required by the recent take-off technique progress trends.

Keywords: *ski jumping, take-off, angular characteristics, elite ski jumpers, junior ski jumpers.*

Background. Modern ski jumping sport is ranked among the technically challenging Winter Olympic sports disciplines. The growing competitiveness urges the sport communities to give a special priority to the technical excellence elements and the relevant training trends. Russian elite ski jumpers have been regretfully unsuccessful for the last few years in competitions with the world best "flying skiers", with only a few national competitors demonstrating occasional successes due to their special training systems.

Objective of the study was to profile and analyze variations in the ski jumping take-off angles and techniques of the world best jumpers versus the Russian elite and juniors in the major events of 2015 through 2020.

Methods and structure of the study. Side views (profiles) of the take-off techniques were video-captured in the following major men's and junior's events in the 2014-2015/ 2019-2020 winter seasons: Continental Cup finals of 15.03.15 in Nizhny Tagil (K120m ramp); All–Russian Youth Ski Jumping Competitions of the 15-16-year-olds (born in 2000-2001); Kavgolovsky Games of 16.02.15 (K65m ramp) in St. Petersburg; World Cup qualifiers of 08.12.19 in Nizhny Tagil (K120m ramp); All–Russian Youth Ski Jumping Competitions for the 15-17 year-olds (born in 2003-2005) at the X Winter Student Spartakiad on 03.03.2020 in Tchaikovsky (K95m ramp).

The take-off technique was side-captured at 50 fps by Sony HDR-CX650 E video camera fixed perpendicular to the jumping line opposite the take-off table edge, with the take-off technique sequence processed by DartFish Pro 10.0 software to track variations in the following test rates: shin angle, trunk angle, knee angle, and take-off angle (angle between the hip-to-ankle line and take-off table line. We captured the take-off technique of the top-10 world best, top-9 Russian leaders who qualified for the events under the

Table 1. *Group take-off technique in the 2019-2020 qualifiers*

Group		Trunk angle	Knee angle	Shin angle	Take-off angle
Model rates, 2019		**30-35**	**≥130**	**60-65**	**83-88**
Top-10 world best	Ẋ	▲39,86	140,20*	62,85	▲81,21*●
	δ	3,62	11,96	4,07	2,82
Top-9 Russian elite	Ẋ	36,57	132,94	62,09♦	84,43♦
	δ	5,26	9,26	4,67	2,54
Top-10 Russian juniors	Ẋ	35	122	65♦	93♦
	δ	8,91	▲9,71*	3,84	▲4,21*

*Note: statistically significant differences at ● p<0.05 for the world best versus Russian elite; * p<0.05 for the world best versus Russian juniors; ♦ p<0.05 for the Russian elite versus Russian juniors;* ▲ p<0.05 for variations in the related samples *(2005-2019*

national quota, and top-10 junior competitors of the All-Russian Youth Ski Jumping championships.

Results and discussion. The 2014-2015 take-off angle variation profiles of the Russian elite were found partially corresponding to the-then standards (model rates) [3]; although the world bests take-off techniques were tested more active, with the more acute shin angle, trunk angle and the resultant take-off angle. Such a take-off technique helps attain the key strategic goal upon the take-off – that is to secure the aerodynamically best position of the skier-ski system for the flight with a minimal air drag and maximal lifting forces. This take-off technique version with the fast transition to the flight phase may be viewed as the priority goal of every ski jumping technique excellence system. It is commonly understood that every minor detail in the take-off biomechanics, with all the other technical elements being equal, may be crucial for success in the highly competitive events.

Youth ski jumping training systems should make a special emphasis on compliance with the modern model rates due to the fast puberty-related changes in anthropometrics and functionality, when a plain copying of the adult leaders' techniques is still impossible. Table hereunder gives the test data of 2019-2020.

We found statistically significant differences ($p<0.05$) between the take-off angles of the world best versus the Russian juniors in the take-off angle and knee angle; plus the statistically significant ($p<0.05$) differences between the Russian elite and juniors in the shin angle and take-off angle.

As reported by German experts [4] the 2014-2018 Olympic cycle has seen further changes in the take-off technique of the world best jumpers, with the body mass center actively pushed forward to reduce the resultant take-off angle – at some sacrifice of the vertical take-off speed element. This finding clearly demonstrates the trend towards fast taking the best aerodynamic position for the flight upon the take-off phase.

Our test data confirmed the above findings of the German experts. The world best take-off angle average was tested to drop to 81.2°, with the knee joint extension angle growing to 140.2° versus the 2015 average. The Russian elite for the same period made no progress in these aspects – that may mean that their training systems still underestimate the recent take-off technique progress trends.

The Russian junior group was tested with the take-off angles falling within the valid standards (model ranges), with the take-off angle averaging above 90° - that means that their training systems are still insensitive to the modern take-off technique progress trends [1, 2]. A comparative analysis of two related samples found statistically significant ($p<0.05$) changes in the world best take-off technique elements in 2015 and 2019: trunk angle (Tem=3, Tkr=10) and take-off angle (Tem=6, Tkr=10) at.

The Russian elite take-off technique analysis found no significant changes for the same period; whilst the Russian juniors were tested with statistically significant ($p<0.05$) changes in the take-off angle (Tam=1, Tcr=10) and knee angle (Tem=0, Tcr=10). In view of the above reported take-off technique variation trend, we would classify it as a regress indicative of serious errors in the junior ski jumping training systems.

Conclusion. The ski jumping take-off technique profiling study demonstrate the need for revision of the standard national ski jumping training systems as required by the recent take-off technique progress trends.

References

1. Zakharov G.G., Voronov A.V. Technical execution tests and analyses in youth ski jumping competitions. Theory and practice of physical culture, 2021. No 8. P.75-77. (In Rus.).
2. Zakharov G.G., Novikova N.B., Kotelevskaya N.B. Modern tendencies in ski jumping tech-

nique for Nordic combined athletes. Methodological guide. St. Petersburg, SPbNIIFK publ., 2019. p.64.
3. Sergeev G.A., Zlydnev A.A., Yakovleva A.A. Methodology for development of complex target programs for training of regional combined teams of elite athletes for four-year training cycle (case study of Nordic combined athletes of the Russian Federation). Textbook. St. Petersburg: NSU named after P.F. Lesgaft, 2013. p.132.
4. Muller S., Kreibich S., Kirschner M. Analyse der nationalen und internationalen Leistungsentwicklung im Skispringen und in der Nordischen Kombination. Schriftenreihe Angew. Trainingswissenschaft, 2019. No 14. pp. 31-46. (In Germ.).
5. Müller S., Kreibich S., Wiese G. Analyse der nationalen und internationalen Leistungsentwicklung im Skispringen. Zeitschrift für Angewandte Trainingswissenschaft, 2014. Vol. 21. No 2. pp. 97-111. (In Germ.).

Competitive analysis of performance of strongest junior and senior cross-country skiers

UDC 796.012.37

PhD **N.B. Novikova**[1]
I.G. Ivanova[1]
PhD **N.B. Kotelevskaya**[1]
PhD **A.I. Golovachev**[2]
[1]St. Petersburg Scientific Research Institute for Physical Culture,
[2]Federal Science Center of Physical Culture and Sport (VNIIFK), Moscow

Corresponding author: novik-nat@mail.ru

Abstract

Objective of the study was to profile and analyze the dynamics of competitive progress of the national and foreign elite cross-country skiers in the international events in the youth and senior age.

Methods and structure of the study. The reports of the major 2005-2021 World Ski Championships, Olympic Winter Games, European Youth Olympic Festival and Youth Olympic Winter Games were analyzed, along with the statistical data analysis, and percentages, the data visualization was done using RSudio v. 3.6.3 and Microsoft Excel graphics.

Results and conclusion. We found that for the study period Russia and Norway junior cross-country skiers were virtually at par in youth competitions, whilst at the major international events and Olympic Games Norway was 2.4 times more successful than Russia in the men's individual medal standings, and twice as likely to rank in the top-six. Most of the Russian leaders at the 2021 World Cup entered the national elite at the age of 17-18; although only two (0.56%) of them still compete in the World Cup events. The other study data and analysis show that the national long-term cross-country skiing training system has long been in need of improvements.

Keywords: *long-term training system, cross-country skiers, competitions, age groups, Youth Olympic Games.*

Background. The 2021 FIS Nordic World Ski Championships demonstrated the continued leadership of the Norwegian men's cross-country skiing team due to, among other things, the perfectly designed youth reserve long-term training system. We believe that the still secondary competitive progress of the Russian elite cross-country skiers may be partially explained by the premature intensification of the youth training systems [1]. A few studies have proved that a premature specialization and plain mimicking of the adult elite training methods by the children's and youth sports groups drains the adaptive resources and, hence, hampers progress in the sports disciplines with high loads on the cardiovascular system [2]. It was also found that winners and runner-ups of the summer youth events seldom if ever show excellent competitive success at the Youth Olympics. The cross-country skiing research community still needs the relevant studies as far as we know.

Objective of the study was to profile and analyze the dynamics of competitive progress of the national and foreign elite cross-country skiers in the international events in the youth and senior age.

Methods and structure of the study. We analyzed, for the above purposes, reports of the 2005-2021 World Ski Championships (WSC), Olympic Winter Games (OWG), European Youth Olympic Festival (EYOF) and Youth Olympic Winter Games (YOWG) readily accessible at fis-ski.com ; plus reports of the Youth cross-country skiing events and national cross-country skiing events [3, 4] for the period – to mine the individual results in the youth and senior cross-country skiing events classified by the classic, freestyle, skiathlon, sprint and ski cross (exclusively YOWG event).

Results and discussion. In 2005-2020, 13 nations have been dominating at the international youth events (EYOF, and YOWG), with 25, 22 and 14 medals won by Norway, Russia and Finland, respectively. It should be mentioned that leadership of the Norwegian competitors of this age group is noticeable albeit not overwhelming (see Fig. 1).

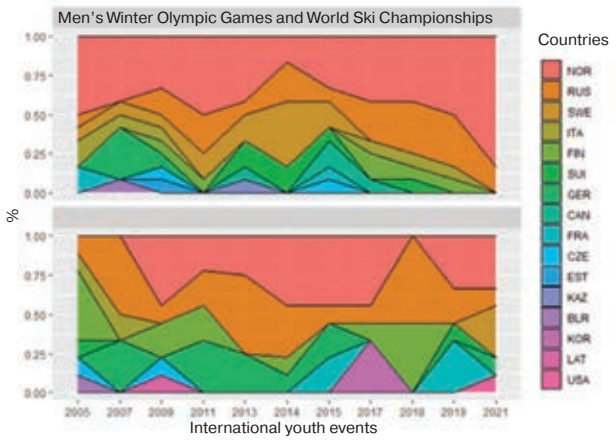


Figure 1. *Medals won by the leading nations in the 2005-2021 major men's/ youth cross-country skiing events, %*

At the World Ski Championships and Winter Olympics of this period, Norway, Russia and Sweden have won 58, 24 and 14 medals, respectively – versus at most 10 medals scored by other nations. As demonstrated by the curves, Norway marked some decline in 2015 to let Sweden ahead, but since then demonstrated excellent competitive progress.

Analysis of the top-six results in each race shows the similar trends. The international youth games have been more competitive than the men's ones (see the Table hereunder). We found that for the study period Russia and Norway youth teams were actually at par in the top-six standings at the major international competitions, whilst in the men's events Norway was twice as often in the top-six than Russia. Note that the average competitive performance (top-six places to the team total ratio) was about the same for the both nations.

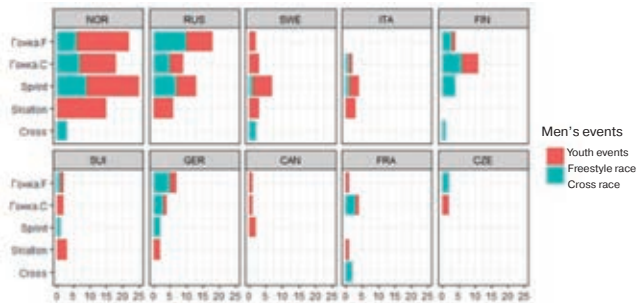


Figure 2. *Medals won by the leading nations for the period*

Russia has demonstrated leadership in the freestyle races, but has never won medals in the new ski cross discipline with obstacles (Fig. 2) – versus Norway that collected virtually the same medal stocks in both disciplines.

Furthermore, we analyzed the progress of the national 15-16-year old youth in the Russian cross-country skiing events. The best of those who competed in the 2011-2013 events have since then joined the men's team competing at the World Cup and Olympic Games. For three seasons of 2011-2013, classic and skate ski races and sprints were won by 36 juniors,

Table 1. *Performance of junior and senior athletes at international cross-country skiing events: comparative analysis*

	EYOF and YOWG			WSC and OWG		
Nation	Top-6	Places in Top-6	Average success	Top-6	Places in Top-6	Average success
NOR	18	42	2,3	28	97	3,5
RUS	18	36	2,0	14	47	3,4
SWE	4	9	2,3	13	31	2,4
FIN	12	27	2,3	4	12	3,0
FRA	10	19	1,9	7	12	1,7
ITA	2	5	2,5	6	12	2,0
GER	11	18	1,6	4	11	2,8
SUI	0	0	-	1	10	10,0
CAN	0	0	-	2	9	4,5
CZE	1	3	3,0	3	7	2,3
BLR	0	0	-	2	5	2,5
USA	1	3	3,0	2	2	1,0
SVK	0	0	-	1	2	2,0

Note: Listed are the nations having 1+ places in the top-6

with only 22.2% of them qualified for the All-Russian competitions; only three (0.83%) ranked among the top-40 cross-country skiing competitors; and only two (0.56%) still competing in the World Cup events.

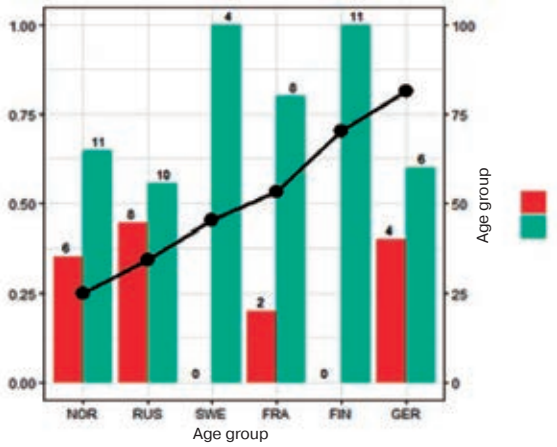


Figure 3. *Leading junior cross-country skiers' careers for 2009-2017: still active and retired, %*

We analyzed careers of the leading junior cross-country skiers on the global arenas for 2009-2017 as reported by the major international competitions. Ranked in the top-six in races and sprints for the period were 81 athletes of 15 nations. Presently 69% of them still compete in the international and national events having active FIS points. Given on Figure 3 are the percentages of the strongest active/ retired junior cross-country skiers with the median FIS points for the period.

We also found that of the 12 competitors at the 2021 World Cup, only two won medals at the Russian Youth Cross-Country Skiing Championship for 15-16-year-olds; and 9 of them, having reached 17-18-plus years of age won medals in at least some race. Figure 4 shows averaged competitive progress of the Russian elite cross-country skiers in the youth/ senior events – that demonstrate meaningful growths in the core and ranking events at 17-18 years of age. This age appears critical for progress and selection in the modern cross-country skiing sport.

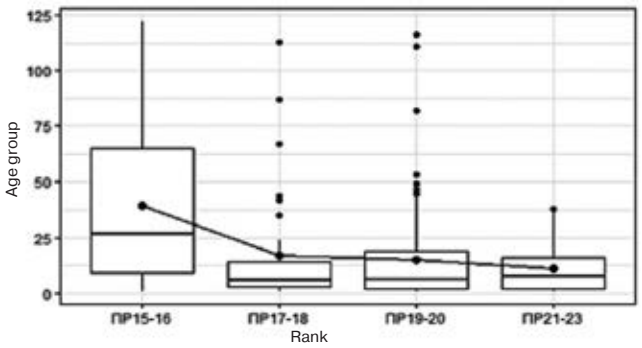


Figure 4. *Competitive progress of the Russian elite cross-country skiers in the youth/ senior events*

Conclusion. Our analysis of the competitive progress of the national Nordic skiing elite in the major senior (men's)/ youth international events demonstrate that the national youth cross-country skiing long-term training system need to be improved fast to facilitate the progress of the young prospects and take leadership at the Winter Olympics and World Ski Championships.

References

1. Platonov V.N. Training system in Olympic sports. General theory and its practical applications. Textbook for physical education and sports university students. Moscow: Sovetskiy sport publ., 2005. 820 p.
2. Platonov V.N., Bolshakova I.V. Forcing long-term training of athletes and Youth Olympic Games. Nauka v olimpiyskom sporte. 2013. No. 2. pp. 37–42.
3. Russian Ski Racing Federation. [Electronic resource]. Available at: https://flgr-results.ru.
4. Fédération Internationale de Ski, FIS [Electronic resource]. Available at: https://www.fis-ski.com/.

Progress benchmarking and test system to manage competitive fitness in para sports

UDC 796.092

PhD, Associate Professor **A.A. Baryaev**[1]
Dr.Hab., Associate Professor **A.G. Abalyan**[2]
Dr.Hab., Associate Professor **T.G. Fomichenko**[2]
[1]St. Petersburg Research Institute of Physical Culture, St. Petersburg
[2]Federal Scientific Center for Physical Culture and Sports, Moscow

Corresponding author: barsey@yandex.ru

Abstract

Objective of the study was to develop and scientifically substantiate a new progress benchmarking and test system for Para sports.

Methods and structure of the study. The progress benchmark systems should be designed to facilitate competitive progress by the training goals set versus the sport-specific competitive performances of the best Paralympians with account of the sport functionality classifications (mentally retarded sports, blind sports, musculoskeletal disability sports, etc.). The study analyzes benefits of a new progress benchmarking and test system to manage competitive fitness in Para sports, customizable for every Para sport discipline and sports functionality (nosological) class.

Results and conclusion. The new progress benchmark and test system was tested in application to Paralympic judo, athletics and sledge hockey. The test data and analysis have been proved beneficial for the progress benchmarking, training system management and competitive success. The Para sports competitive fitness and training system benchmarking database and practical training and competitive performances and progresses profiling data demonstrated benefits of the progress benchmarks and tests for the training system individualization purposes with due sensitivity to specific sport functionality classes and progress needs.

Keywords: *Para sports, progress benchmarks, training system, theoretical and practical provisions.*

Background. For the last few years of the pandemic-caused crisis, the global sports have been seriously stalled due to many regular top-ranking events being postponed or canceled, with the relevant detrimental effects on the training systems and calendars in many sport disciplines. This situation needs to be addressed by different instruments including progress benchmarking systems for Para sports to timely test and manage the competitive fitness [2]. Such progress benchmarks with tests should help rate the current performance at every stage of the training system using a wide range of competitive fitness tests and analyses with due psychological, didactic and communication tools.

Objective of the study was to develop and test benefits of a new progress benchmarking and test system for Para sports.

Methods and structure of the study. The progress benchmark systems should be designed to facilitate competitive progress by the training goals set versus the sport-specific competitive performances of the best Paralympians with account of the sport functionality classifications (mentally retarded sports, blind sports, musculoskeletal disability sports, etc.). The progress benchmarks system will include a set of adjustment coefficients to effectively customize it to the age, disability, skill level and other groups, with every progress benchmarks used not only to track absolute growths but also assess the

progress potential in every competitive fitness element.

Such progress benchmarks will set a framework for the relevant psychological and physical progress test data and analyses to effectively manage the training system and competitive performance for success in every Para sports discipline. The valid progress benchmarking and test systems of the national Paralympic sports teams with its theoretical and practical provisions are designed to [1]:

– Rate the general and special fitness versus the Federal Sports Training Standards by a set of special test exercises to analyze an individual competitive resource of every Paralympian;

– Analyze performance in the training process using the individual diaries and training system design and management reports, and verify them by surveys and interviews of the coaching teams;

– Rate and analyze the technical fitness using efficient digital video data processing tools;

– Rate and analyze physical working capacity and cardiovascular system functionality to profile the individual adaptability and find potential reserves; and

– Rate and analyze psycho-physiological fitness.

Knowing the key training conceptions and specific requirements of the modern Para sports, we may customize every progress benchmarks set to the training system based on the progress analysis. A complete progress benchmarks system will offer a special sequence/ procedure to select the most efficient progress benchmarks and test set for a specific Para sports group.

First the progress benchmarks system will analyze standards for the Para sport discipline in a wide range of the modern mentally retarded, blind, musculoskeletal disability and other sports, with account of the nosological groups (diagnoses). Next the progress benchmarks system will be customized to the training system stage versus the relevant Federal Sports Training standards and the actual skill level/ qualification. Then the system will select the most beneficial test set based on the practical experience and research recommendations; and use the most advanced test equipment to efficiently excel the Para sports training system as recommended by the innovative solutions of the sports science. Most of the existing progress benchmarks methods need to be customized to the training system progress stage, competitive fitness needs and schedules and the relevant Para sports functionality class. The above progress benchmarks system formation logics will help set the efficient individual/ group progress benchmarks with sound recommendations and correction patterns for the training system for competitive success. Progress tests and analyses will then be made to timely rate progresses in the training system by the test set versus the individual progress benchmarks. Our research projects made it possible to develop an innovative combined physical fitness and progress test and benchmarking system and test it in a few practical Para sports training systems.

Results and discussion. Having tested our new progress benchmarks and test system in a few Para sports, we collected a competitive performance database. Our Para sports training and competitive performance tracking data outlined hereunder demonstrate that the individual progress benchmarks, test, training and competitive performance systems need to be customized to the actual individual diagnoses in Para sports.

This in case of Para athletics we sampled a musculoskeletal disability group (n=16) of athletes and rated their individual psycho-physiological fitness using a gas-discharge visualizing test system by the morning and evening tests. The competitive performance was rated by a questionnaire survey on 11 progress scales. The study made it possible to find the key competitive progress benchmarks and make individual competitive performance recommendations for every athlete.

In case of Para sledge hockey, we used SIGVET-TEAM test system made by St. Petersburg Research Institute of Physical Culture to rate and correlate the pacing-rhythmic patterns in the teamwork, individual contributions, leadership qualities, proneness to individualism/ collectivism, and psycho-emotional control skills and activity in a team of up to 10 players [3]. The test data were used to rate the psycho-physiological compatibility in the 13-16-year-old SKA-Arrow Para sledge hockey team (n=5+5). The tests and analyses found the teamwork being good enough to efficiently model and control the competitive performance as verified by the visual-motor response and response-to-moving object tests.

In case of blind and partially sighted judo, our study was designed to test contributions of unconscious and conscious key psycho-physiological responses of the nervous system as markers of the individual psycho-physiological fitness for competitive success. The study was timed to the precompetitive training stage of the 23-45 year-old Russian national blind and par-

tially sighted judo team (n=16, 6 women and 10 men) including two HMS, seven WCMS, four MS and three CMS – that accounted for 70% of total formal blind and partially sighted judo team list at that time.

The above blind and partially sighted judo team tests and analyses found the competitive performance determined the now-fear mindsets in fights with knowingly stronger opponents; low exposure to the prestart fever or apathy; stress tolerance of the autonomic nervous system; and the ability to cope with negative experiences and hard physical and mental competitive stressors. The Para judo group was tested with the excellent precompetitive physical and mental resource mobilizing skills; high determination with the ability to concentrate when needed to correct errors and come back, cope with negative emotions and mobilize for competitive success.

Conclusion. The new progress benchmarking and test system for Para sports implies the following procedure to have it customized to every Para sport discipline:

– Rate it for the Para sports functionality (nosological) class;

– Customize to the training system stage and group progress in the multiannual training context;

– Select the best test set;

– Apply the best modern test technologies;

– Develop the individual/ group progress benchmarks; and

– Come up with recommendations on how the training system should be exceled.

We believe that new developments in the progress benchmarks and test systems to facilitate trainings and competitive performance in Para sports customizable for the individual sports functionality classes/ diagnoses may be highly beneficial for competitive progress in every Para discipline.

References

1. Abalyan A.G. Comprehensive pedagogical control system in elite Paralympic athlete training. M.: Print Pro publ., 2018. 400 p.
2. Baryaev A.A. Scientific and methodological support of disabled athletes. Study guide. Lesgaft National State University of Physical Culture, Sports and Health, St. Petersburg, 2017. 80 p.
3. Ivanov A.V., Vorobev S.A., Baryaev A.A. et al. Methodology for assessing, forming and correcting (conducting trainings) psychophysiological compatibility in sledge hockey team. Adaptivnaya fizicheskaya kultura. No. 4. 2020. pp. 36–38.

Predictors of hydrodynamic technical and tactical training system for blind and partially sighted paralympic swimmers

UDC 796.015+797.21

PhD, Assistant Professor **L.V. Vinokourov**[1]
Dr. Hab., Professor **D.F. Mosunov**[1, 2]
Honored Coach of Russia, Associate Professor **I.L. Tveryakov**[3]
[1]Saint-Petersburg Research Institute for Physical Culture, St. Petersburg
[2]Lesgaft National State University of Physical Education, Sport and Health», St. Petersburg
[3]Sports Training Centre of Russian National Teams, Moscow

Corresponding author: leon_1205@mail.ru

Abstract

Objective of the study was to analyze and test benefits of a new individual technical abnormalities sensitive technical and tactical training system for blind and partially sighted swimming elite.

Methods and structure of the study. We made a qualifying analysis of the surface/ underwater swimming technique videos to rate every phase in the Paralympic swimmers' techniques in every style, with occasional applications of skin-fixed LED indicators [1]; plus an expert survey and practical experience analyses by specific topics on a sample of the blind and partially sighted elite (Masters of Sports, World Class Masters of Sports, Honored Masters of Sports) coaches

Results and conclusion. The study found specific and typical individual technical abnormalities in the elite blind and partially sighted sample, with their identification and classification showing the coach and athlete the individual technical and tactical training service and swimming technique improvement needs and priorities. We believe that the individual technical abnormalities should no more be perceived as swimming technique errors in the blind and partially sighted swimming sport as they are necessitated by the individual blind-and-partially-sighted-related primary locomotion patterns. We analyze herein the individual technical abnormalities classes and differences with practical correction options.

Keywords: *blind sports, Paralympic swimmer, technical and tactical, abnormalities, predictors, reserves, technical abnormalities, correction.*

Background. Individual technical abnormalities may be defined as deviations in the Paralympic swimmers' motor skills as compared to that of the healthy peers due to blind-and-partially-sighted-related functional, physical and psychological limitations that need to be respected by the blind-and-partially-sighted-specific technical and tactical training service [2,3]. Such individual technical abnormalities have long been unwelcomed as technical errors of the blind and partially sighted athletes, and only recently were recognized as the lifelong individual swimming versions necessarily customized to the physical conditions, world imaging, spatial orientation specifics, etc., that naturally differ from the healthy ones. It is these "errors" that are addressed by the technical and tactical training model analyzed herein. We re-qualified these errors with individual technical abnormalities classes subject to individualized technical and tactical training service with the relevant corrective tools. In other words, the individual technical abnormalities-customized technical and tactical training model lists and prioritizes the correction/ compensation process goals to facilitate progress in the Paralympic swimming skills, techniques and tactics.

Objective of the study was to analyze and test benefits of a new individual technical abnormalities sensitive technical and tactical training system for blind and partially sighted swimming elite.

Methods and structure of the study. We made a qualifying analysis of the surface/ underwater swimming technique videos to rate every phase in the Paralympic swimmers' techniques in every style, with occasional applications of skin-fixed LED indicators [1]; plus an expert survey and practical experience analyses by specific topics [3] on a sample of the blind and partially sighted elite (Masters of Sports, World Class Masters of Sports, Honored Masters of Sports) coach-

Table 1. *Specific individual technical abnormalities versus the key blind and partially sighted elite's swimming technique elements*

Swimming technique elements	Individual technical abnormalities
1. Body propulsion angle, degrees	Muscle tensions due to fear of collision
2. Legs working angle, degrees	Misperceptions of own motor skills
3. Knee bending angle, degrees	
4. Mid-stroke elbow bending angle, degrees	
5. Post-stroke elbow bending angle, degrees	
4. Elbow bending range, degrees	
Cycle time, s	—
Stroke phase time, s	
Rhythm, %	Fear of collision prior to turns
Pace, cycles/ min	

es (n=9). We analyzed 352 individual swim videos captured in trainings and competitions in 2019-2021 within the ongoing research and practical support service to the Russian Paralympic blind and partially sighted swimming elite. The nine elite coaches were subject to verbal semi-structured survey and interviews to prioritize the key individual technical abnormalities versus the training service goals.

Table 2. *Typical individual technical abnormalities versus the key blind and partially sighted elite's swimming technique elements with correction options*

Key typical individual technical abnormalities	Manifestations of the typical individual technical abnormalities in the swimming technique need to be corrected	Swimming technique correction options
1. Muscle spasm	Early stop of the stroke, water pull inefficiency, faults in the stroke curve	Correctable by massage
2. Zigzag swim trajectory	Longer swim and harder work on distance	Provisionally correctable by in-water support/ guidance, feel of water and spatial control improvement service
3. Strength shortage	Early stop of the stroke, elbow/ wrist bending errors, downward stroking	Correctable by strength trainings
4. Imperfect stroking curve	Early stop of the stroke, faults in the stroke and/ or hand dip curve	Correctable by in-water support/ guidance, feel of water and spatial control improvement service
5. Low coordination skills	Early stop of the stroke, faults in the stroke and/ or hand dip curve	Correctable by ground workouts with the controlled movement mimicking practices
6. Stiff joints	Short extension of hands on dip, short stroke	Correctable by flexibility training
7. Fear of side collision		Provisionally correctable by supported turns, feel of water and spatial control training service
8. Too high dip angle	Inadequately streamlined position prone to vertical one	Correctable by massage (of very tense muscles) and swimming technique excellence
9. Low speed/ speed-strength endurance	Slow-downs on distance, stalled competitive progress	Correctable by special endurance trainings
10. Movement asymmetry	Stroking asymmetry	Correctable by in-water guidance, stroke imaging, feel of water and spatial control training service

Results and discussion. The survey and analyses found specific and typical individual technical abnormalities in the blind and partially sighted elite sample. *Specific individual technical abnormalities* may be defined as dictated by the individual diagnoses (nosology) and their effects on the motor skills of the blind and partially sighted athletes. The specific individual technical abnormalities were basically classified into (1) muscle tension due to fear of collision; (2) misperceptions of own motor skills; and (3) fear of collision prior to turns. Table 1 lists the individual technical abnormalities contributions to the eight key swimming technique elements. It should be noted that two of the swimming technique elements (cycle time and stroke phase time) were tested insensitive to the individual technical abnormalities.

Typical individual technical abnormalities may be defined as the basic swimming technique deviations due to specific combinations of health conditions with the associating morphological and functional issues – fairly common for the blind and partially sighted athlete's functionality classes. Table 2 lists the functionality class unspecific typical individual technical abnormalities of the blind and partially sighted elite. We found that most of the typical individual technical abnormalities of the sample may be corrected completely or partially, conditional on the technical and tactical training service being well customized to the individual conditions, resources and progress goals.

On the whole, we found typical individual technical abnormalities for eight functionality classes out of nine, namely S11, S12, S13, SB11, SB12, SB13, SM12 and SM13.

Conclusion. The individual technical abnormalities grouped and analyzed in the study are recommended for application by coaches of the blind and partially sighted swimmers to effectively identify and analyze the individual technical and tactical training progress lapses, needs and options; find the options most beneficial for every blind and partially sighted athlete; and select one of four main swimming styles as potentially most beneficial for competitive progress agenda of the athlete.

References

1. Belousov S.I., Vinokurov L.V. LED indicators for video recording and correction of elements of sports swimming technique in blind sports. Adaptivnaya fizicheskaya kultura. 2020. No. 2 (82). pp. 35–36
2. Tveryakov I.L. Summarizing athletes' long-term training experience in blind sports - swimming discipline. Uchenye zapiski universiteta im. P.F. Lesgafta 2015. No. 8 (126). pp. 179–184
3. Mosunov D.F. [ed.] Technical and tactical training of Paralympic swimmer. St. Petersburg: Lesgaft NSU publ., 2018. 316 p.

Features of body response of students with health limitations to multidirectional physical loads

UDC 796.01:612

PhD, Associate Professor **V.A. Vishnevsky**[1]
Dr.Hab., Associate Professor **N.V. Peshkova**[1]
[1]Surgut State University, Surgut

Corresponding author: fizkult@teoriya.ru

Abstract

Objective of the study was to reveal the features of the body response of students temporarily exempted from physical education classes to multidirectional loads in the modified version of S.P. Letunov's functional test.

Methods and structure of the study. The study conducted at Surgut State University involved 16 first-year female students temporarily exempted from physical education classes. After setting up the equipment and a 5-minute rest, the female students sequentially performed an orthostatic test: 20 squats in 30 seconds, a 15-second run in place at a maximum pace, a 3-minute run at a pace accessible to the subjects (the rest intervals after loading were, respectively, 2, 3, 4, and 5 minutes).

The mobile COSMEDK5 and GuarkT12x systems were used to measure respiratory, metabolic and electrocardiogram parameters during testing. The following baseline values were recorded: oxygen consumption, carbon dioxide production, pulmonary ventilation, heart rate, blood pressure, energy consumption. Based on these data, the following parameters were calculated: respiratory coefficient, oxygen pulse, pulse cost and a number of other parameters.

Results and Results and conclusions. The study found that, in terms of a comprehensive body response, the most informative tests were 20 squats and 3-minute run. We detected a more significant increase in the respiratory parameters of the students compared to the hemodynamic ones. In this view, the determination of the type of body response to physical loads based exclusively on pulse and blood pressure does not fully reflect the real picture. The use of advanced mobile systems to assess physical load tolerance in the field provides the necessary information for dosing physical loads.

Keywords: *S.P. Letunov's test, body response to physical loads, students exempted from physical education classes.*

Background. Demographic problems and negative trends in the health of the younger generation have created the conditions for an increase in the proportion of students temporarily exempted from physical education classes [2, 3]. At the same time, the authors agree that exemption from sports for health reasons can only be temporary, and it is necessary to search for possible options to involve students in health and fitness activities [4]. It should also be taken into account that the studied group is extremely heterogeneous in terms of health condition. Thus, it was found [1] that when assessing the functional reserves of the body in response to an active orthostatic test, only 48% of students demonstrate a normal transient process and an adequate response, while 28% have an increased response range of the cardiovascular system, and 24% - a decreased one. This indicates that this group of students can engage in physical education but with strict dosing of physical loads, taking into account their individual characteristics. In this regard, there is a need to search for available and safe methods for determining physical load tolerance.

Objective of the study was to reveal the features of the body response of students temporarily exempted from physical education classes to multidirectional loads in the modified version of S.P. Letunov's functional test.

Methods and structure of the study. The study conducted at Surgut State University involved 16 first-year female students temporarily exempted from physical education classes. After setting up the equipment and a 5-minute rest, the female students

sequentially performed an orthostatic test: 20 squats in 30 seconds, a 15-second run in place at a maximum pace, a 3-minute run at a pace accessible to the subjects (the rest intervals after loading were, respectively, 2, 3, 4, and 5 minutes).

The mobile COSMEDK5 and GuarkT12x systems were used to measure respiratory, metabolic and electrocardiogram parameters during testing. The following baseline values were recorded: oxygen consumption, carbon dioxide production, pulmonary ventilation, heart rate, blood pressure, energy consumption. Based on these data, the following parameters were calculated: respiratory coefficient, oxygen pulse, pulse cost and a number of other parameters.

Results and discussion. In the initial position, the studied group was characterized by tachycardia (92±16 bpm), rapid breathing (18±4, min), and low oxygen pulse (3.3±1.1 ml/min). The respiratory coefficient (0.85±0.07 c.u.) reflected the nature of the mixed diet (0.85-0.9). In general, the rates obtained at rest were typical for an untrained person. The transition of the subjects to a standing position (orthostatic test) did not cause serious changes in their body, there was only a tendency towards cardiac acceleration (up to 101 ± 15 bpm, by 9.8%) and an increase in oxygen consumption (up to 329 ± 87 ml/min, by 13%); however, the changes in these indicators were not statistically significant.

The second stage of the test caused a more significant body response (see Table). Upon performing 20 squats, we observed an increase in pulmonary ventilation, which reached its maximum in the 1st minute of recovery and remained significantly higher than the baseline values until the end of the 3rd minute. This was due to the depth of breathing (74.1%) rather than frequency (26.3%). Moreover, the respiratory rate was restored already in the 2nd minute after the test, and the respiratory volume remained elevated (53.7%) until the end of the 3rd minute of recovery.

Oxygen consumption in the subjects was found to increase when they performed physical loads and reached its maximum in the 1st minute of recovery (221%). The maximum carbon dioxide production occurred a minute later (254.2%). The maximum respiratory coefficient was even more inert and reached the highest values in the 3rd minute of recovery (150%), while its value exceeded the anaerobic threshold. This was probably due to the high concentration of hydrogen ions in the blood, which excited the respiratory center, caused increased carbon dioxide production, an increase in its concentration in the exhaled air ($FeCO_2$ in the second minute of recovery - 126.5%), and oxygen consumption in the 3rd minute of recovery dropped significantly.

Among the hemodynamic parameters, it was heart rate that was the most responsive. It reached its maxi-

Body response of female students to 20 squats during test

Indicators, M±σ	Time of recording				
	Baseline values	20 squats	1 min	2 min	3 min
Rf (per min)	19±4	22±5	24±5*	21±5	19±4
VT (l)	0,54±0,16	0,59±0,22	0,86±0,27*	0,94±0,25*	0,83±0,21*
VE (l/min)	9,8±2,8	12,5±3,7*	19,8±5,6*	19,2±5,6*	15,6±4,5*
IV(ml)	459±170	716±270	878±247	733±191	609±145
VO_2 (ml/min)	338±74	397±91*	747±222*	695±179*	438±104*
VCO_2 (ml/min)	264±65	334±88*	606±177*	671±214*	512±156*
RQ	0,78±0,05	0,83±0,58*	0,82±0,11*	0,98±0,14*	1,17±0,18*
VE/VO_2	24,8±4,2	27±4,8	25±4,2	26±5,5	33±6,5*
VE/VCO_2	31,6±4,2	32,3±4,7	30,3±3,5	26,8±3,3*	28,2±3,5
VO_2/kg (ml/min/kg)	6,2±0,9	7,3±1,6*	13,6±2,8*	12,7±2,4*	8,1±2,2*
METS	1,8±0,3	2,1±0,4*	3,9±0,8*	3,6±0,7*	2,3±0,6*
HR (bpm)	91±13	119±18*	117±14*	102±12*	97±13
VO_2/HR (ml/beat)	3,8±1,0	3,4±1,1	6,5±1,8*	6,9±2,0*	4,5±1,1*
FeO_2 (%)	16,8±0,6	17±0,6	16±0,6	16±0,6	17±0,6
$FeCO_2$ (%)	3,4±0,4	3,4±0,4	3,8±0,4*	4,3±0,5*	4,0±0,5*
SBP (mmHg)	122±15	-	135±15*	126±11	121±11
DBP (mmHg)	75±10	-	82±10*	78±9	75±8
PP (mmHg)	47±15	-	52±10	47±8	45±8
SV5 (mV/s)	1,00±0,39	1,01±0,71	1,62±0,62*	1,35±0,43*	1,08±0,43
SV6 (mV/s)	0,78±0,33	0,66±0,94	1,16±0,45*	1,01±0,34	0,85±0,44

* the changes are significant at $p<0.05$.

mum value during squats (130.8%) and fully recovered already in the 2nd minute of rest. Immediately after loading, we recorded the maximum values of the systolic (110.7%) and diastolic (109.3%) blood pressure, which did not differ significantly from the baseline values already in the 2nd minute of rest. Moreover, judging by the fact that the pulse pressure did not change significantly, it was the chronotropic effect of adaptation to physical loads that was mainly realized. A significant deepening of the S wave in V5 (162%) and V6 (148.7%) leads of ECG in the 1st and 2nd minutes of recovery also indicated low cardiac contractility.

There were no significant changes in the structure of correlation relationships during squats. Oxygen consumption still indicated a wide range of relationships: depth of breathing ($r=0.716$, $p<0.05$); pulmonary ventilation ($r=0.847$, $p<0.05$); carbon dioxide production ($r=0.960$, $p<0.05$); oxygen pulse ($r=0.725$, $p<0.05$); specific oxygen consumption ($r=0.578$, $p<0.05$); METS ($r=0.587$, $p<0.05$). At the same time, the heart rate values revealed a significant correlation with oxygen pulse only ($r=0.692$, $p<0.05$). Approximately the same situation persisted in the 1st minute of recovery, with the exception of pulse, which was found to correlate with the respiratory coefficient ($r=-0.549$, $p<0.05$).

Therefore, it can be argued that the body response to 20 squats of students exempted from physical education classes is characterized as imperfect. Taking into account the elevated diastolic pressure, the absence of an increase in pulse pressure, incomplete recovery of a number of indicators by the end of the 3rd minute, increase in the respiratory coefficient above the anaerobic threshold, the type of reaction to physical loads was deemed not normotonic (not optimal). It should also be emphasized that a more significant increase was observed in the respiratory parameters compared to the hemodynamic ones, which to a greater extent reflect the body response to physical loads and correlate with many other integral indicators of body state.

Given this fact, as well as the absence of broad correlation relationships between heart rate and blood pressure, it can be stated that the determination of the type of body response to physical loads based exclusively on pulse and blood pressure does not fully reflect the real picture. Nor can we assess the recovery of the body as a whole by heart rate and blood pressure only, since a number of other integral indicators of the body (oxygen consumption, carbon dioxide production, pulmonary ventilation, respiratory coefficient, and oxygen pulse) exceed the baseline values even by the 3rd minute of recovery.

The most significant body response was observed during the 3-minute run at a pace that the subjects considered optimal for themselves. The test results indicated that the trainees chose a rate of 145±17 bpm on average, with oxygen consumption of 261% of the baseline values, carbon dioxide production of 232% and respiratory rate of 0.93±0.09. This pace appeared to have been somewhat increased. This was evidenced by a significant increase in oxygen consumption (394%) and carbon dioxide production (382%), increase in diastolic blood pressure (13.5%), deepening the S wave in V5 (248.5%) and V6 (361.3%) leads of ECG in the 1st minute of recovery and further increase of respiratory rate to 1.20±0.14 by the 3rd-4th minute of recovery. At the same time, there were also some signs of increased efficiency in the body function (increase of oxygen pulse, pulse pressure, fuller utilization of oxygen from the inhaled air, decrease of ventilatory equivalent for carbon dioxide). Most of the indicators (except respiratory rate) recovered by the 3rd-4th minute of rest.

Conclusion. The use of advanced mobile systems to assess physical load tolerance in the field significantly enhances the insight into the adaptation mechanisms and provides the necessary information for dosing physical loads. Based on this, we have developed a physical education model for students temporarily exempted from physical education classes, which includes methodical-practical sessions devoted to the development of individualized health and fitness, rehabilitation programs and their subsequent implementation in practice.

References

1. Vishnevskiy V.A., Peshkova N.V. New academic physical education and sports service model for disadvantaged health groups. Teoriya i praktika fiz. kultury. 2021. No. 3. pp. 91–94.
2. Echevskaya O.V. Adaptive physical education of special health group students. Vestnik TGU. 2011. No. 9 (101). pp. 90–94.
3. Krasilnikova E.V., Konovalova N.G., Yarullina A.I. Physical education teaching method for special health group students. Vestnik Kuzbasskoy gosudarstvennoy pedagogicheskoy akademii. 2011. pp. 5–34.
4. Karpinskiy A.A., Gardagina L.G., Karpinskaya N.I. et al. Organization of work with students exempted from physical education practices. Uchenye zapiski universiteta im. P.F. Lesgafta. 2019. No. 4 (170). pp. 128–131.

Statodynamic exercises in self-rehabilitation of post-stroke patients at home

UDC 796.077-056.266

PhD, Associate Professor **I.E. Yudenko**[1]
[1]Surgut State University, Surgut

Corresponding author: yudenko_ir@mail.ru

Abstract

Objective of the study was to evaluate the effectiveness of using statodynamic physical exercises in the self-rehabilitation of persons who have suffered a cerebral stroke.

Methods and structure of the study. Subject to the study were a total of 19 persons (mean age - 58.5±7.3 years) who suffered a cerebral stroke and underwent a rehabilitation course at the Department of Neuro-Rehabilitation of the Surgut Clinical Psychoneurological Hospital. To determine whether the developed complex of statodynamic exercises is effective, we measured the functional indicators (heart rate, blood pressure), tolerance to hypoxia using Stange and Gen he's tests, as well as the parameters characterizing the efficiency of physical rehabilitation: goniometry and dynamometry of the paretic arm, the level of muscle spasticity on the Ashworth Scale.

Results and conclusions. The study findings indicate that it is appropriate to use the developed complex of statodynamic exercises in the post-stroke rehabilitation. There were statistically significant changes (at $p<0.05$) in most functional indicators, as well as in the parameters characterizing the efficiency of physical rehabilitation, which significantly improved the quality of everyday social and household activities of the patients.

Keywords: *patients, cerebral stroke, statodynamic exercises, physical rehabilitation indices, functional indicators.*

Background. The overall incidence of cerebrovascular diseases makes acute cerebrovascular accident (ACVA) one of the decisive factors of high incapacitation of the population. As a result, up to 80% of patients become weak. In addition, the current pandemic has negatively affected the health status of the population, in particular, that of the inhabitants of the Khanty-Mansi Autonomous Region - Yugra.

It is noteworthy that the medical community has observed a rising incidence of vascular disorders due to the Covid-19 pandemic. This disease leads to intermuscular coordination disorders [1]. As a result of the long-term maintenance of malposition, the muscular-ligamentous apparatus of those exposed to the virus in the past develops persistent secondary disorders. Patients who have acquired a diminished motor function of the arm become noticeably limited in their daily social and household activities [1, 3, 4]. Therefore, in addition to the restoration of the arm movement, a key condition of rehabilitation is a return to domestic, labor, and, where possible, professional activities.

A scientifically based system of self-rehabilitation at home is economically advantageous for society, as it prolongs patients' household and social activities by reducing the periods of temporary incapacity to work and preventing adverse outcomes and disability. The main task of self-rehabilitation at home as such is to restore physical and somatic health, overall and special working capacity of patients [4].

The urgency of the issue necessitates the elaboration of self-rehabilitation measures, including statodynamic physical exercise.

The inclusion of statodynamic exercises in the rehabilitation course for post-stroke primarily affects the body reaction to muscle work. The use of statodynamic exercises in the rehabilitation of patients after an acute cerebrovascular accident makes it possible to perform any physical exercise softly and spring-like [2, 5]. At the same time, the trainees' heart rate (hereinafter HR) does not change, while the blood pressure (BP) rates increase less significantly than during the performance of exercises in the dynamic mode [5, 6].

Objective of the study was to evaluate the effectiveness of using statodynamic physical exercises in the self-rehabilitation of persons who have suffered a cerebral stroke.

Methods and structure of the study. The study was carried out at the Department of Neuro-Rehabilitation of the State Budgetary Institution of KhMAO-Yugra "The Surgut Clinical Psychoneurological Hospital". Subject to the study were a total of 19 post-stroke patients (mean age - 58.5±7.3). The rehabilitated subjects made up the Experimental Group (EG, n=10). They performed a complex of statodynamic exercises for upper limbs, developed together with the doctors in therapeutic physical culture. The Control Group (CG, n=9) subjects performed only the exercises recommended to them upon discharge. So did the EG ones. The controlling influence lasted for 22 weeks.

To determine whether the developed complex of statodynamic exercises is effective, we measured the functional indicators (HR, BP), tolerance to hypoxia in Stange and Gen he's tests, as well as the parameters characterizing the efficiency of physical rehabilitation: goniometry and dynamometry of the paretic arm, the level of muscle spasticity on the Ashworth Scale.

The methodically correct application of statodynamic exercises implies ease of use, does not cause high fatigue, does not injure trainees. Each

Table 1. *Suggested list of statodynamic exercises*

Initial position	Content of routine	Dosing
I.P. sitting on a chair, arm down by the sides	Side bends with the stretched/ bent arms until the onset of fatigue. In all directions, swaying a bit with the minimal (possible) amplitude.	until the onset of fatigue
I.P. sitting on a chair (standing), hands on hips	Backbends on count 8 (swaying a bit)	4-6 reps
I.P. sitting on a chair (standing), arms sideways, back of the hands towards oneself.	Alternate arm circling backwards with average amplitude.	4-6 reps
I.P. sitting, arms sideways, wrist-lock downwards	Arm circling forward with average amplitude (forcefully and tensely).	until the onset of fatigue
I.P. sitting, arms sideways	Raising tensed straight arms	4-6 reps (until the onset of fatigue)
Same I.P.	Lowering tensed straight arms	4-6 reps (until the onset of fatigue)
I.P. sitting (standing), arms forward, sideways, bent at the elbows, fingers clenched	Forceful fist adduction to the chest (a light weight may be used)	4-6 reps
I.P. sitting (standing), arms sideways	1 – hands backward, palms outward (pronation); 2 – hands backward, palms downward; 3 – hands backward, palms outward (supination); 4 – hands backward, palms downward.	until the onset of fatigue
I.P. sitting (standing)	Spreading fingers using a rubber band	until the onset of fatigue
I.P. sitting (standing)	Lifting and/or holding a disk (different weights) using a «pincer grip» (closing the thumb and the palm)	2-6 reps (until the onset of fatigue)

Table 2. *Test rates in EG and CG before and after self-rehabilitation course at home (M±δ)*

Indicators	EG (n=10)		CG (n=9)	
	Before	After	Before	After
Dynamometry of the paretic arm, kg	13,9±11,4	16,4±12,7	14,1±12,0	15,8±12,1
AmM in radiocarpal joint, degrees	16,2±6,9	30,2±9,4*	12,4±4,1	14,5±3,9#
AmM in elbow joint, degrees	52,5±5,2	71,7±5,1*	58,8±6,4	64,0±5,2
AmM in shoulder joint, degrees	152,5±11,3	176,0±5,8*	155,3±6,8	160,9±5,5#
Level of arm spasticity on the Ashworth Scale, points	3,0±0,6	1,7±0,5*	3,0±0	2,3±0,5#

* statistically significant changes in EG at p<0.05; statistically significant changes as opposed to CG at p<0.05.

Table 3. *Functional indicators in EG and CG patients before and after self-rehabilitation course at home (M±δ)*

Indicators	EG (n=10)		CG (n=9)	
	Before	After	Before	After
SBP, mmHg	149,1±14,6	119,1±14,3*	142,9±15,3	131,1±14,6
DBP, mmHg	86,5±7,5	72,5±6,0*	82,2±7,1	78,6±6,8
HR, bpm	96,6±8,6	80,5±7,8*	89,6±8,4	80,5±8,9
Stange's test, sec	39,4±17,7	47,5±13,2	37,5±16,8	43,2±13,1
Genche's test, sec	23,3±9,9	29,7±9,6	26,9±10,9	28,9±10,2

* statistically significant changes in EG at p<0.05

exercise, distinguished by the features of the movement structure, no matter how small, is characterized by the specificity of its effect on the body [5, 6]. As part of this study, we proposed statodynamic exercises that can be performed at home and are aimed to strengthen muscles. Table 1 lists the exercises in the statodynamic mode (resistance and non-resistance ones). All statodynamic exercises are performed without a breathhold. If necessary, the trainees are actively assisted (spotting and correction) by their relatives.

Results and discussion. The test results are presented in Tables 2 and 3. Before the experiment, the average amplitude of movement (AmM) of the radiocarpal joint was 16.2°±6.9, of the elbow joint - 52.5°±5.2, and of the shoulder joint - 152.5°±11.3. The level of spasticity on the Ashworth Scale before the experiment was 3.0±0.6 points. The hand dynamometry before the experiment was 13.9±11.4 kg. After the experiment, the test rates changed as follows: the amplitude of movement of the radiocarpal joint improved to 30.2°±9.4, of the elbow joint - to 71.7°±5.1, and of the shoulder joint - to 176.0°±5.8. The level of spasticity on the Ashworth Scale fell to 1.7±0.5 points. All the results obtained in EG after the experiment changed statistically significantly at p<0.05 except for the dynamometric indices.

In our view, this was due to the fact that, in most cases, it was the working hand that was a paretic one. It should be noted, however, that the average hand dynamometry rate increased by 3 kilograms - to 16.4±12.7 kg. The data obtained in CG indicated changes, though not statistically significant. In addition, at the end of the experiment, we found that in the 3 tests, the results differed significantly (at p<0.05) between the two groups of patients - EG and CG. These were the indicators of mobility in the radiocarpal and elbow joints, as well as the level of spasticity on the Ashworth Scale, which improved as opposed to the same indicators in CG.

At the beginning of the study (Table 3), the mean value of systolic blood pressure (SBP) in EG was 149.1±14.6 mmHg and that of diastolic blood pressure (DBP) - 86.5±7.5 mmHg, HR - 96.6±8.6 bpm. Before the experiment, the Stange' test rate was 39.4±17.7 sec and the Genche's test rate was 23.3±9.9 sec.

After the experiment, the systolic blood pressure rates in the EG patients reduced to 119.1±14.3 mmHg. There was also a decrease in the diastolic blood pressure rates - to 72.5±6.0 mmHg, and HR - to 80.5±7.8 bpm. The Stange's test rates improved to 47.5±13.2 sec. It should be emphasized that this decrease was also statistically significant (p<0.05). Changes in the Genche's test rates indicated an uptrend. There were functional changes in CG, too; however, by the end of the experiment there were no significant changes in this group's indicators.

Conclusions. Therefore, the chosen approach to the use of statodynamic exercises at home allows for the effective rehabilitation of the isolated, complex and purposeful arm movements.

The use of statodynamic exercises in the self-rehabilitation at home, as well as the extension of the range of the organizational and methodological conditions for their use in a medical institution, will

make physical rehabilitation more accessible and systematic in face-to-face handling of patient, who are able to continue the an active physical rehabilitation course after being discharged from the hospital, which, in turn, will significantly accelerate the restoration of the motor function of the upper limb.

References

1. Belova A.N., Shchepetova O.N. Guidelines for rehabilitation of patients with movement disorders. In 2 vol. V. 1. Moscow: Antidor publ.. 1998. 224 p.
2. Seluyanov V.N. Health-improving physical education technology. Moscow: SportAkademPress publ., 2001. 172 p.
3. Skvortsova V.I. Fundamentals of early rehabilitation of patients with acute cerebrovascular accident. Neurology teaching aid for medical students. Moscow: Litterra publ., 2006.
4. Chogovadze A.V.; Epifanov V.A. [ed.] Non-fixed changes in musculoskeletal system. Physical Therapy. Guide. Moscow: Meditsina publ., 1987. pp. 407 409.
5. Yudenko I.E. Hardware mechanotherapy for effective restoring of upper limbs performance in post-stroke patients. Interaction of spiritual and physical education in formation of harmoniously developed personality. Proc. IV International research-practical online conference. Slovyansk: Donbas State Pedagogical University publ., 2017. pp. 408–414.
6. Yudenko I.E. Organizational and methodological conditions of health-improving classes of special health group students diagnosed with neurocirculatory dystonia (case study of Surgut universities). PhD diss. abstract. Tyumen, 2002. 26 p.

Motor progress facilitating socio-psychological adaption model for preschoolers with musculoskeletal disorders and their families

UDC 372.32:376.2

Dr.Hab., Professor **L.A. Rapoport**[1]
PhD, Associate Professor **N.A. Dubrovina**[1]
PhD, Associate Professor **L.V. Tokarskaya**[1]
PhD, Associate Professor **T.R. Tenkacheva**[2]
[1]Ural Federal University (UrFU), Yekaterinburg
[2]Ural State Pedagogical University, Yekaterinburg

Corresponding author: rla66@mail.ru

Abstract

Objective of the study was to test and analyze benefits of a new motor-progress-facilitating socio-psychological adaption model for the musculoskeletal-disorders-diagnosed preschoolers and their families.

Methods and structure of the study. We sampled for the motor-progress-facilitating socio-psychological adaption model testing experiment the musculoskeletal-disorders-diagnosed children and their family members (n=122+122). Progress of the sample was tested by seven survey methods, including two questionnaire surveys of our own design to rate the motor progress and self-serving skills. The experimental model was designed to advance the family socio-psychological adaption by three adaptive physical education courses for the children with the family counseling on every issue of the musculoskeletal-disorders-diagnosed child upbringing and training.

Results and conclusion. The motor-progress-facilitating socio-psychological adaption model was tested to improve the family socio-psychological adaption resource, with the group motor skills tested to grow by 2.19 points and self-serving skills to 9.65 points on average. The model with the test data and analyses is recommended for application by the adaptive physical education specialist community in the preschool education, rehabilitation and other relevant establishments.

Keywords: *children with musculoskeletal disorders, motor skills, self-serving skills, socio-psychological adaption.*

Background. Musculoskeletal-disorders-diagnosed children may be defined as the clinically, psychologically and didactically polymorphic group since the disorders may be due to a wide range of ailments and conditions including cerebral palsy, polio, clubfoot, torticollis, congenital dislocation of the hip and other deformities of the feet, plus spine/ vertebral disc/ limb/ fingers developmental malformations, arthrogryposis, injuries, polyarthritis, etc. [2]. It should be emphasized that the clinical pictures of these diseases/ disorders are rooted in some motor defect with the snowballing malformations and motor functionality regresses up to disability in some cases. In particularly severe cases of musculoskeletal disorders, the child may be fully unable to walk and serve oneself [2].

Objective of the study was to test and analyze benefits of a new motor-progress-facilitating socio-psychological adaption model for the musculoskeletal-disorders-diagnosed preschoolers and their families.

Methods and structure of the study. We used, for the purposes of the study, the N.P. Fetiskin Self-development Agenda Realization Probe [8]; S. Maddi Resiliance Test adapted by D.A. Leontiev [3]; K. Shriner Stress Test [1]; N.N. Melnikova Adaptive Behavioral Strategies survey [4]; A.Y. Varga and V.V. Stolin Parental Attitude test [5]; Motor Skills Formation Progress test [7]; and the Self-serving Skills Rating matrix [6]. The tests were run at “Nadezhda” Club in Yekaterinburg city.

We sampled for the motor-progress-facilitating socio-psychological adaption model testing experiment the 3-7-year-old musculoskeletal-disorders-diagnosed children (n=122) from kindergartens plus their unemployed family members (n=122, 116 mothers and 6 fathers). The sample was split up into Experimental Group (EG, n=62) and Control Group (CG, n=60). Children in the both groups were pretested with

preserved intelligence and minor-to-moderate motor disorders. Moderate motor disorders imply violations of muscle tone, developmental asymmetry, limited self-serving skills, and (not necessarily) hyperkinetic movements. Unassisted walking is normally at formation stage, with the children moving only with walkers or canes and/or holding an adult's hand, although standing on their own; with heavy retardations in the self-service skills.

The study included pre-experimental, progress and post-experimental tests. The pre-experimental motor skills were tested mostly medium and low in 60 and 44 children, respectively; high in 18 children; and 51 children were tested with basic self-serving skills.

Test data correlation analysis found a direct correlation of the children's skills with their parents' personal resource elements as follows: Behavioral Strategies with motor skills (R=0.185, p=0.041) and Self-serving Skills (R=0.235, p=0.008). The parent's behavioral strategies were found directly correlated with their children's motor skills and self-serving skills in the following elements: Environment Changing Activity with the children's motor skills (R=0.371), and Active Self-improvement with the self-serving skills (R=0.189; p=0.036); plus an inverse correlations between the parents' Environment Leaving to Find a New One behavioral strategy with the self-serving skills (R=-0.219, p=0.015); and Abstract from the Environment to Immerse in the Inner World behavioral strategy with the motor skills (R=-0.365, p=0.000).

Note that the tests found around half of the parents prone to the infantile behavioral strategy – apparently in in response to the child's health issues. This may be the key reason for the direct correlation between the Passive Self-presentation behavioral strategy and the child's motor skills (R= 0.371, p = 0.000). Generally the higher is the child's motor progress the higher is the parental self-presentation and self-assertion standing. On the whole, 94.3% of the parents were tested prone to this strategy.

The Passive Submission to Environment behavioral strategy was found inversely correlated with the child's motor skills (R=-0.306, p= 0.000) – that means that the lower is the parent's dependence on environment the higher is the child's motor progress. This strategy may be interpreted as the avoidance of any unpleasant environmental influences [4], and it was tested in every parent regardless of the motor skills and self-serving skills rates, although was the lowest in the parents (n=40) of the children tested with low-to-moderate motor skills.

In the new model testing experiment, we strived to improve the family socio-psychological adaption by special trainings to make the families fit for efficient adaptive physical education service to their children, with counseling on every issue of upbringing and training of the musculoskeletal-disorders-diagnosed children to facilitate their motor progress. Parents were also trained to monitor variations in motor skills to effectively manage the individual motor progress programs by the adaptive physical education toolkit.

Results and discussion. The EG test data correlation analysis found progress in the parents' behavioral strategy of facilitating effects on the children's self-serving skills. As a result, the children were tested with progress in motor and self-serving skills due to the active contributions of the families in their upbringing and education process. The tests found motor skills progress in every test including lower/ upper limbs control; walking; spatial control test rates; hygienic habits; eating and dressing; and movement coordination abilities: see Table 1 hereunder.

On the whole, the new motor-progress-facilitating socio-psychological adaption model for the musculoskeletal-disorders-diagnosed preschoolers and their families was found to encourage positive transformations in the family personality resource with improvements in the child-parent relations, socio-psychological adaption, and the children's motor and self-serving skills.

Table 1. *Post-experimental test data correlations between the parent's behavioral strategy and child's motor progress in the EG, p≤0,05 / R (Spearman 's ratio), significant progress*

Behavioral strategies	Motor skills		Self-serving skills	
	R	p	R	p
Self-improvement	0,037	0,771	***0,293***	***0,020***
Abstraction from environment	-0,053	0,681	***-0,305***	***0,015***
Immersion in the own self	-0,177	0,167	***-0,251***	***0,048***
Passive submission	-0,228	0,074	***-0,380***	***0,002***
Passive wait	-0,144	0,261	***-0,374***	***0,002***

Conclusion. The new motor-progress-facilitating socio-psychological adaption model for the musculoskeletal-disorders-diagnosed preschoolers and their families was found beneficial for the children's motor progress due to the effective psychological and training service to their families; motor-progress-facilitating counseling and adaptive physical education basics training course for the families; step-by-step individual motor progress instructions and other elements that contributed to the children's motor progress. Tests in the model piloting experiment found the EG motor skills growing by 2.19 points and self-serving skills growing to 9.65 points on average. The family socio-psychological adaption was tested to grow to high level in 49 (79%) of the EG families.

References

1. Dmitriev M.G., Belov V.G., Parfenov Yu.A. Psychological and pedagogical diagnosis of delinquent behavior in difficult adolescents. (Parts 4-9). St. Petersburg: PONI publ., 2010. 316 p.
2. Levchenko I.Y., Prikhodko O.G. Technologies of education and upbringing of children with musculoskeletal disorders. Study guide for students sec. ed. institutions. M.: Akademiya publ., 2001. 192 p.
3. Leontyev D.A., Rasskazova E.I. Vitality test. M.: Smysl publ., 2006. 63 p.
4. Melnikova N.N. Diagnosis of socio-psychological adaptation of personality. Study guide. Chelyabinsk: SUrSU publ., 2004. 57 p.
5. Nemov R.S. Psikhologiya [Psychology]. textbook. for stud. higher ped. ed. institutions: in 3 books. 4th ed.. M.: VLADOS publ., 2001. Book. 3: Psychodiagnostics. Introduction to scientific psychological research with elements of mathematical statistics. 640 p.
6. Poletaeva (Dubrovina) N.A., Serova N.B. Pedagogical support of families as rehabilitation tool for preschoolers with cerebral palsy. Development of health saving technologies in modern society. Proc. international student scientific and practical conference (Yekaterinburg, June 3-4, 2015). Yekaterinburg: Ural. un-ty publ., 2015. pp.143-162.
7. Toporkova (Dubrovina) N.A. Monitoring o formation of motor skills in preschoolers with cerebral palsy. Adaptivnaya fizicheskaya kultura. Quarterly magazine. 2012. No. 3 (51). pp. 24–25.
8. Fetiskin N.P., Kozlov V.V., Manuylov G.M. Socio-psychological diagnostics of personality development and small groups. M.: Institute of Psychotherapy publ., 2002. 490 p.

Combined precompetitive mental conditioning model customized for pandemic-related limitations

UDC 796.01:159.9.072

PhD **A.A. Banayan**[1]
A.K. Lashkul[1]
[1]St. Petersburg Research Institute of Physical Culture, St. Petersburg

Corresponding author: abanayan@spbniifk.ru

Abstract

Objective of the study was to develop a new combined precompetitive psychological training model customizable for the pandemic-related limitations.

Methods and structure of the study. In addition to the traditional live/ offline test equipment, the combined precompetitive mental conditioning model included an access to psychological information. At the end individual precompetitive mental conditioning plan was developed for a specific sports event.

The popular social network VKontakte was used for the athletes from all over Russia who received an access to the precompetitive-mental-conditioning-related information and individualized precompetitive mental conditioning service to facilitate their trainings for specific events.

Results and conclusion. Distance/ online precompetitive mental conditioning service formats have their benefits in at least the following domains: practical knowledge and guidance is accessible from any point of the globe; and the service is rather flexible and customizable for the individual training and competitive needs and goals. Such a service may be particularly efficient when combined with a reasonable direct/ live communication a sports psychologist with athlete at key points to facilitate competitive progress.

Keywords: *sports psychology, distance survey, social networks, precompetitive training, autogenic training.*

Background. Lately the global sports communities have demonstrated a growing need for psychological support service as verified by the practical national and foreign studies and new mental conditioning models during the pandemic [3, 13, 14]. The growing demand for the mental conditioning service from the professional sports elite is due to the pandemic-related limitations and the associating burnouts and disappointments with lapses in the competitive progress agendas and uncertainties in the further sports careers [2, 3]. The studies for the period of COVID-19 pandemic have found a correlation between visioning of specific clear progress goals and success motivations – that are important for the individual 'immune resource' with its coping strategies [4]. These considerations urged us to develop and pilot a distance component complementary to the standard precompetitive mental conditioning service to respond the pandemic-related crisis in sports [7].

Objective of the study was to develop a new combined precompetitive psychological training model customizable for the pandemic-related limitations.

Methods and structure of the study. The combined precompetitive mental conditioning model offers, in addition to the traditional live/ offline test equipment, an access to critical psychological information and guidance online, to develop and manage individual precompetitive mental conditioning systems for specific sports events. The online test toolkit includes the following elements:

- Mental self-control tests using Verim ProNet skin-galvanic response test system with a Mind-Reflection adapter [8];

- Gas-discharge visualizing (GDV) non-invasive fast test to rate the current psycho-physiological health, adaptability and rehabilitation in training process [9]; and

- Tests of the individual innate conditions with the nervous system functionality typing, using Prognosis test system based on the E.P. Ilyin (1972) motor re-

sponse test system [9]. The distance precompetitive mental conditioning service format was piloted in the popular social network VKontakte (VK) within a closed group of athletes from all over Russia who received an access to the precompetitive-mental-conditioning-related information (with audio and video contents) and individualized precompetitive mental conditioning service to facilitate their trainings for specific events.

Results and discussion. As of November 07, 2021, the VK group was joined by 86 athletes from sailing, ice hockey, figure skating, blind table tennis, Nordic skiing; and adaptive/ Paralympic athletics, powerlifting, sledge hockey and other disciplines. For seven months of the group activity, the content was claimed more than 1100 times. The group attendance statistics show dominance (62.7%) of the 21-30-year-olds in the 18+ years old pool from more than 10 cities in Russia and even Japan – that is indicative of the growing popularity of the precompetitive mental conditioning content, particularly prior to and during the 2020 Olympics and Paralympics in Tokyo. The content was accessed mostly by cell phones (67.68%) and computers (32.32%) as it is offered in a user-friendly format.

The distance precompetitive mental conditioning content included video briefs and precompetitive mental conditioning sessions adapted to specific Olympic and Paralympic disciplines, with a special priority to the intuitively understandable graphics. The precompetitive mental conditioning content offered to the VK group includes, among other things:

1) Precompetitive mental conditioning basics and 'what it is needed for' (521 views), with a list of most common sports-related negative emotions and conditions, coping strategies, self-control and precompetitive mental conditioning toolkits;

2) "Precompetitive mental conditioning in sports, Part 2: Ideomotor training" video (312 views) that explains basics of modern ideomotor training, how it is designed and managed, and its benefits for the individual training and competitive agendas;

3) 12 self-training sessions to facilitate the post-stress rehabilitation (140 to 160 views); and

4) References to the relevant questionnaire surveys designed by St. Petersburg Research Institute of Physical Culture and accessible online at the Lime Survey platform, with the Competitive Consistency Self-Rating Survey (n=300) and individual recommendations for the precompetitive mental conditioning service for every subscriber.

Conclusion. Distance/ online precompetitive mental conditioning service formats have their benefits in at least the following domains: practical knowledge and guidance is accessible from any point of the globe; and the service is rather flexible and customizable for the individual training and competitive needs and goals. Such service may be particularly efficient when combined with a reasonable direct/ live communication a sports psychologist with athlete at key points to facilitate competitive progress.

References

1. Banayan A.A., Lashkul A.K. Assessment of psycho-emotional state of hockey players during compulsory self-isolation period. Actual problems and prospects for development of system of sports training, mass physical education and sports. Proc. res.- practical. conferences with international participation (25-26.10.2021, St. Petersburg). St. Petersburg, 2021. pp. 128–133.
2. Banayan A.A Psychophysiological factors of sports success of elite Paralympic athletes (case study of sledge hockey). Abstract of PhD diss. St. Petersburg, 2020. 24 p.
3. Ivanova I.G., Banayan A.A., Yanina E.A. et al. Features of voluntary self-regulation in Paralympic athletes with musculoskeletal disorders from various sports classes. Uchenye zapiski Universiteta im. P.F. Lesgafta. 2020. No. 6 (184). pp. 440–448.
4. Korotkova A.K., Banayan A.A. Design of remote survey system for athletes. Adaptivnaya fizicheskaya kultura. 2020. No. 3 (83). pp. 46–47.
5. Banayan A.A., Vorobev S.A., Kiseleva E.A. et al. The structure and content of the general psychological training of elite Paralympic athletes. Teoriya i praktika fiz. kultury. 2021 no. 6 (994). S. 24–26.
6. Trifonova E.A. Stress coping strategies and human somatic health: theoretical approaches and empirical studies. Izvestiya RGPU im. A. I. Gertsena. 2012. No. 145. pp. 97–108.
7. Leguizamo F., Olmedilla A., N ez A., Verdaguer FJP, G mez-Espejo V., Ruiz-Barqu n R., Garcia-Mas A. Personality, Coping Strategies, and Mental Health in High-Performance Athletes During Confinement Derived From the COVID-19 Pandemic. Front Public Health. Available at: https://www.frontiersin.org/articles/10.3389/fpubh.2020.561198/full (date of access: 24.05.2021).
8. Szczypi ska M., Same ko A., Guszkowska M. Strategies for Coping with Stress in Athletes During the COVID-19 Pandemic and Their Predictors. National Library of Medicine. Available at: https://pubmed.ncbi.nlm.nih.gov/33737896/ (date of access: 24.05.2021).

Regional physical education and sports sector development statistics: comparative analysis

UDC 796:311

PhD, Associate Professor **S.A. Vorobyev**[1]
PhD, Associate Professor **N.A. Breider**[1, 2]
Dr.Hab, Associate Professor **M.Y. Shchennikova**[1, 3]
PhD **G.V. Bogomolov**[3]
[1]St. Petersburg Research Institute of Physical Culture, St. Petersburg
[2]Russian State Hydrometeorological University, St. Petersburg
[3]Federal Scientific Center for Physical Culture and Sports, Moscow

Corresponding author: fizkult@teoriya.ru

Abstract

Objective of the study was to find the status of the national physical education and sports sector based on the comparative analysis of the regional progress.

Methods and structure of the study. We analyzed in the study the national physical education and sports sector development statistics with the regional (Federal District) progress elements for 2012–2019.

Results and conclusion. Our analysis of the physical education and sport sector progress statistics, with a special priority to the macroeconomic (socio-economic) progress indicators, showed an overall growth trend, with a special progress in the North Caucasian Federal District. The average federal physical education and sport sector funding for the period was reported to grow by as much as 167.57%, and the physical education and sport committed population by 70.86%; although these growths were of little effect on the physical education and sports infrastructure expansion (by 4.88% only) and physical education and sport sector staffing (by 13.58%) on the federal scale.

Our analysis showed that the long-term progress of the physical education and sports sector at the federal and regional levels requires growth in every physical education and sport sector progress element in harmony with the macroeconomic progress as all these progress aspects are directly correlated.

Keywords: *physical education and sports development strategy in Russia, physical education-and-sports-committed population, physical education development statistics.*

Background. An integrative analysis of the long-term progress of the regional and total physical education-and-sports-committed populations and other relevant physical education and sport sector process statistics makes it possible to explore correlations of the progress data and understand the key progress trends in every core domain across the Russian Federation.

Objective of the study was to analyze the national physical education and sports sector development statistics by a regional progress profiling analysis.

Methods and structure of the study. We have rated and analyzed the regional socio-economic development statistics with the physical education and sport sector progress data reported for the period 2012-2019 for the Russian Federation on the whole and the following 8 Federal Districts in particular: Central, Northwestern, Southern, North Caucasian, Volga, Siberian, Ural, and the Far Eastern Federal Districts.

Results and discussion. Our analysis of the above physical education and sport sector progress statistics, with a special priority to the macroeconomic (socio-economic) progress indicators, showed an overall growth trend. There was, however, a general regress in the federal population on the whole versus some regional growth in the Central, Northwestern and North Caucasian Federal Districts.

The physical-education-and-sport-committed populations was reported to grow in every Federal District leaded by the North Caucasian Federal District with its 153.95% reported progress for the period – versus the total regional population growth by

4.01% and regional physical education and sport sector funding growth by +893.33%; average per capita income growth of 33.18%; physical education and sports infrastructure expansion by 14.24%, and the physical education and sport sector staffing by 15.18%.On the whole, the North Caucasian Federal District have demonstrated a direct correlation of the economic progress statistics with the physical education and sport sector progress ones.

The Central Federal District was ranked second on the regional physical education and sport sector progress scale for the period, with its physical education-and-sports-committed population growth reported at 83.59%; total population growth by +2.07%; and the physical education and sports funding by +118.8% (although at was 7 times lower than in the North Caucasian Federal District). The regional physical education and sports infrastructure was reported to grow by +18.63%, and the physical education and sport sector staffing by +38.47% versus the average per capita income growth by +42.90% - that was above the federal average. On the whole, this economic progress have contributed to the physical education and sport sector development process.

The Ural Federal District was ranked third with its reported physical education and sports-committed population progress by 82.21%, plus two high (above the federal average) and closely correlated progress rates: physical education and sports infrastructure growth by +13.55% and physical education and sport sector full-time staff growth by +22.24%. These progress data are particularly impressive in the context of the total population sagging trend, and this gives reasons to assume that the physical education-and-sports-committed population growth may be partially due to the general population outflow from the region. The physical education and sport sector funding for the period was under the federal average but still high enough at +81.28%; and the average per capita income was reported to grow by +32.16%.

The Siberian Federal District was ranked 4th in the federal physical education and sport statistics with its physical education and sport sector staffing growth by 79.60% and other growth trends for the period, although the progresses were still lower than the federal average: see Table. Our analysis of correlations in the physical education and sports progress data arrays with a special attention to the physical-education-and sports-committed population growth showed the local physical education and sport developments being generally driven by the overall economic progress.

The Southern Federal District was ranked the last on the list with its only 29.40% growth in the physical-education-and-sports-committed population versus the total population sagging trend of -15.05%, and the still low physical education and sports funding growth of +36.36% (much lower than the national average); plus regress in the physical education and sports infrastructure development by -13.01% and staffing of -6.03% - that apparently proves the above assumption. Note that the average per capita income growth in the region was maximal for Russia at +95.57% (2.3 times higher than the federal average), and this fact may be interpreted as indicative of the regional population being unmotivated for physical education and sports and, hence, the regional income management policies are still inefficient and incompliant with the physical education and sport sector policies and priorities.

Correlation analysis of the physical education and sport sector progress rates including the physical education and sport -committed population growth and the physical education and sport sector staffing, infrastructure and funding statistics found them directly correlated, with some macroeconomic indicators – such as the average per capita income growths versus the total populations – being of little contributions to the physical education and sport sector progress.

On the whole for the Russian Federation for the period, the physical education and sport sector funding was reported to grow by 167.57% in correlation with the physical education and sports-committed population growth by 70.86%. Growth in the physical education and sport sector funding in every Federal District was associated with growth in the physical education and sports-committed populations. Since the physical education and sport sector funding in 2012-2019 varied in a wide range across the Federal Districts, average growth was found not always correlated with progress in the physical education and sports-committed populations. Moreover, targeted specific physical education and sport sector funding increments in different regions were found little if ever contribute to the physical education and sports-committed population growths. Note that the correlation analysis showed the other physical education and sport sector progress rates being not always directly correlated.

On the whole, the reporting data analysis showed that the considerable growth of the federal physical education and sport sector funding by 167.57% on

average was of little effect on the physical education and sports infrastructure expansion (by 4.88%) and physical education and sport sector staffing (by 13.58%) statistics. On the national average scale, the physical education and sport sector funding was inefficient in the physical education and sports assets/ infrastructure building and physical education and sport service staffing elements – although these two elements are critical for the physical education and sport sector progress and grass-rout sports human resource and Olympic resource building agendas. Therefore, we would recommend the available physical education and sport sector funding being disbursed on a more focused and efficient basis, with a special priority to the physical education and sports infrastructure development and physical education and sport staff advanced training and retraining initiatives. It should be emphasized in this context that the North Caucasian Federal District reported the highest growth in the physical education and sport sector funding (9 times higher than in 2012) with the associating progress in the physical education and sport infrastructure by +14.24%, and physical education and sport sector full-time staffing by +15.18%.

Conclusion. Our analysis showed that the long-term progress of the physical education and sport sector at the federal and regional levels requires growth in every physical education and sport sector progress element in harmony with the macroeconomic development on the whole as all these processes are directly correlated. Such analysis will help the statistical monitoring of the physical education and sport sector progress profiles using a timely updated reporting database – to facilitate the efforts to prudently design and manage the physical education and sport sector staff flows with every other associating progress element including the local governance, social development, business and social processes.

References

1. Vorobev S.A., Shchennikova M.Y., Breider N.A. et al. Physical education and sports sector specialists: supply and demand situation analysis and forecast. Teoriya i praktika fiz. kultury. 2021. No. 8. pp. 104–106. http://www.teoriya.ru/ru/node/14570.
2. Klendar V.A., Krylova V.M. Analysis of dynamics and relation of indicators of development of physical education and sports and macroeconomic indicators of the Russian Federation. Vestnik sportivnoy nauki. 2015. no.6. Available at: https://cyberleninka.ru/article/n/analiz-dinamiki-i-vzaimozavisimosti-pokazateley-razvitiya-fizicheskoy-kultury-i-sporta-i-makroekonomicheskih-pokazateley-rossiyskoy.
3. Official state statistics. Available at: https://rosstat.gov.ru/folder/210.

Competitive progress related psychological aspects of trainer-trainee relationship

UDC 796.01:159.9

Dr.Hab., Professor **A.G. Gretsov**[1, 2]
PhD, Associate Professor **Y.S. Pezhemskaya**[2]
PhD, Associate Professor **N.L. Somova**[2]
Dr.Sc.Psych., Professor **E.B. Laktionova**[2]
[1]St. Petersburg Research Institute of Physical Culture, St. Petersburg
[2]Herzen State Pedagogical University St. Petersburg

Corresponding author: agretsov@mail.ru

Abstract

Objective of the study was to survey and analyze the trainer-trainee relationship versus the self-attitudes, competitive progress and mental wellbeing test data.

Methods and structure of the study. We sampled for the survey the averagely 22-year-old academic athletes (n=182, 47% male 53% female sample, including 55% and 45% of skilled and unskilled athletes, respectively) majoring in the Physical Education discipline at Herzen State Pedagogical University, Lesgaft National State University and Pushkin Leningrad State University in St. Petersburg. The sample was subject to the Trainer's Social Perception, Personality and Managerial Skills Survey (by Y. Khanin, A. Stambulov); Self-attitude Questionnaire (by V.V. Stolin, S.R. Pantileev); and K. Riff Mental Wellbeing Scale (adapted by L. Zhukovskaya and E. Troshchikhina).

Results and discussion. The sample was tested with competitive success / skills unspecific generally positive trainer-trainee relationship – that may be due to the high professional determination of the sample and cooperative trainer service. Competitively successful and skilled athletes, males and females, were tested higher on the self-attitude and integral mental wellbeing scales than the unskilled peers.

Keywords: *athlete, trainer, self-attitude, competitive progress, mental wellbeing, student.*

Background. Theoretical analysis of the psychological and pedagogical studies of competitive success and competitive progress issues made it possible to prioritize the psychological competitive progress factors as follows: coaching style; trainer-trainee relations with their emphases and emotional contexts; and the roles and expectations in the trainer-trainee cooperation system. The studies generally demonstrate that the competitive success and competitive progress of an athlete tend to improve the trainer-trainee relationship [2, 4, 7, 9], with the mutual attitudes spurring up the competitive progress and diligence in the training process [1, 3, 8].

Objective of the study was to survey and analyze the trainer-trainee relationship versus the self-attitudes, competitive progress and mental wellbeing test data.

Methods and structure of the study. We used the following methods: psychological surveys; primary statistical data processing tools; and the Mann-Whitney U-test for comparative analysis. The trainer-trainee relationship was rated by the Trainer's Social Perception, Personality and Managerial Skills Survey (by Y. Khanin, A. Stambulov) [8] to assess the trainer-trainee modality in the gnostic, emotional and behavioral components. The gnostic component rates the athlete's attitude to the coach as a professional; the emotional component rates the emotionality and personal attitude to the coach; and the behavioral component rates the trainer-trainee cooperation in the training process [5]. Self-perceptions were rated by the Self-attitude Questionnaire (by V.V. Stolin, S.R. Pantileev) [6]. And the subjective mental wellbeing was rated by the K. Riff Mental Wellbeing Scale (adapted by L. Zhukovskaya and E. Troshchikhina) on the following six scales: autonomy, competence, personality progress, positive attitudes, life goals, and self-acceptance.

We sampled for the survey the averagely 22-year-old academic athletes (n=182, 47% male 53% female sample, including 55% and 45% of skilled and unskilled athletes, respectively) majoring in the Physical Education discipline at Herzen State Pedagogical University, Lesgaft National State University and Pushkin Leningrad State University in St. Petersburg; and split them up into two (skilled and unskilled) groups. The sample equally represented the following sports: athletics; team sports (volleyball, basketball, football); wrestling (judo, taekwondo, karate, sambo, boxing, kickboxing); individual competitive disciplines (swimming, skiing, cycling, equestrian, powerlifting, tennis); and aesthetic sports (dancing, aerobics, rhythmic gymnastics).

Results and discussion. A comparative analysis of the athlete-to-coach attitudes (Fig. 1) found insignificant intergroup (competitive-success-specific) differences. The test values (5.6+ points out of 7) in the gnostic, emotional and behavioral components were indicative of the positive athlete-to-coach attitudes regardless of the skill/ competitive success level.

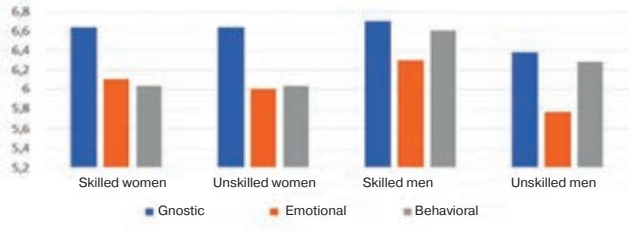


Figure 1. *Athlete-to-coach attitudes in the competitive success / skills groups: gnostic, emotional and behavioral components*

This may be due to sample being specific enough since every sampled athlete majors in the Y. Khanin, A. Stambulov physical education system with the relevant professional determination and priorities contributing to the trainer-trainee cooperation.

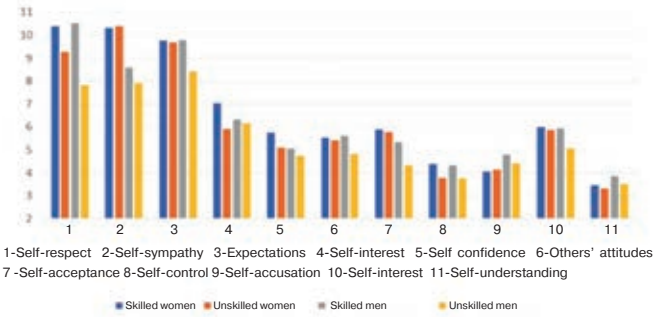


Figure 2. *Competitive-success-specific self-attitudes*

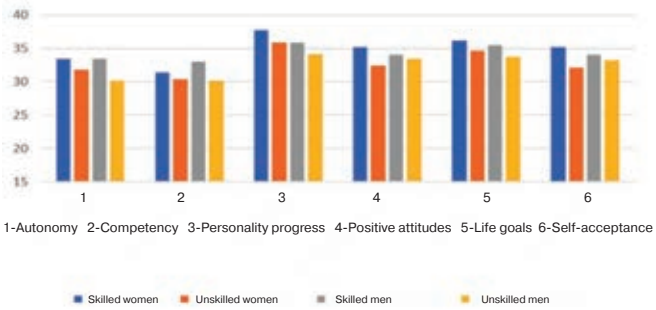


Figure 3. *Competitive-success-specific mental wellbeing test data*

The self-attitude (Fig. 2, Table 2) and mental wellbeing (Fig. 3, Table 3) test data analysis found the competitive success / skill specific group differences. The competitively successful women's group was tested statistically significantly higher on the self-attitude and mental wellbeing scales including self-interest, self-confidence, self-control, personality progress, positive attitudes, self-acceptance and integral mental wellbeing ones.

The men's group mental wellbeing tests (Fig. 3, Table 4) found the competitive success / skill specific

Table 1. *Competitive-success-specific self-attitudes: significant differences, women's subsample*

Test scale	Skilled women (up to CMS)	Unskilled women	p
Self-interest	7,03	5,9	p≤0,01
Self-confidence	5,75	5,09	p≤0,05
Self-control	4,39	3,77	p≤0,05

Table 2. *Competitive-success-specific mental wellbeing test data: significant differences, women's subsample*

Test scale	Skilled women (up to CMS)	Unskilled women	p
Personality progress	37,69	35,83	p≤0,05
Positive attitudes	35,18	32,42	p≤0,05
Self-acceptance	35,18	32,08	p≤0,01
Integral mental wellbeing	204	191	p≤0,01

Table 3. *Competitive-success-specific mental wellbeing test data: significant differences, men's subsample*

Test scale	Skilled men (up to CMS)	Unskilled men	p
Autonomy	33,43	30,1	p≤0,01
Competency	33	30,1	p≤0,05
Integral MWB	200,95	187,24	p≤0,05

significant intergroup differences on the autonomy (p≤,01), competence (p≤0.05), and integral mental wellbeing (p≤0.05) scales, with the skilled athletes tested higher than the unskilled ones. This means that the competitively successful skilled men demonstrate the higher mental wellbeing than the unskilled unsuccessful ones.

Conclusion. The study found generally positive competitive-success-unspecific trainer-trainee relationships – that may be due to the high professional determination, priorities and cooperation with the trainers. The competitively successful and skilled women were tested significantly higher in the self-attitudes and mental wellbeing domains on the self-interest, self-confidence, self-control, personality progress, positive attitudes and self-acceptance scales than their unskilled unsuccessful peers. The competitively successful skilled men were tested significantly higher in the mental wellbeing domain on the autonomy and competence scales than their unskilled unsuccessful peers. Athletes, both males and females, with the high competitive success were tested higher on the integral mental wellbeing than the unskilled subsample.

References

1. Vorobyev S.A., Gretsov A.G., Laktionova E.B., Pezhemskaya Yu.S., Somova N.L. Coach image and psychological wellbeing of student athletes. Teoriya i praktika fiz. kultury. 2020. No. 8. pp. 98–100.
2. Ilyin E.P. Sport psychology. St. Petersburg: Piter publ., 2008. 352 p.
3. Kolomeytsev Y.A. Study of influence of interpersonal relations on sports performance. PhD diss. Abstract. Tartu, 1974. 45 p.
4. Lubysheva L.I. Profession "Coach": to know, to understand, to love... Teoriya i praktika fizicheskoy kultury. M.: Teoriya i praktika fizicheskoy kultury i sporta publ., 2018, P. 93.
5. Melnik E.V., Silich E.V., Kuhtova N.V. Coach's Psychology: theory and practice. Guidelines. Vitebsk: Masherov VSU publ., 2014. 58 p.
6. Pantileev S.R. Self-attitude as emotional-evaluative system. M.: Moscow University publ., 1991. 110 p.
7. Rodionov A.V. Effect of psychological factors on sports results. M.: Fizkultura i sport publ., 1987. 112 p.
8. Svetlova A.A. Athlete and coach relationships as factor in success of sports activities. [Electronic resource] Psikhologicheskaya nauka i obrazovanie psyedu.ru. 2014. No. 3. Available at: http://psyedu.ru/journal/2014/3/Svetlova.phtml (date of access: 09.06.2021).
9. Hanin Y.L. Psychology of communication in sports. M.: Fizkultura i sport publ., 1980. 208 p.
10. Ryff C.D., Keyes C.L.M. The structure of psychological well-being revisited. Journ. Pers. Soc. Psychol. 1995. No 69. pp. 719–727.

First- versus last-year university students' physical education motivations

UDC 159.9.07

Dr.Hab., Professor **V.N. Irkhin**[1]
PhD, Associate Professor **Y.N. Gut**[1]
PhD, Associate Professor **S.A. Korneeva**[1]
PhD, Associate Professor **S.V. Rylsky**[1]
[1]Belgorod State National Research University, Belgorod

Corresponding author: nikulin_i@bsu.edu.ru

Abstract

Objective of the study was to survey and analyze physical education motivations of the first- versus last-year university students not majoring in sports.

Methods and structure of the study. Belgorod State National Research University's Psychology Department students (n= 98) were sampled for the survey run in 2021. They were subject to My Attitude to Physical Education questionnaire survey by Y.N. Gut, S.A. Korneeva; Sports Motivations test by A.V. Shaboltas; and the Personality Success Motivations and Failure Avoidance tests by T. Ehlers. The survey data were processed by the standard statistical toolkit with the nonparametric Mann-Whitney U-test for unrelated samples using the SPSS 25 software.

Results and conclusion. The study was designed to survey and analyze physical education motivations of the first- versus last-year university students. We found the first-year students more physically active, although the seniors were tested trained on a more regular and determined basis knowing the benefits of physical education for health, mood and wellbeing. The younger group was tested focused on the socializing, peer communication, friends-making, public approval and recognition aspects. As for the GTO Complex test motivations, the seniors are reportedly more focused on success. The survey data and analysis found the genuine physical education motivations being volatile and underdeveloped in the younger group majoring not majoring in sports.

Keywords: *physical education motivation, university physical education classes, sports-unrelated first- and last-year students.*

Background. Modern health research community generally agrees that low physical progress motivations and underdeveloped health agendas are the key reasons for the university students' physical inactivity [1-4]. Surveys of the student physical education motivations make it possible to rate the actual interests, physical education agendas, values and priorities. Having analyzed the students' interests and motivations, one may forecast whether or not they will keep committed for the physical education / sports later on or their physical education needs and ambitions will rapidly fade with time in the academic period.

Knowing the basic physical education motivations, we can select and apply the most efficient corrective tools in the academic physical education service to help them make a transition from volatile opportunistic motivations centered on an immediate results (socializing purposes, friends-making and pleasing, fashions, self-assertion needs, etc.) to more stable and healthy physical education motivations; and develop their ability to prudently manage their own motivational contexts so as to grow good determination for physical education, healthy lifestyle and physical progress as such.

Objective of the study was to survey and analyze physical education motivations of the first- versus last-year university students.

Methods and structure of the study. We sampled for the survey (run in 2021) the Belgorod State National Research University's Psychology Dept students (n= 98). The sample was subject to My Attitude To Physical Education questionnaire survey by Y.N. Gut, S.A. Korneeva; Sports Motivations Probe by A.V. Shaboltas; and the Personality Success Motivations

and Failure Avoidance tests by T. Ehlers. The survey data were processed by the standard statistical toolkit with the nonparametric Mann-Whitney U-test for unrelated samples using the SPSS 25 software.

Results and discussion. As provided by the questionnaire survey data, 85% and 78% in the first- and last-year groups (respectively) are reportedly physically active; and 15% and 22% inactive (U=772; p≤0.05;). Only 8.8% and 24.2% reported habitual physical education for they "feel energized and happy" in trainings; versus 41.8% and 40% trained on a "periodic" basis; plus 48.4% and 35.2% on a "rather irregular" basis (U=765; p≤0.05,).

The first-year group reported the following preferred physical education / sports: volleyball (17.6%), jogging (13.2%), body building (11.2%), swimming (11.2%), and vague "different sports" (8.8%). The senior group ranked the favorite sports as follows: fitness (19.8%), jogging (19.8%), stretching (8.8%); gym trainings (8.8%), etc. The physical education / sporting motivations were ranked as follows: 8.8% and 11% in the first- and last-year groups (respectively) reported no motivations whatsoever; 26.6% and 4.4% motivated by fashion and sporting image; and 30% and 37% motivated by the individual health agendas.

However, most in the first- and last-year groups (55% and 50.5%, respectively) were found indifferent to the daily active breaks and activation workouts in the classes; whilst the rest were virtually equally split into supporters (22% and 19.8%) and critics (22% and 28.6%) of the above physical activity initiatives, with an insignificant intergroup difference. Furthermore, only 39.6% and 27.4% of the above (respectively) reported joining the university physical education / sports events and movements on a habitual or periodic basis - versus 52.8% and 52.8% in the both groups reluctant to join the GTO Complex trainings and tests; and 30.8% and 37.4% plus 15.4% and 8.8% reporting "periodic" and "habitual" participation in the events, trainings and tests, respectively.

The above reluctance is mostly explained by disinterest (39.6% in every group); whilst. 30.8% and 8.8% in the first- and last-year groups (respectively) mentioned compulsion/ strong pressure from outside among their physical education motivations. Furthermore, 28.6% and 11% in the groups reported motivated by the GTO badges; and 13.2% and 8.8% said they just followed suit of their acquaintances and friends in the physical education activities.

On the whole, the first- and last-year groups reported mostly motivated for the GTO Complex trainings and tests by the socializing and success agendas, respectively; apparently due to the younger group being more driven by emotional aspects of the physical education classes than the senior peers. It should be mentioned in this context that the first-year group was tested higher on the physical-education-related emotionality scale (8.3 versus 6.0 points, respectively; U=671; p≤0.05). This means that the emotional informal communication and socializing aspects of the physical education classes are higher appreciated by the younger group.

Note that the senior group was tested higher on the sports success motivation scale than the first-year one (7.7 versus 4.5 points, respectively, U=570; p≤0.01). This finding partially explains why the seniors are generally more systemic in the physical education / sporting behaviors being more motivated by their own physical progress goals than the still unstable first-year group.

This finding agrees with the questionnaire survey data. The seniors are reportedly more aware of the shortage of physical activity in their lifestyles and tend to go in for sports to "have a break in mental work" and "energize". We would mention in this context, that the civil-patriotic motivations were tested significantly higher in the senior group as well (U=425; p≤0.01). It may be concluded, therefore, that students tend to develop more prudent, healthy and balanced attitudes to the academic physical education / sports with time, with their personality progress, friends-making and success motivations being complemented by the team spirit/ pride, patriotism and healthy lifestyle related ones. On the whole, however, the first-year group was tested notably more ambitious and higher on the physical education success motivation scale than the seniors –17.4 versus 15.1 points on average, respectively (U=585; p≤0.01).

Conclusion. The survey found the first-year group physical education / sports practices more frequent and active than in the senior group, although the latter were tested more determined and regular in the trainings due to their better-shaped health/ mood/ well-being agendas. The younger group reported more sensitive to the physical-education-related fashion, social image, socializing/ communication/ friends-making opportunities – i.e. being driven by their self-assertion, social approval and recognition needs. They also rank higher the "aesthetic pleasure" and more sensitive to the com-

munal opinions. These group motivations, however, are rather volatile as they tend to fade with the growing disinterest form surrounding, time pressures etc.; and it is not unusual that the younger group is rapidly discouraged or disinterested in the academic PW/ sports with time. Generally, the survey data and analysis found the genuine physical education motivations being volatile and underdeveloped in the younger students majoring in sports-unrelated specialties.

We recommend the academic physical education / sports curricula being complemented by the psychological comfort building elements; competitive/ team sport practices and active games; difficulty-stepping emotional workouts till sub-maximums; sports-exploration, socializing, morality and team spirit centered elements; physical self-assertion and health prioritizing drivers; competitive progress goal setting initiatives; and good teamwork and trainer-trainee communication encouragement methods. Such methods and tools will help develop healthy physical education / sporting agendas in the university students to facilitate their personality and physical progress for success in professional career.

The study was qualified as a bid for the "Intramural Grant Line No. 826-OD of the Belgorod State National Research University to support the social and humanitarian research initiatives" of 14.08 2020

References

1. Martyn I.A. Motivating students for physical education and sports. Universum: Psikhologiya i obrazovanie. Scientific e-journal. 2017. No. 6 (36).
2. Raspopova E.A., Postolnik Y.A. Comparative characteristics of dominant motives that encourage students of various universities to do sports. Pedagogiko-psikhologicheskie problemy fizicheskoy kultury i sporta. 2018. V. 13. No. 1. pp. 125–132. DOI 10/14526/01_2018_291.
3. Smutina A.O. Personal motivation of students to physical education. Molodoy ucheny. 2020. No. 4 (294). pp. 316-318. Available at: https://moluch.ru/archive/294/66860/ (date of access: 02.03.2021).
4. Gao Z.; Lee A.M.; Harrison L. Understanding Students' Motivation in Sport and Physical Education: From the Expectancy-Value Model and Self-Efficacy Theory Perspectives. Quest, 2008, No. 60, pp.236–254. [Google Scholar] [CrossRef].

Schoolchildren's physical education competency versus physical fitness self-rates: survey and analysis

UDC 37.062.5

PhD, Associate Professor **N.B. Lukmanova**[1]
A.V. Malinin[1]
D.N. Pukhov[1]
Dr.Biol. **T.F. Abramova**[2]
[1]St. Petersburg Research Institute for Physical Culture, St. Petersburg
[2]Federal Science Center of Physical Culture and Sport (VNIIFK), Moscow

Corresponding author: nlukmanova@spbniifk.ru

Abstract

Objective of the study was to survey the schoolchildren's reported physical education competency versus their physical fitness self-rates and run a correlation analysis.

Methods and structure of the study. We run a questionnaire survey of the 11-year-old schoolchildren (n= 485) under the ongoing international Health and Behavior of Schoolchildren (HBSC) Research Project and grouped by their physical education competency self-rates into reportedly competent Group 1 and incompetent Group 2. Then we processed the group questionnaire survey data by a statistical toolkit $\chi 2$ criterion and made a physical education competency versus physical fitness correlation analysis to find correlations of the reported physical education competency with the physical fitness elements.

Results and conclusion. The survey and analysis of the schoolchildren's reported physical education competency versus their physical fitness self-rates found them significantly correlated. The 11-year-olds with excellent and good physical education competency and physical fitness self-rates demonstrated significantly higher physical education competency / physical fitness correlations in virtually every physical fitness element than their lower self-rated peers.

Keywords: *physical education competency, self-rate, physical fitness, schoolchildren.*

Background. Modern school physical education research is designed to facilitate the schoolchildren's physical, emotional, intellectual, social and personality progress in the mobilizing historical, general cultural contexts with healthy values and priorities [8]; with the physical education competency component apparently contributing to the individual general culture, motor progress, healthy lifestyle and confidence. The national and international physical education competency research communities have always been interested in the school physical education competency related issues. Thus, V.K. Balsevich (2008) formed basics of the sports-driven physical education system making a special emphasis on the physical education knowledgebase within the relevant general cultural and social contexts [1]. The ongoing international Health and Behavior of Schoolchildren (HBSC) Research Project surveys their commitment for physical activity to facilitate school physical education technologies and physically activate school populations, with a special emphasis on the physical education competency rating component [7]. The studies found the schoolchildren's health conceptions having multiple components with the relevant physical, psychological, social and intellectual progress factors of influence [4] that need to be detailed by further special analyses. It should be mentioned in this context that the foreign studies of the school physical education competency correlations with the physical activity / physical fitness are still rather fragmental [2, 3, 5, 6], and this was the reason for us to explore them in herein.

Objective of the study was to survey the schoolchildren's reported physical education competency

versus their physical fitness self-rates and run a correlation analysis.

Methods and structure of the study. We formed an empirical basis for the study by a questionnaire survey of the 11-year-old school population of both sexes (n= 485) under the ongoing international Health and Behavior of Schoolchildren (HBSC) Research Project. The sample was grouped by their physical education competency self-rates into reportedly competent Group 1 and incompetent Group 2. Their physical fitness was ranked by the question "What are your motor skills on a 5-point scale?" (very poor to excellent rated by 1 to 5 points, respectively) with the following elements: V5301 "muscle strength"; V5302 "reaction speed"; V5303 "physical endurance"; V5304 "physical flexibility"; and V5305 "movement coordination".

Results and discussion. Fig. 1 hereunder demonstrates the individual physical fitness self-rates depending on the reported physical education competency. The reportedly competent Group 1 self-rated its physical fitness significantly higher ($p<0.05$) than incompetent Group 2. Further analysis of the key physical fitness elements (strength, speed, endurance, flexibility and coordination) showed the both groups rating speed higher than flexibility, with the Group 2 and Group 2 physical fitness averages estimated and 4.2 and 3.2 points, respectively.

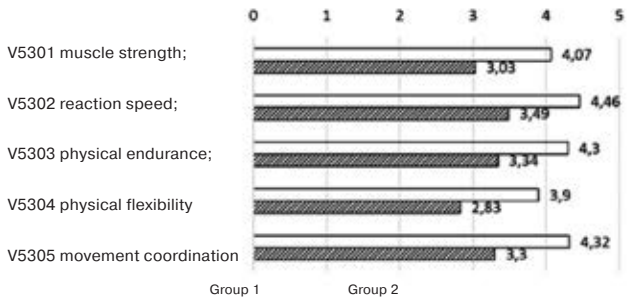


Figure 1. *Averaged group physical fitness self-rates, points, p<0.05*

Figure 2 gives analysis of the reportedly "excellent" (5 points) and "good" (4 points) motor skills in the strength, speed, endurance, flexibility and coordination domains. Group 1 and Group 2 self-rated their motor skills excellent and good 52.5% to 90.8% and 28.2% to 51.6%, respectively.

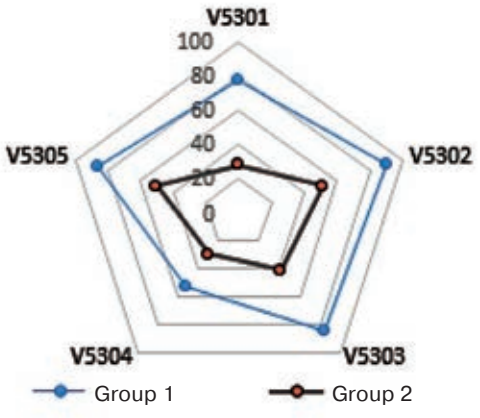


Figure 2. *Group 'excellent' and 'good' motor skills self-rates, p<0.05*

Group 1 Group 2

Group physical fitness data correlation analysis found higher correlations of the reported physical education competency with physical fitness in Group 1 versus Group 2, with the average bilateral correlations significant ($p<0.01$, $r = 0.318$ to 0.476) in the both groups. Group 1 was tested with higher significant direct correlations than Group 2 (9 and 5, respectively). We found no significant correlations of:

– Flexibility versus coordination in Group 1; and

– Strength versus flexibility; strength versus coordination; speed versus flexibility; flexibility versus coordination; and endurance versus coordination in Group 2.

The close and significant correlations give fair grounds to conclude that the physical education competency and physical fitness self-rates are interdependent in the causes and effects, with this result supporting our prior assumption. In other words, the 11-year-olds with excellent and good physical education competency and physical fitness self-rates demonstrated significantly higher physical education competency / physical fitness correlations in virtually every physical fitness element than their lower self-rated peers. This finding is consistent with the prior study reports [2, 3, 5, 6] that found the schoolchildren's self-reported physical education competences being correlated with the physical activity / physical fitness self-rates.

Conclusion. The survey and analysis of the schoolchildren's reported physical education competency versus their physical fitness self-rates found them significantly correlated. It gives us grounds to recommend that the school physical education

teaching community should give due priority to special physical progress encouragement methods and tools customizable to the age-specific physical education competency and knowledgebase.

References

1. Balsevich V.K. Sports-effective physical education: educational and social aspects. Teoriya i praktika fiz. kultury. 2008. No. 5. P. 19.
2. Barnett L.M.a,Morgan P.J.b,van Beurden E.c, d,Beard J.R.a, d, e. Perceived sports competence mediates the relationship between childhood motor skill proficiency and adolescent physical activity and fitness: A longitudinal assessment. International Journal of Behavioral Nutrition and Physical Activity. V. 58. August 2008. No. 40. DOI 10.1186/1479-5868-5-40.
3. Inchley J.,Kirby J.,Currie C. Longitudinal changes in physical self-perceptions and associations with physical activity during adolescence Pediatric Exercise Science. May 2011. V. 23, V. 2, pp. 237 – 249 DOI10.1123/pes.23.2.237.
4. Khaibullina D.R. Features of schoolchildren's theoretical knowledge and system of ideas in health and physical education. Almanakh sovremennoy nauki i obrazovaniya Tambov. Gramota. 2008. No. 10. V. I. pp. 177-179. ISSN 1993-5552.
5. Longmuir P.E.a, b, Boyer C.a, Lloyd M.c, Yang Y.d, Boiarskaia E..d, Zhu W.d. The Canadian Assessment of Physical Literacy: Methods for children in grades 4 to 6 (8 to 12 years. BMC Public Health. Tom 15, no. 111 August 2015. ISSN14712458. DOI10.1186/s12889-015-2106-6.
6. Maher C.a, Lewis L.a, Katzmarzyk P.T.b, Dumuid D.a, Cassidy L.c, Olds T.a The associations between physical activity, sedentary behavior and academic performance. Journal of Science and Medicine in Sport. V. 19, V.12, pp. 1004-1009 December 2016. DOI10.1016/j.jsams.2016.02.010
7. Matochkina A.I., Malinin A.V., Pukhov D.N. Approval of physical condition self-testing technology for schoolchildren to increase their involvement in physical education. Uchenye zapiski universiteta im. P.F. Lesgafta. 2019. No. 8 (174). pp. 146-149.
8. Order of the Ministry of Education and Science of Russia of December 17, 2010 N 1897 «On approval of the federal state educational standard of basic general education».

Correlation of primary students' physical activity and progress in regulatory functions

UDC 159.943.8

A.N. Shatskaya[2]
Academician of the Russian Academy of Education, Dr.Sc.Psych. A.N. Veraksa[1, 2]
A.Y. Fominykh2
[1]Lomonosov Moscow State University, Moscow
[2]Russian Academy of Education, Moscow

Corresponding author: shatskaya.msu@gmail.com

Abstract

Objective of the study was to analyze correlations between regulatory functions and physical activity in primary school groups.

Methods and structure of the study. We sampled for the study the 8 year-old 2-grade students (n=103, 47 boys and 56 girls) at Moscow schools and split them up into unsporting Group 1 (n=49) and sporting Group 2 (n=54) of individuals trained at least twice a week for 45+min in 1+ sport groups on an off-class basis for at least one year. The sample was tested on an individual basis, with the test data processed by SPSS 21.0 software written in R-language (version 4.0.3). We used NEPSY-II Neuropsychological Test System (designed to test mental functions in the 3-16-year-olds) to rate the self-regulation elements in the sample. Visual operational memory was rated by a Design Memory subtest; restraining control by an Inhibition subtest run in two series with different triggers/ stimuli; cognitive flexibility by a Sorting Animals subtest using cards with animals; and the short-term auditory memory was rated by the A.R. Luria's Ten Words test.

Results and conclusion. Our tests and and analyses rated the habitually sporting children meaningfully higher on the self-regulation and short-term auditory memory scales than their unsporting peers, with the highest progress and inter-group differences in the cognitive flexibility tests. This finding gives us the reasons to recommend reasonably high physical activity among the most efficient cognitive progress facilitation methods.

Keywords: *regulatory functions, self-regulation, operational memory, physical activity, sport, primary schoolchildren.*

Background. Regulatory function is referred herein as the array of cognitive functions responsible for non-standard (non-stereotyped) responses to new/ challenging situations in need of special concentration. As provided by Miyake et al., the self-regulation functions are headed by visual and auditory operational memory, restraining control (to inhibit a standard response and find the right one) and cognitive flexibility (that facilitates transition from one rule/ viewpoint to another) [7]. It should be noted that the self-regulation skills are often more important for social success than the intellectual abilities [8], and this is the reason for the modern child development programs to give a growing priority to the self-regulation encouragement methods.

Physical activity is commonly ranked among the most accessible methods to facilitate progress in the self-regulation domain since mental functionality is known to fall with sags in the physical fitness [2]. Thus children with sedentary lifestyles are always tested with low restraining control [4], whilst habitual team sports and active games are known to improve cognitive flexibility [10] and develop operational memory in sporting underage groups [3]. Some authors believe, however, that physical activity is beneficial for self-regulation only in case of high-intensity trainings [6]; whilst the others find no meaningful progress in regulatory functions with habitual physical activity [9]. Therefore, benefits of physical activity for progress in self-regulation functions are still arguable in the research community.

Objective of the study was to analyze correlations between regulatory functions and physical activity in primary school groups.

Methods and structure of the study. We sampled for the study the 8 year-old 2-grade students (n=103, 47 boys and 56 girls) at Moscow schools and split them up into unsporting Group 1 (n=49) and sporting Group 2 (n=54) of individuals trained at least twice a week for 45+min in 1+ sport groups on an off-class basis for at least one year. The sample was tested on an individual basis, with the test data processed by SPSS 21.0 software written in R-language (version 4.0.3). We used NEPSY-II Neuropsychological Test System (designed to test mental functions in the 3-16-year-olds) to rate the self-regulation elements in the sample [9]. Visual operational memory was rated by a Design Memory subtest; restraining control by an Inhibition subtest run in two series with different triggers/ stimuli; cognitive flexibility by a Sorting Animals subtest using cards with animals; and the short-term auditory memory was rated by the A.R. Luria's Ten Words test [10].

Results and discussion. We first rated and analyzed correlations between the sporting lifestyle and self-regulation function elements (see Table 1); and found the highest correlation for cognitive flexibility. This finding gives us the reasons to believe that physical activity facilitates progress in cognitive flexibility critical for decision-finding and problem solving capacity.

Table 1. *Correlations between the sporting lifestyle and self-regulation function elements (*p<0.05; ** p<0.01)*

Tests	Sporting lifestyle
Visual operational memory	,28**
Naming time	-,2*
Inhibition time	-,31*
Attention switch, missed errors	-,2*
Switch time	-,3**
Cognitive flexibility, number of right groups	,43**
Short-term auditory memory, reps needed to memorize	-,22*

Then we analyzed the subtest data of the unsporting Group 1 versus sporting Group 2: see Table 2.

Sporting Group 2 was on average tested higher than the unsporting on the Visual Operational Memory Image and Visual Operational Memory Total Score scales; and faster in the Inhibition test, although the group error rates were virtually the same. It is not unlikely that the sporting lifestyle develops the fast decision-making abilities encouraged by the sport-specific instructions and goals, with a top priority to fast completion; and this is the reason why the sporting children get used to concentrate on this aspect as required by their sporting experiences. Furthermore, sporting Group 2 was tested meaningfully better than Group 1 (56% correct namings versus 36%, respectively) in the Sorting

Table 2. *Group 1 and Group 2 test data averages and differences, (*M *– average, p – meaning ratio)*

Subtests	Group 1	Group 2	t / U test	p
Visual operational memory				
Design memory: image	48,92	52,43	t = -3,317	0,001
Design memory: location	26,63	27,69	U = 957,0	0,013
Design memory: total score	107,4	118,9	t = -2,876	0,005
Restraining control				
Naming: missed errors	0,24	0,15	U = 1241,0	0,411
Naming: corrected errors	0,65	0,37	U = 1110,0	0,085
Naming: time	60,16	56,2	t = 2,128	0,036
Inhibition: missed errors	1,29	1,24	U = 1290,	0,816
Inhibition: corrected errors	2,38	2,26	U = 1212,5	0,458
Inhibition: time	88,88	79,8	t = 2,542	0,013
Attention switch: missed errors	5,08	2,79	U = 1021,5	0,043
Switch: corrected errors	4,67	3,66	U = 1137,5	0,217
Switch: time	126,6	111,8	t = 3,108	0,002
Cognitive flexibility				
Sorting animals	4,37	6,76	t = -4,87	0,000
Short-term auditory memory				
Ten Words: reps needed to memorize	4,51	3,93	U = 989,5	0,024

Animals test – that may be interpreted as indicative of the higher cognitive flexibility. And the short-term auditory memory tests also rated sporting Group 2 significantly higher than Group 1 – that may be due to the fact that sporting children naturally develop due attention to verbal instructions on tactics and goals in the sports groups, with their short-term memorizing abilities facilitated by the training and competitive settings more efficiently.

Conclusion. Our tests and and analyses rated the habitually sporting children significantly higher on the self-regulation and short-term auditory memory scales than their unsporting peers, with the highest progress in the cognitive flexibility tests. Therefore, sporting lifestyles were tested to facilitate self-regulation skills critical for success in the learning and socializing domains. We recommend further studies to anlayze correleations of the regulatory functions with the sport-specific physical activity to find the sport disciplines most beneficial for the children's development agendas.

References

1. Luria A.R. Fundamentals of neuropsychology. Study guide for students of higher education institutions. 3rd ed., ster. 2004.
2. Maksimova E.N., Alekseenkov A.E. Effect of motor activity on physical condition and intelligence of individual. Nauka-2020. 2019. no. 4 (29).
3. Nikolaeva E.I., Isayko A.A., Fedoruk A.S. Relationship between operational memory and inhibitory control characteristics and specific immediate environment of preschooler and his involvement in physical activity. Kompleksnyie issledovaniya detstva. 2019. V. 1. no. 2.
4. Chieffi S. et al. Exercise influence on hippocampal function: possible involvement of orexin-A. Frontiers in physiology. 2017. V. 8. P. 85.
5. Korkman M., Kirk U., Kemp S.L. NEPSY II. Administrative manual. San Antonio. TX: Psychological Corporation. 2007.
6. McNeill J. et al. Longitudinal associations of physical activity and modified organized sport participation with executive function and psychosocial health in preschoolers. Journal of Sports Sciences. 2020. V. 38. no 24. pp. 2858–2865.
7. Miyake A. et al. The unity and diversity of executive functions and their contributions to complex «frontal lobe» tasks: A latent variable analysis. Cognitive psychology. 2000. V. 41. no. 1. pp. 49–100.
8. Moffitt T.E. Childhood self-control predicts adult health, wealth, and crime. Paper presented at the Multi-Disciplinary Symposium Improving the Well-Being of Children and Youth. 2012.
9. Morris J. L. et al. The Daily Mile™ initiative: Exploring physical activity and the acute effects on executive function and academic performance in primary school children. Psychology of Sport and Exercise. 2019. V. 45. pp. 101583.
10. Schmidt M. et al. Cognitively engaging chronic physical activity, but not aerobic exercise, affects executive functions in primary school children: a group-randomized controlled trial. Journal of Sport and Exercise Psychology. 2015. V. 37. No. 6. pp. 575–591.

Project management in academic physical education system: benefits analysis

UDC 37.013

Dr.Sc.Phil., Professor **V.P. Babintsev**[1]
PhD, Associate Professor **S.V. Goncharuk**[1]
PhD, Associate Professor **A.P. Peresypkin**[1]
Postgraduate **Y.A. Goncharuk**[1]
[1]Belgorod State National Research University, Belgorod

Corresponding author: goncharuk_ya@bsu.edu.ru

Abstract

Objective of the study was to analyze benefits of a project management technology for the modern academic physical education system.

Methods and structure of the study. We run, for the purposes of the study, the academic physical education system Management Survey in the Belgorod, Kursk and Lipetsk Oblasts using a questionnaire survey of the academic physical education system communities and focus group interviews. We sampled students (n=1000), faculties and researchers (n=300), and university management (n=140). The survey was designed to find attitudes of the academic physical education system communities to the academic physical education system management system and potential benefits of the modern project activity for the latter.

Results and conclusion. We found the project management technology being potentially beneficial for the academic physical education system, conditional on the sound institutional and technological provisions analyzed herein.

Keywords: *academic physical education system, project management technology, dispositions, strategies, system (project) approach, partnership, pertinency.*

Background. Project management may be defined as the systemic process to attain specific goals in specific missions, with their outcomes ratable on the time, cost, effectiveness and quality scales. This multisided process is applicable in the modern academic physical education system based on sound theoretical and practical provisions supported by empirical data. Reforms of the academic physical education system are mostly driven by the shareholders' policies and agendas and, hence, the management group practices and behavioral standards. The socio-technological missions of such reforms are extremely challenging for at least the following reasons: first, not every variable in the academic physical education system is controllable by the university management; second, they reforms are always limited by the communal values, priorities and standards; and, third, every social technology has its limitations.

It should be mentioned that every socio-technological approach generates a range of opportunities and solutions, and some of them are offered by the modern project management technology that may be beneficial for the academic physical education system – viewed as the cluster of interrelated and interdependent institutions geared to ensure health protection and physical progress of the academic communities by multisided physical education and culturing services – within their natural limitations [1].

Objective of the study was to analyze benefits of a project management technology for the modern academic physical education system.

Methods and structure of the study. We used as a starting point for the study the Academic Physical Education System Management Survey (2018-2021) in the Belgorod, Kursk and Lipetsk Oblasts using the following methods: 1) questionnaire surveys of the academic physical education system communities: students (n=1000), faculties and researchers (n=300), and university management (n=140); and (2) focus group interviews of the university faculties and researchers (n=12) and university management (n=12).

Results and discussion. The survey found the university faculties and researchers generally happy with the existing academic physical education system management system rated by 7.6 points on a 10-point scale; although the present academic physical education system management policies and procedures were rated high by only 22.3% of the faculties and researchers; whilst 43.3% and 10.7% of the sample rated them acceptable with reservations and low, respectively [2]. Therefore, most in the key academic physical education system actors realize more or less clearly drawbacks of the existing institutional mechanisms that effectively limit the management process and give rise to the relevant specific problems classifiable by the management levels. The student community, for instance, was tested unhappy with the limited choice of sports; limited sports competitions; remote locations of the university sports facilities, etc. This means that the academic physical education system community shows an implicit demand for reforms in the system management methods. These reforms could be facilitated, among other things, by the modern project management technology.

Clear benefits of the project management for the system are due to (a) its practical focuses; (b) special provisions for the academic learning being efficiently combined with practical professional progress facilitated by the practical project activity; (c) prioritization and individualization of the physical education service; and (d) potential cooperation in the project teams with leaders from a wide range of institutions.

The respondents were found little aware of the potential benefits, logics and application mechanisms of a project approach in the academic physical education system management system, with only 52.3% of the faculties and researchers found somewhat informed about the project approach applications for the academic physical education system progress goals [3] – and may be for this reason the university management rated benefits of the project approach for the academic physical education system progress by only 6.6 points on a 10-point scale – in spite of their little awareness of its potential benefits.

Despite this relative skepticism of academic physical education system communities, we believe that benefits of the modern project management for the system are well grounded for many reasons. Great potential of the project management is due at least to the fact that it helps mobilize the passive strata in the system, with every APES actor effectively encouraged to contribute to the management policies and practices and given a chance to advance its progress agenda in the project design and implementation process. It should be emphasized, however, that every project approach has its natural time limitations and, therefore, its strategic visioning is relatively short.

Project activity may be highly beneficial when it is designed on principles of strategic vectoring, systemic approaching, due partnership and relevance (pertinence). Thus, the strategic vectoring principle means that the academic physical education system management will be customized to the nonlinear social progress with account of the theoretically grounded progress forecasts for the nation on the whole and university in particular. The systemic approaching principle implies the efforts to interconnect the solutions in the project activity based on a comprehensive provisioning [4] so as to contribute to the progress strategies of the academic physical education system on the whole and university in particular. This means that every project will be designed to contribute to the relevant project chain/ ring, with each of them addressing a specific problem found by surveys of the academic physical education system communities.

The partnership principle implies that the university management should be open for contributions from the university community – to effectively improve the management decision-making, expand the resource base and competencies of the project team, and thereby attain the project goals more effectively. Such partnership will be managed by a public council as its key management body and a fundamental platform for the project initiation.

And the relevance/ pertinence principle means that the potential benefits of the project should be analyzed by an efficient set of progress criteria to avoid formalism in the project implementation and progress reports so as to rate the project progress and benefits on a highly objective and dependable basis.

Conclusion. We recommend the academic physical education system being advanced by reasonably prioritized institutional and technological solutions as follows. First, the system needs an academic physical education system progress strategy to secure healthy lifestyle building opportunities for every academic physical education system actor with a ready access to and facilitating provisions for the physical education and sports services. These solutions will be addressed by the long-term goals with the relevant efficient man-

agerial, institutional and educational tools to facilitate healthy changes in the communal preferences and behavioral standards, with every actor offered an access to the project activity on a voluntary basis.

Second, the system will cultivate fitness and ability of each actor to contribute to the project design process, with the systemic project activity increasingly ranked among the individual needs and priorities with the growth of interest, skills and experience in the practical project activity.

Third, the academic physical education system will be put on a sound management structure to effectively coordinate the project activity, with the public councils recommended as the best institutional body composed of the university managers, faculty members, researchers, students and NGO activists. Such public councils will take management decisions for academic physical education system progress to consider the system progress options, analyze the progress reports and coordinate the academic physical education system advancement activities.

And fourth, the academic physical education system progress initiatives will be evaluated by a set of efficient progress criteria to rate: benefits of the project on the whole; project deliverables and outcomes; project progress reports; project implementation experience and practical skills; and self-reports of the project benefits by the teams.

References

1. Goncharuk Ya.A., Komarova I.G., Goncharuk S.V. Conceptualization of health concept within modern academic sports educational space. Vestnik MIRBIS: Moscow International Business School MIRBIS (Institute). 2021. No. 2 (26). pp. 192–200.
2. Goncharuk Y.A. Substantiation of academic physical education space. Izvestiya Saratovskogo universiteta. Ser. Sotsiologiya. Politologiya. 2019. No. 1. pp. 32–36.
3. Polukhin O.N., Babintsev V.P., Goncharuk S.V. et al. Project-based approach to management of development of academic educational and physical and sports environment. Teoriya i praktika fiz. kultury. 2020. No. 7. pp. 66–68.
4. Iskrin N.S., Chichkanova T.A. Management in education: system approach. Obrazovanie i nauka. 2015. No. 1 (120). pp. 7–21.

Physical education department students: year-to-year physical progress tests and analysis

UDC 796.01

Dr. Hab., Professor **I.V. Irkhina**[1]
PhD, Associate Professor **A.V. Voronkov**[1]
Postgraduate student **V.P. Ospishchev**[1]
PhD student **A.A. Grebtsova**[1]
[1]Belgorod State National Research University, Belgorod

Corresponding author: nikulin_i@bsu.edu.ru

Abstract

Objective of the study was to reveal the dynamics in the physical fitness of the Physical Education Department students.

Methods and structure of the study. Subject to the study were the 4-year students (2017 through 2020) of Belgorod State National Research University (n=72, 36 young women and 30 young men). The researchers used analysis and summaries of the reference scientific literature, physical fitness tests and standard mathematical statistical data processing toolkit. The experiment was 4 years long. Physical fitness was ranked excellent, good, moderate and low according to the GTO gold, silver, bronze badge and lower standards, respectively.

Results and conclusion. The studies showed the Physical Education Department students' physical fitness level remaining virtually same throughout the academic period, moreover some progress was noted in some physical fitness components. Knowing that the practical Physical Education training hours in the curriculum tend to fall by the fourth year, we may assume that the main reason for the specific progress is the still high interest and commitment for Physical Education in the students.

Keywords: *physical fitness, GTO Complex, Physical Education Department students.*

Background. As reported by many researchers, health standards of the national school and university populations have been on decline for the last decades [1] despite the commonly recognized need for healthy university graduates committed for a healthy lifestyle as a basis for progress. This holds particularly true for graduates of the Physical Education specialist training system [2, 4], and it was the reason for us to test and analyze the year-to-year physical progress of the Belgorod State National Research University students using the standard GTO Complex test set.

Objective of the study was to test and analyze the year-to-year physical progress of the Physical Education Department students.

Methods and structure of the study. We sampled for the 4-year study (2017 through 2020) the 1-4-year students of Belgorod State National Research University (n=72, equal gender split), with exclusion of the 3rd year due to the self-isolation period. We used analyses and summaries of the reference scientific literature, physical fitness tests from the standard GTO Complex test set and a standard mathematical statistical data processing toolkit. Physical fitness was ranked excellent, good, moderate and low according to the GTO gold, silver, bronze badge and lower standards, respectively.

Results and discussion. A comparative analysis of the averaged physical fitness test data found virtually no year-to-year physical progress in the sample on the whole, with some variations in specific tests in the male group. Thus the speed tests found some progress or no regress; strength tests showed some progress at the start with a regress later on; whilst flexibility was tested to sag by year 2 and then grow by year 4. In the standing long jump test, the male group showed some regress with age

Table 1. *Year-to-year physical fitness test data: male group*

Tests	year 1	year 2	year 4
60m sprint, s	t=1,5; p>0,05		
	8,2±0,10	8,0±0,09	8,0±0,08
		t=0,3; p>0,05	
3km race, s	t=0,1; p>0,05		
	818,7±46,6	825,8±27,96	828,5±32,58
		t=0,1; p>0,05	
Pull-ups, reps	t=1,4; p>0,05		
	12,3±2	16,3±2,23	14,3±1,85
		t=0,7; p>0,05	
Front leans on a bench, cm	t=0,1; p>0,05		
	15,4±1,46	15,1±2,08	14,9±1,69
		t=0,1; p>0,05	
Standing long jump, cm	t=1,0; p>0,05		
	246,3±4,24	255,3±8,09	249,5±4,16
		t=0,6; p>0,05	
1min sit-ups test, reps	t=0,7; p>0,05		
	52,3±2,62	54,6±2,16	49,6±2,54
		t=1,5; p>0,05	

Table 2. *Year-to-year physical fitness test data: female group*

Tests	year 1	year 2	year 4
60m sprint, s	t=0,5; p>0,05		
	9,9±0,26	9,7±0,26	9,7±0,2
		t=0,0; p>0,05	
2km race, s	t=0,3; p>0,05		
	650,7±22,28	659,6±24,3	612,2±21,38
		t=1,5; p>0,05	
Pull-ups, reps	t=1,1; p>0,05		
	16,4±2,07	21,4±4,06	19,0±2,8
		t=0,5; p>0,05	
Front leans on a bench, cm	t=0,1; p>0,05		
	16,5±1,33	16,2±2	18,8±1,87
		t=1,0; p>0,05	
Standing long jump, cm	t=0,0; p<0,05		
	198,9±4,8	199±4,46	195,6±4,20
		t=0,6; p>0,05	
1min sit-ups test, reps	t=1,3; p>0,05		
	46,7±1,87	51±2,73	48,9±2,4
		t=0,6; p>0,05	

– versus progress in the speed-strength rating 1min sit-ups test.

In the female group, the physical fitness components were also tested to vary differently with age. Thus the speed tests showed no regress, whilst endurance rated by the 2 km race test showed a regress with age – in contrast to strength tested to grow significantly year-to-year. Flexibility wa tested to grow by year 2 and stand virtually the same thereafter. The sit-ups test showed some regress to year

2 and a plateau thereafter. On the whole, the optional tests caused no problems in the female group, with every girl tested high.

It should be emphasized that the standard Physical Education service hours contract year-toyear in every discipline. Only 24 individuals in the sample reported committed for their sports careers and actively competing, whilst the rest reported commitment for self-reliant physical practices with different purposes.

Conclusion. The Physical Education Department students' year-to-year physical progress tests and analysis showed the physical fitness on the whole standing virtually the same for the academic period, despite some progresses in the speed, strength and speed-strength endurance tests. Knowing that the practical Physical Education training hours in the curriculum contract by year 4, we may assume such a progress being due to the still high interest and commitment for Physical Education prior to and upon graduation, with the young Physical Education specialists mostly having good physical progress agendas and healthy lifestyle and actively trained.

The study was sponsored by State Contract No. 0624-2020-0012 for 2020-2022 with the Belgorod State National Research University for "Integrative Academic Specialist Training Methodology: universal competencies and priorities, social service agenda and poly-subjectivity formation in future teachers"

References

1. Arynova R.A., Bomin V.A. Management of physical education and sports a higher educational institution. Problems and prospects for cultivating healthy lifestyle in information society. Proc. international research-practical conf., Irkutsk: Yezhevsky ISAU publ., 2016. pp. 17–19.
2. Vilenskiy M.Y. Healthy image and lifestyle of student: methodological analysis. Pedagogicheskoe obrazovanie i nauka. 2009. no. 3. pp. 15–18.
3. Nikulin I.N., Serdyukov O.E. On introducing All-Russian physical culture and sports complex "Ready for labour and defense in the Belgorod region and SRU BelSU". Current state and trends in development of physical education and sports. Proc. cor. national research-practical conf., October 10 2014 SRU «BelSU»; I.N. Nikulin [ed.]. Belgorod: "Belgorod". SRI BelSU publ., 2014. pp. 15–18.
4. Voronkov A.V., Nikulin I.N., Irkhin V.N. et al. Training for All-Russian physical culture and sports complex "Ready for work and defense" in educational organizations. Belgorod. SRI BelSU publ., 2016. 124 p.