T&PPC

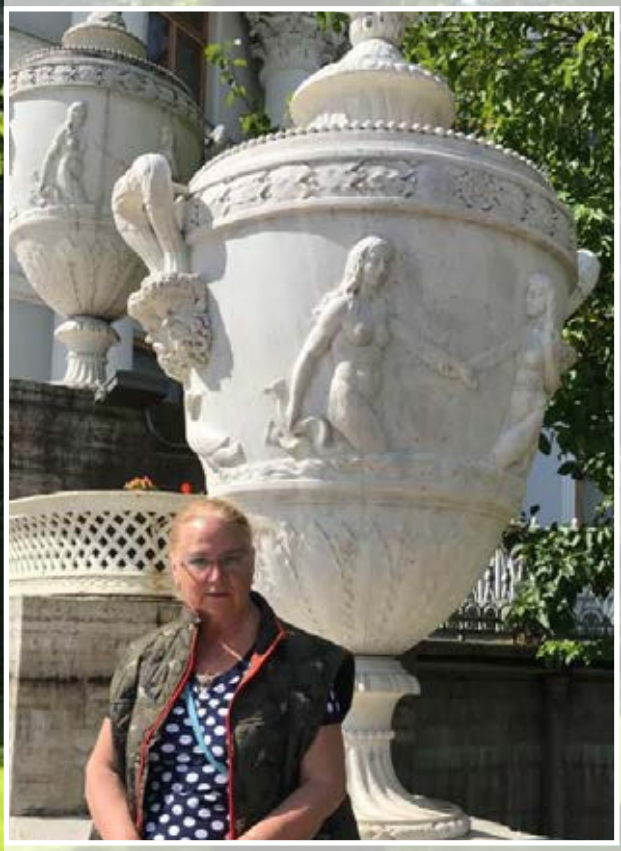
№ 9 September 2021

# Theory & Practice of Physical Culture

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

EDITORIAL

# *Key issues of the modern sports science for discussion*



## Innovative scientific and sports projects of Russian universities

The modern system of sports training in Russia is characterized by dramatic changes caused by high competition of athletes on the world stage. In this regard, scientific approaches to solving numerous problems associated with achieving high sportsmanship are also changing.

One of the promising scientific directions is energy supply and research of biomechanical characteristics of athletes. An example of the development of this problem is scientific work, which is carried out under the guidance of Doctor of Biological Sciences, Professor Sergei Kolmogorov. In particular, his scientific team studies the relationship between the power of active metabolism and swimming speed in the pool, and also creates a technology for controlling the fitness of athletes based on the Swim Planyzer application computer program.

Another popular area in modern university science is sports psychology. In the light of the recent events of international sports life and the Olympic movement caused by doping scandals, a pandemic, athletes are often not allowed to compete or transfer them. Based on the current problematic situation, on the basis of the Tchaikovsky Academy of Physical Culture and Sports, research has begun on the social aspects of negative manifestations that affect athletes, ways to prevent and eliminate them.

Today, sports nutrition is one of the young and intensively developing areas of sports science of interest to university studies. After conducting a series of scientific studies, scientists from Petrozavodsk State University draw attention to the fact that sports nutrition belongs precisely to the category of supplements and is an addition to the main diet, consisting of ordinary products. The commercial orientation of the distribution of dietary supplements requires the development of new methods for assessing the quality of drugs, conducting studies that could confirm the effectiveness, feasibility and usefulness of sports nutrition as an alternative to the use of doping in order to increase the sports result.

The inclusion of children and adolescents with disabilities in the state of health in sports is a relevant scientific direction that attracts a large number of university specialists. For example, teachers from the Volga University of Physical Culture and Sports are designing a model based on the principle of inclusion, which involves determining effective mechanisms for managing the processes of introducing and applying new forms and methods of teaching and raising children with disabilities in intellectual development with the aim of their social adaptation and successful integration into society.

The digital transformation of education is of great interest for involving a large number of scientific teams in research related to the use of the latest computer programs, technology and sports equipment in research aimed at developing models of active longevity. So, a team of scientists from Nizhny Novgorod State University named after N.I. Lobachevsky is developing the hardware and software complex "Active Longevity," which is based on the model of the "Smart House" of an aging person, which ensures the organization of the life of an elderly person, monitoring his state of health using biological feedback methods.

The proposed priority areas of scientific research of university sports science show their relevance in connection with the changing demands of society for a healthy lifestyle and winning victories in sports of the highest achievements, which involves interdisciplinary interaction in science and practice and collaboration of scientific and educational groups.

***We invite scientists to publish articles that are aimed at finding new approaches in the development of university sports science.***

**Chief editor of TPPC,**
**Honored Worker of Physical Culture of the Russian Federation, Dr. Hab., Professor L. Lubysheva**

Theory and Practice of Physical Culture

9'2021

Monthly Scientific-theoretical Journal, founded in 2013

ISSN 2409-4234

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Theory and Practice of Physical Culture

# Contents

# Welcome to research revolution in national sports science?

UDC 57.049

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**Abstract**

**Objective of the study** was to analyze the present situation and developmental prospects of the national sports training theory and practice.

**Methods and structure of the study.** For the last three decades, the ongoing modeling projects have been implemented in different timeframes and domains, for example:

1) Small molecules: organic and inorganic compounds modeled using molecular mechanics codes to understand their repertoire and degrees of freedom [12];

2) Biological macromolecules: RNA, DNA and protein molecules may now be modeled using molecular dynamics technologies – e.g. ribosome and RNA polymerase models available in high resolution;

3) Cellular models: molecular-genetic systemic mechanisms of bodily adaptation under extreme stressors;

4) Biomechanical models including the cardiovascular system model, respiratory system model, skeletal geometry model, neuromuscular control model for locomotion, etc..

5) Central nervous system is the key system in the bodily systems hierarchy, and that is why subject to new models are the motor sills control and learning systems, with every skill controlled by specific neuromodulatory brain mechanisms. Computational learning models play the key role for the adaptive behavior understanding and management goals.

On the whole, subject to the above modeling projects are the biological systems behind the sports-specific motor skills mastering and excelling processes; and every relevant bodily system may now be described by specific formalisms.

**Conclusion.** Further progress of the modern computational technologies applicable in the sports science may be described by a few progress vectors. Of special importance are the efforts to create adequate data mining toolkits to analyze bodily states in the context of the newly discovered biological regularities. In the near future we expect a few breakthroughs in the hardware upgrade domain with implantable special-purpose microprocessors and new technologies to grow special artificial receptors using modern bionanomaterials inside bodily organs.

***Keywords:*** *scientific revolution, modeling, sports science, digitalization.*

**Background.** For the last few years, the global sports industry has been increasingly open for contributions from the modern research projects in elite sports; although the modern national sports science is still lagging behind and largely stalled due to the following: shortening inflow of the young human resource; poor quality education with the new research and teaching human resource failing to meet modern requirements and unable to offer efficient solutions for the priority scientific problems; outdated practical research approaches and concepts mostly alien to the new evidence from the fundamental sciences; still limited efforts to implement new technologies and developments of the national sports science into elite sports training systems, etc.

Reforms to modernize the national sports science should strictly follow the general progress trends in the scientific approaches and general strategies as provided by the Scientific and Technological Development Strategy of the Russian Federation [11].

The Scientific and Technological Development Strategy gives a special priority, among other things, to the advanced digital intelligent industrial technologies, robotic systems, new materials and design methods, large data processing systems, machine learning and artificial intelligence, with transition to personal-

ized digital medicine taking benefit of the modern health technologies [1].

As things now stand, the situation in the national science has reached the point when, as provided by T. Kuhn [6], a research revolution comes due. He defines it as the breakthrough with the research paradigms being fully revised by the scientific community. Presently we see the following provisions for the revolution in place: on the one hand, interpretations of the mounting empirical materials on the training systems from the traditional theoretical standpoint fail to explain and solve their multiple problems; and on the other hand, modern research has gone far beyond the traditional conceptions of human body, its resources and developmental logics and drivers. New technologies in the context of the Scientific and Technological Development Strategy need to be wider used to identify and solve problems faced by the training systems within the new paradigm for interpretation of the relevant processes – to lay a sound foundation for and spearhead the upcoming reforms in the national sports science.

**Objective of the study** was to analyze the present situation and developmental prospects of the national sports training theory and practice.

**Methods and structure of the study.** We believe that the empirical stage of the national sports training theory was finalized by the V.M. Zatsiorsky's monograph that prioritizes strength, speed, endurance, flexibility and dexterity as the five key physical qualities and analyzes their biological progress facilitation methods and models [5]. Later on the national sports training theory was advanced by the growing contributions from biological sciences with analyses of physical qualities in every aspect [2, 3, 4]; followed by what may be called a crisis of the national sports science [10]. This crisis may be interpreted as caused by the obvious contradictions between the available and actually needed knowledge of the human bodily functions on the one hand, and the competitive progress opportunities for an athlete who has exhausted the natural performance improvement resource on the other hand [13].

It may be assumed that an individual potential resource in modern sports may be mobilized in the social and biological (bios) domains at the cellular, bodily and social levels viewed as a hierarchical structure – i.e. the organism-environment system with the relevant connected levels: gene-in-organism, organism-in-environment and ecosystem on the whole [13], and with the cross-level interconnections analyzable by interdisciplinary efforts.

Organisms are known to run complex operations that are guided by a sort of digital information – that means that the bimolecular reactions and bodily functions on the whole are controlled by instructions written in the genome by a sequence of nucleic acids [7]. N.A. Bernstein in the early 60s underlined broad and promising research perspectives for the biological/ physiological patterning/ modeling initiatives [1]. New information technologies provide effective toolkits that may be used, as provided by N.A. Bernstein, to rapidly energize and advance research in the biological functions modeling domain.

V.N. Seluyanov pioneered the mathematical modeling projects in the national sports [8]. It was in the early 90s that he offered the short- and long-term athletic adaptation process models. Such adaptation processes simulating models helped develop fundamentally new design approaches for the sports training and health improvement physical education systems [9]. This is how the sports training theory has made a transition to the modeling method as a theoretical research tool. It implies new artificial objects being designed (to mimic an athlete's body and training environment, e.g.) with the key properties copied by the behavioral models. Presently the sports training efficiency improvement initiatives give a high priority to analyses and explanations of the individual athlete's body systems interactions and progress logics so as to effectively forecast benefits and drawbacks of every training system. This means that the research community needs to produce individual physical progress forecasts for one or another training system rather than only fix and try to explain the post-training test data variations.

To meet these and other requirements of the relevant state contract, Federal Physical Education Research Institute is developing an Athlete's Electronic Diary. First of all the research team digitized the traditional training schedules made by the coaching staff classified by the target physical qualities. However, the bodily systems modeling and performance forecasting aspects need descriptions in "biological language" plus the relevant parametric test data analyzing methods than can hardly be modeled by the traditional statistical toolkit.

The above problems need to be solved by the toolkits offered by the modern systematic/ computational biology based on computational formalism with the machine learning and artificial intelligence driven methods – that need in their turn an appropriate computational toolkit for the relevant biological structures. For guaranteed and efficient application of the above in the modern sports training systems, the relevant

application software must be closely related with and tested by specific biological research projects; and the data processing and analyzing concepts need to be prudently selected as required to ensure efficiency of the relevant modeling methods; with a top priority to the biological accuracy and probability of the key processes addressed in the training system design.

For the last three decades, the ongoing modeling projects have been implemented in different time-frames and domains, for example:

1) Small molecules: organic and inorganic compounds modeled using molecular mechanics codes to understand their repertoire and degrees of freedom [12];

2) Biological macromolecules: RNA, DNA and protein molecules may now be modeled using molecular dynamics technologies – e.g. ribosome and RNA polymerase models available in high resolution;

3) Cellular models: molecular-genetic systemic mechanisms of bodily adaptation under extreme stressors [15];

4) Biomechanical models including the cardiovascular system model, respiratory system model, skeletal geometry model, neuromuscular control model for locomotion, etc. [14].

5) Central nervous system is the key system in the bodily systems hierarchy, and that is why subject to new models are the motor sills control and learning systems, with every skill controlled by specific neuromodulatory brain mechanisms. Computational learning models play the key role for the adaptive behavior understanding and management goals.

On the whole, subject to the above modeling projects are the biological systems behind the sports-specific motor skills mastering and excelling processes; and every relevant bodily system may now be described by specific formalisms.

**Conclusion.** Further progress of the modern computational technologies applicable in the sports science may be described by a few progress vectors. Of special importance are the efforts to create adequate data mining toolkits to analyze bodily states in the context of the newly discovered biological regularities. In the near future we expect a few breakthroughs in the hardware upgrade domain with implantable special-purpose microprocessors and new technologies to grow special artificial receptors using modern bionanomaterials inside bodily organs.

*The study was run on state contract with the Federal Physical Education Research Institute for "Data mining, processing and presentation technology development to facilitate individual training system design in elite sports" Research Project*

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# Relationship between serum creatinine as biochemical marker and sport-specific technical mastery level of elite weightlifters

UDC 796.012

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**Abstract**

**Objective of the study** was to test and analyze the serum creatine phosphate versus competitive performance/ skill levels in the elite Kazak weightlifters.

**Methods and structure of the study.** The experiment involved 11 elite weightlifters, members of the national team of the Republic of Kazakhstan. The biochemical control was carried out 4 weeks before the World Cup or Asian Championship.

**Results and conclusions.** The study found a statistically significant relationship between a sports result, being expressed in points and representing an absolute sports result per unit of own body weight, and creatinine rate per kg of own body weight r=0.78 (p<0.01). The mean group result in the double-event, expressed in points (the Sinclair table), was M=395.4; S=20.0. The mean group creatinine rate was M=144.8 μmol/L; S=11.8. The mean group creatinine rate per kg of own body weight was M=1.82 μmol/L per kg of body weight; S=0.5. The study showed that creatinine as a biochemical marker can be an informative indicator for evaluating the effectiveness of athletic training under such a criterion as the special orientation of training loads on the development of creatine phosphate mechanism of energy supply to the contracting muscles when performing exercises with the maximum effort.

***Keywords:*** *elite weightlifters, creatine phosphate energy mechanism, creatinine indices, sports skill level.*

**Background.** Modern sports are getting increasingly competitive to urge the sports communities to look for the ways to excel the training systems using new efficient training and progress test technologies including a variety of biochemical tests such as the serum creatinine tests indicative of the individual creatine phosphate energy (muscle contraction) mechanism capacity and efficiency [1-3,7].

**Objective of the study** was to test and analyze the serum creatine phosphate versus competitive performance/ skill levels in the elite Kazak weightlifters.

**Methods and structure of the study.** We sampled for the study the Kazakh weightlifting sport leaders (n = 11) competing for the national team, with virtually every athlete decorated with titles and medals of the Asian, World and Olympic Championships. Laboratory creatine phosphate tests were timed to the theoretical and practical training cycles, with the blood sampled from the cubital vein after the high-intensity physical stresses, night sleeps and on empty stomach in the morning using the three-component disposable safe sampling equipment (needles, holders, test tubes etc.) of the AVATUB production; plus an automatic biochemical express analyzer SpotchemSP-4430 (made by Arkray Factory Inc., Japan) with a dry chemical technology including a solid-phase reagent (multitype test strips) of two types: multi- (with six reaction fields) and mono-strips. The test team scheduled the tests are required by the valid Standard Laboratory Athletes' Test Program to rate the creatine phosphate

level i.e. the interim stable products of creatine decay in μmol/ L [3]; plus the creatine phosphate per body mass ratios.

The competitive performance in combined events was scored on a Sinclair table scale, with the weightlifting results per body mass ratios – interpreted as indicative of the absolute skill levels. The weightlifting sample was trained as required by the well-tested practical training program described in our prior studies [5]. The precompetitive trainings with blood sampling were run prior to the Asian and World Championships on the individual physical fitness peaks, mostly four weeks before the main event.

Results and discussion. The sample represented a range of weight classes from 55kg to 140kg. The group averages in the combined event were M = 331.2kg; and S = 43.2. The result in points (on the Sinclair table scale) averaged M = 395.4; S = 20.0; with creatine phosphate level estimated at M = 144.8 μmol/ l; S = 11.8. The creatine-phosphate-to-body-mass (body mass ratio) was M = 1.82 μmol/ l / kg; S = 0.5.

A correlation analysis found a significant correlation ($r = 0.74$, $p < 0.01$) between the individual body mass and competitive result in the combined total; with the positive albeit insignificant correlations between the results in kg ($r = 0.33$) or points ($r = 0.57$) and the creatine phosphate totals. Of special interest was a comparison of the creatine phosphate test rates in the elite weightlifters and sports orienteering competitors whose group averages were M = 93.88 points/ l; m = 20.44 [1].

Of no less interest was the statistically significant correlation of the competitive result in points and creatine-phosphate-to-body-mass ratio estimated at $r = 0.78$, $p < 0.01$. This means that the individual skill level in the weightlifting elite largely depends on the creatine phosphate muscle contraction mechanism. This correlation may be due to the creatine phosphate growth being associated with the growth of the myofibrillar ATP resynthesis rate of special influence for the muscle contraction [3]. One more explanation is that the creatine growth activates the intracellular mechanisms that spur up on operations of the genetic apparatus of muscle fibers to make more intensive the synthesis of nucleic acids and the contractile protein (actin) and, hence, facilitate growth of myofibrils mass [4].

The study also found that biochemical creatine phosphate tests are rather informative and indicative of the training process efficiency and vector versus the muscle contraction power (creatine phosphate energy mechanisms). Such tests provide more objective and accurate data on bodily processes and, hence, facilitate the individual training service customization efforts for success. We still need to know, however, whether or not such objective test technologies are productive and beneficial enough for the fundamentally new training technologies and models design purposes, for us to be able to selectively control the creatine phosphate energy mechanisms in muscles and thereby improve the training service efficiency on a targeted basis.

One of the key goals of every training system is to activate the creatine phosphate energy mechanisms and avoid excessive accumulation of lactic acid, which should never exceed 6-8 μmol/ l [7] – since, as provided by some study reports, high lactate level tends to slow down the creatine phosphate production, suppress the working capacity and compromise specific training goals [7]. The high and long-standing lactate levels in muscle cells may heavily damage the cell structures and membranes to slow down the rehabilitation processes and suppress synthesis of structural proteins, including myofibrils [4].

The above by-effects of excessive lactate may be prevented in the weightlifting sport by high-intensity (80-100% of the individual maximum) 20-25-minute workouts with the core weights and 4-6 reps 1-2 times and 15-20-min rest breaks – for the lactic acid utilization and creatine phosphate energy mechanisms restoration purposes [4].

Excessive alactate trainings, however, are known to suppress the physiological aspects of the creatine phosphate energy mechanisms with the relevant regresses in the creatine phosphate energy mechanisms power building i.e. they undermine the muscle contraction strength and speed. Some studies report the elite weightlifters occasionally making resort to workouts geared to push up the lactate level to 14-plus μmol/ L [2] – that, as we believe, are detrimental to the specific goals and cumulative benefits of the training systems. To prevent excessive lactate increase, we would recommend the workouts being alternated with 15-20-min passive rest breaks after every exercise [4] as this time is required for the lactate level to sag by 50-60% [6].

Conclusion. The study data and analyses showed the biochemical tests on the whole and the creatine phosphate tests in particular being beneficial for monitoring the individual responses to trainings in the elite

weightlifters' training systems and their management efficiency. The study found an experimentally proved significant correlation between the competitive performance and the creatine-phosphate-to-body-mass ratios in the elite weightlifters.

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# Benefits of specific strength training model with water resistance control gear for rowing and canoeing sports elite

UDC 796.012

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**Abstract**

**Objective of the study** was to analyze benefits of a special strength training model with water resistance control gear for the rowing and canoeing sports elite, with muscle electrical activity tests of the key muscle groups.

**Methods and structure of the study.** The muscle electrical activity tests in the special strength training model testing experiment were run using SportLab Computerized Test System (Russia-made) with an eight-channel telemetric electromyography unit, accelerometer, video cam, and a synch unit. Technical specifications of the test system and test procedures are described in detail in a prior study report.

The study procedure was as follows. We sampled for the serial tests elite rowing and canoeing paddlers (n=5, three males and two females) qualified Candidate Masters and Masters of Sports. They were tested on a 90-110m distance by varied-intensity tests with application of water resistance control gear and/ or 6-14kg weights; with 5-8-min rest breaks. Every paddling style was played 2-3 times. We fixed the muscle electrical activity data by the skin electromyography (EMG) of the key right/left limb and trunk muscles versus the vessel speed and acceleration records. Every vessel was equipped with an accelerometer synchronized with the EMG test system and video cam – to read, among other things, the maximal vessel acceleration per stroke.

We fixed the electrodes on the muscle convex centers, with no adjustments allowed in the experiment. The EMG data were inverted and smoothed by the moving average method with a 50ms averaging window. We profiled every single muscle's muscle electrical activity by standardized test cycles to produce averaged EMG amplitudes per stroke for every muscle.

We tested on the whole five rowing styles at competitive speeds with water resistance control gear and 6/ 8/14kg weight application, when the paddlers were requested to work as hard as possible.

**Results and Conclusion.** The study found that the water resistance control gear (water breaks) and weights may significantly change not only the electric signal amplitudes (i.e. the stroking power), but also the muscle electrical activity synchronization patterns. This trend was found to grow with weight or controlled water resistance. We also found that the water resistance stress and/or weights should never exceed 5-7% of the individual body mass for the special strength training efficiency. A special priority in trainings should be given to the rowing pace kept within the competitive range. High-speed paddling practices should be managed so as to keep within the competitive rowing standards to avoid potential damage for harmonized sport-specific muscle groups coordination patterns i.e. motor skills sets.

***Keywords:*** *rowing and canoeing sports, muscle electrical activity, strength training.*

**Background.** Modern rowing and canoeing sports require high physical strength for paddling, and this is the reason for the sports communities giving so high priority to specific strength training methods and tools [1, 4, 5]. The everyday long and high-intensity trainings are known to increase the individual maximal strength, strength endurance and speed strength qualities – although mostly in the sport-specific aspects typical for the training process. As found by a few studies, strength training machinery assisted and weightlifting practices may not be beneficial enough for the rowing and canoeing sports elite since such strength resource often turns useless in the rowing and canoeing sports competitions [6, 7].

It should be mentioned that the rowing and canoeing sports community is still in need of practical and beneficial solutions in the water resistance control gear (water breaks, extra weights, etc.) application

domain. Thus, the researchers still differ in their recommendations on how the vessel speed should be controlled to successfully build an ideal motor skill/ stereotype and specific strength in paddlers. There is still a need for the paddlers' competitive muscle electrical activity profiling experimental data producible by elementary muscle electrical activity test models applicable on water.

**Objective of the study** was to analyze benefits of a special strength training model with water resistance control gear for the rowing and canoeing sports elite, with muscle electrical activity tests of the key muscle groups.

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$$СрЭМГ_i^K = \frac{\left(\sum_{j=1}^{N} \frac{\int_{t=0}^{t=T_j} СглЭМГ_i^{j,K} dt}{T_j}\right)}{N}$$

$СглЭМГ_i^{j,K}$ means the average EMG amplitude for j stroking cycle, mkV; i – muscle; K – paddling style; j – stroking cycle; N – strokes per distance; $T_j$ – stroke time, s

We tested on the whole five rowing styles at competitive speeds with water resistance control gear

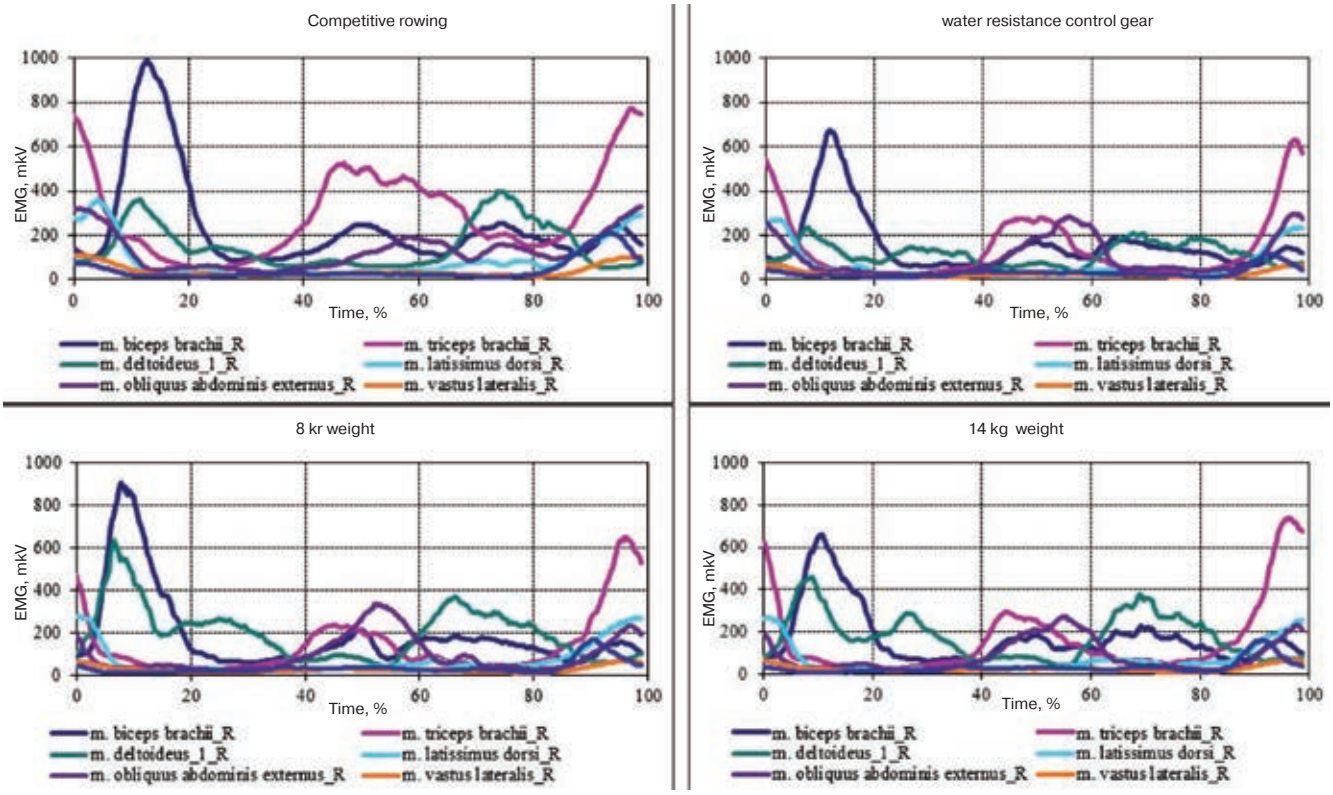


**Figure 1.** *Stroking-cycle-specific muscle electrical activity of the key muscle groups in the rowing tests*

**Table 1.** *Specific strength training tools we recommend for rowing and canoeing sports elite*

| Gear | Vessel speed and pace, % of the competitive ones | Water resistance control range | Test distances | Reps | Rest breaks: reps/ styles |
|---|---|---|---|---|---|
| Water resistance control | 90-100 | Keep the vessel speed/ pace | 200 = 2x100/ 200<br>500 = 5x100/ 2x250<br>1000 = 4x250/ 2x500 | 1-3 | 20-30s/<br>10-20min |
| Weight | | 5-7% of the body mass | | | |

and 6/ 8/14kg weight application, when the paddlers were requested to work as hard as possible.

**Results and discussion.** A comparative analysis of the muscle electrical activity data of the key muscle groups found that the water resistance control gear and weights may significantly change not only the electric signal amplitudes (i.e. the stroking power), but also the muscle electrical activity synchronization patterns: see Figure 1 hereunder that clearly shows variations in amplitudes and muscle groups activation times in the rowing cycles, with meaningful differences in the movement synchs depending on the stroking styles.

This trend was found to grow with weight or controlled water resistance. The high stress and fatigue in the muscle groups resulted in the muscle electrical activity profile variations different from the standard competitive rowing styles at competitive speeds. This means that the excessive/ inappropriate water resistance control or weights applied in trainings may disharmonize the sport-specific muscle groups coordination/ synergizing patterns. Such trainings may be unbeneficial or even detrimental to the specific strength training purposes of the rowing and canoeing sports elite and disruptive for the well-trained motors skills/ stereotypes. Having analyzed findings of the above special strength training model piloting tests, we would recommend the following special strength training tools potentially beneficial for the rowing and canoeing sports elite training systems: see Table 1 hereunder.

We also recommend the training distances, times and reps being varied in the trainings so as tom ake sure that the high-seed paddling practices are kept within the standard paddling patterns to avoid potential damage for the perfect motor skills sets.

**Conclusion.** The study found that the water resistance control gear (water breaks) and weights may significantly change not only the electric signal amplitudes (i.e. the stroking power), but also the muscle electrical activity synchronization patterns. This trend was found to grow with weight or controlled water resistance. We also found that the water resistance stress and/or weights should never exceed 5-7% of the individual body mass for the special strength training efficiency. A special priority in trainings should be given to the rowing pace kept within the competitive range. High-speed paddling practices should be managed so as to keep within the competitive rowing standards to avoid potential damage for harmonized sport-specific muscle groups coordination patterns i.e. motor skills sets.

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# Biathlon elite's competitive performance versus physical fitness analysis

UDC 796.012

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**Abstract**

**Objective of the study** was to rate and analyze the physical fitness variance versus the competitive success data in the national biathlon elite.

**Methods and structure of the study.** We used in the study the test data flow produced by the regular staged combined tests of the 27+1.4 year-old healthy uninjured elite biathletes (n=6) qualified for the Russian national team, active in trainings and competitions and subject to the staged combined tests at least six times for the study period. We rated their competitive performance in 18 sprint events at the 2018-19/ 2019-20 World Cups and World Championships using the data available at https://biathlonresults.com/ and using the competitive performance rating method described earlier [3]. The staged combined tests were designed to process the strength, alactate/ aerobic muscle power and cardio-respiratory system functions test data generated by the ski ergometer and treadmill tests with modern standard equipment [2, 5]. The test data were statistically processed and analyzed by Statistica 10.0 software toolkit using nonparametric Mann-Whitney test, with the correlations rated by the Spearman test with the difference significance threshold of 0.05. Based on the competitive performance and Rp data analysis for the last two seasons, we split up the sample into two groups (G1, G2) of three people each.

**Results and Conclusion.** The study data and analyses found the biathletes with better average competitive success rates for the period being more stable in the seasonal competitive performance. The group with the lower competitive success and competitive stability rates was tested with a higher variance of the cardio-respiratory system, energy efficiency and muscle aerobic power test rates in the precompetitive periods. On the whole, the competitive stability (St) rates were found significantly correlated with the physical fitness variances, albeit the positive and negative correlations were virtually equal. This is the reason for us to assume that correlations of the individual competitive performance with adaptabilities in the elite biathletes' training systems deserve further special studies in the context of the training service improvement initiatives.

***Keywords:*** *biathlon, competitive performance, adaptation, physical fitness.*

**Background.** Competitive performance in elite biathlon is commonly rated by representativeness (Rp) and stability (St) [4], among other criteria. Our competitive performance analysis in the research and practical support service to elite biathletes found the Russian biathletes lagging behind the leading teams on the both above scales. It should be also mentioned that the physical fitness test data (unpublished) produced by the regular staged combined tests [1] found the competitors (including the team leaders) being widely different in the physical fitness test data indicative of the individual adaptabilities to trainings.

Moreover, our observations, tests and analyses give grounds to assume that the individual adaptability variations and amplitudes in the pre-season training periods may be correlated with the competitive success data.

**Objective of the study** was to rate and analyze the physical fitness variance versus the competitive success data in the national biathlon elite.

**Methods and structure of the study.** We used in the study the test data flow produced by the regular staged combined tests of the 27+1.4 year-old healthy uninjured elite biathletes (n=6) qualified for the Russian national team, active in trainings and competitions and subject to the staged combined tests at least six times for the study period. We rated their competitive performance in 18 sprint events at the 2018-19/ 2019-20 World Cups and World Championships using the data available at https://biathlonresults.com/ and using the competitive performance rating method described earlier [3]. The staged combined tests were designed to process the strength, alactate/ aerobic muscle power and cardio-respiratory system functions test data generated by the ski ergometer and treadmill tests with modern standard equipment [2, 5]. The test data were statistically processed and analyzed by Statistica 10.0 software toolkit using nonparametric Mann-Whitney test, with the correlations rated by the Spearman test with the difference significance threshold of 0.05. Based on the competitive performance and Rp data analysis for the last two seasons, we split up the sample into two groups (G1, G2) of three people each.

**Results and discussion.** The group competitive performance data are given in Table 1 hereunder to demonstrate that the less successful athletes were tested with the lower competitive stability for the two seasons (12 individual tests). In addition, the groups were insignificantly (on a trend level) different in the average individual variances (V) of the both test rates for the study period.

**Table 1.** *Average individual Rp and St with variances (V) in 18 sprint events*

| Test | Group 1 | | Group 2 | | p |
|---|---|---|---|---|---|
| | Average | V | Average | V | |
| Rp (%) | 80,19 | 6,12 | 57,12 | 5,81 | < 0,01 |
| St (%) | 86,34 | 7,49 | 74,09 | 3,54 | <0,05 |

Table 2 gives the average group physical fitness variances: note that G2 showed higher variances of the cardio-respiratory system functions, muscle aerobic power and energy-efficiency test data; albeit lower variances of the shoulder girdle speed-strength test data.

**Table 2.** *Average individual physical fitness variances (6 tests for the study period)*

| Test | Standard variance, V | | p |
|---|---|---|---|
| | Group 1 | Group 2 | |
| Leg strength, Nm/ kg | 0,21 | 0,19 | 0,79 |
| Flexors/ extensors, % | 0,14 | 0,17 | 0,38 |
| Explosive leg strength, W/ kg | 1,15 | 1,12 | 0,95 |
| Shoulder girdle strength, points | 0,09 | 0,16 | 0,24 |
| Shoulder girdle AMC*, W/ kg | 0,20 | 0,19 | 0,95 |
| Leg AMC*, W/ kg | 0,41 | 0,40 | 0,90 |
| Shoulder girdle peak strength, J/ kg | 0,78 | 0,19 | <0,01 |
| Stroke volume, ml/ m$^2$ | 3,27 | 18,72 | 0,10 |
| $O_{2\,AnT}$ in shoulder girdle, ml/ beat | 1,83 | 1,46 | 0,40 |
| $O_{2\,AnT}$ for running pulse, ml/ beat | 0,70 | 3,63 | <0,01 |
| $VO_{2\,AnT}$ for shoulder girdle, ml/ min/ kg | 2,27 | 1,74 | 0,29 |
| Shoulder girdle power, W/ kg | 0,06 | 0,11 | 0,25 |
| $VO_{2\,AnT}$ in running, ml/ min/ kg | 1,89 | 5,58 | 0,01 |
| Running power, W kg | 0,06 | 0,05 | 0,15 |
| Shoulder girdle energy efficiency, % | 1,31 | 3,02 | 0,07 |
| Running energy efficiency, % | 1,26 | 4,40 | <0,01 |

*Note: AMC: aerobic muscle capacity*

**Table 3**. *Group physical fitness variance versus St correlations for the study period*

| Test | Correlation indices | |
|---|---|---|
| | Group 1 | Group 2 |
| Leg strength, Nm/ kg | 0,91 | 0,88 |
| Flexors/ extensors, % | -0,04 | 0,75 |
| Explosive leg strength, W/ kg | 0,99 | 0,54 |
| Shoulder girdle strength, points | 0,06 | -0,06 |
| Shoulder girdle AMC*, W/ kg | 0,37 | 0,99 |
| Leg AMC*, W/ kg | -0,44 | 0,99 |
| Shoulder girdle peak strength, J/ kg | 0,97 | -0,50 |
| Stroke volume, ml/ m$^2$ | 0,97 | 0,11 |
| $O_{2\,AnT}$ in shoulder girdle, ml/ beat | 0,34 | -0,93 |
| $O_{2\,AnT}$ for running pulse, ml/ beat | 0,97 | 0,87 |
| $VO_{2\,AnT}$ for shoulder girdle, ml/ min/ kg | -0,65 | -0,99 |
| Shoulder girdle power, W/ kg | -0,98 | 0,99 |
| $VO_{2\,AnT}$ in running, ml/ min/ kg | -0,97 | 0,99 |
| Running power, W kg | -0,56 | 0,98 |
| Shoulder girdle energy efficiency, % | 0,97 | 0,94 |
| Running energy efficiency, % | 0,90 | 0,98 |

*Note: significant at 0.05, r > 0.85.*

Correlations ranking analysis of the physical fitness variance versus St found significant correlations for most of the physical fitness / St test rates; although the group correlations were both negative and positive.

**Conclusion.** The study data and analyses found the biathletes with better average competitive success rates for the period being more stable in the seasonal competitive performance. The group with the lower competitive success and competitive stability rates was tested with a higher variance of the cardio-respiratory system, energy efficiency and muscle aerobic power test rates in the pre-season periods. On the whole, the competitive stability (St) rates were found significantly correlated with the physical fitness variances, albeit the positive and negative correlations were virtually equal. This is the reason for us to assume that correlations of the individual competitive performance with adaptabilities in the elite biathletes' training systems deserve further special studies in the context of the training service improvement initiatives.

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# Body mass to length indexing tests to select promising beginner swimmers

UDC 796.015.82

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**Abstract**

**Objective of the study** was to test and analyze the body mass to length ratios in beginner sprint swimming groups versus the successful professionals and rate benefits of the selection criteria.

**Methods and structure of the study.** We sampled for the tests the 16+ year-old swimming professionals (n=47); and young beginners and unsporting individuals (n=47) aged 10-12 years (n = 23) and 13-15 years (n = 24) from the central and southeastern Serbia. The tests were designed to produce the body mass; body length; ideal body mass (IBM); and Body Mass Index (BMI) also known as the Quetelet index. The professional group anthropometric characteristics were found at fina.org [9]; and the beginner swimmers' anthropometrics were taken as recommended by IBP Weiner, Lourie (1968), with the data processed using the Walker method [8]:

- BMI (body mass index, Quetelet index) = body mass / length ($m^2$),
- IBM (ideal body mass) = (body length -100) - [(body length-150) × 0.25],

**Results and Conclusion.** The study data and analysis give grounds to conclude that most of the selected beginner swimmers from Central and Southeastern Serbia will be 180-185cm tall when they are as old (16+) as the young professionals – who are largely (49%) 191+cm tall in fact. It should be emphasized that the swimming sport elite including the top-ranking competitors and champions are very tall and relatively light; and this is the reason why the 14-17 year-old swimmers in the fast growth period, when their physical strength is still insufficient, often demonstrate excellent competitive accomplishments. Our comparative analysis of the BMI in the young professional group versus the BMI forecast in the beginner swimmers showed that these test indices need to be seriously considered by the sports selectors otherwise the beginners may not be that successful in competitions.

***Keywords:*** *swimming, body mass, body length, selection.*

**Background.** Success in modern sports largely depends on the sport-specific individual qualities and functional/ motor/ cognitive resources and abilities. The sports communities give a high priority to informed selections of promising prospects to beginner sports groups using special sets of genetically determined selection criteria [1, 2, 5].

**Objective of the study** was to test and analyze the body mass to length ratios in beginner sprint swimming groups versus the successful professionals and rate benefits of the selection criteria.

**Methods and structure of the study.** We sampled for the tests the 16+ year-old swimming professionals (n=47); and young beginners and unsporting individuals (n=47) aged 10-12 years (n = 23) and 13-15 years (n = 24) from the central and southeastern Serbia. The tests were designed to produce the body mass; body length; ideal body mass (IBM); and Body Mass Index (BMI) also known as the Quetelet index. The professional group anthropometric characteristics were found at fina.org [9]; and the beginner swimmers' anthropometric characteristics were taken as

**Table 1.** *The 10-12 year-old swimmers' body mass and length test data, n=23*

| Test data | Mean | Minimal | Maximal | Standard deviation |
|---|---|---|---|---|
| Body length | 149,4955 | 140,5000 | 158,0000 | 4,493008 |
| Body mass | 44,2727 | 32,0000 | 55,0000 | 6,372798 |
| BMI | 19,7120 | 15,9597 | 22,8060 | 1,939050 |
| Forecast length | 180,6114 | 177,2450 | 184,2200 | 1,887532 |
| Forecast mass | 74,0507 | 72,6705 | 75,5302 | 0,773888 |
| Forecast BMI | 22,7030 | 22,2560 | 23,1318 | 0,237428 |
| Forecast IBM | 72,9586 | 70,4338 | 75,6650 | 1,415649 |

recommended by IBP Weiner, Lourie (1968), with the data processed using the Walker method [8]:

• BMI (body mass index, Quetelet index) = body mass / length ($m^2$),

• IBM (ideal body mass) = (body length -100) - [(body length-150) × 0.25],

**Results and discussion.** The 10-12 year-old selected beginners were 149.49cm tall; the unsporting 10-year-olds were 145.92cm tall; 11 year-olds 150.37cm, and the 12-year-olds 157.30cm tall. Note that the selected beginners' body length was on average shorter than that of their unsporting 10-12 year-old peers.

Having compared the group body length averages with those of the professionals when they were 10/ 11/ 12 years old, we found the professionals leading on the test scale (the age-specific body length was computed using the Tanner's method [3]. Average body length in the beginner swimming group calculated as provided by Walker [8] was estimated at 180.61±1.88 cm versus 189.44cm in the professional group: Table 1.

The BMI averages of 19.71±1.93 kg/ $m^2$ showed the 10-12 year-old beginners having obesity according to the known criteria [6]. The results (Table 1) show the final BMI, body mass and length falling within the range typical for the swimming professionals.

Table 2 shows the 13-15 year-old selects from southeastern Serbia being 170.76±7.39cm tall, with the forecast length of 182.05±3.01cm i.e. lower than the actual average body length of the swimming professionals [4]. Forecast final body length of the group was estimated at176.50-186.99cm versus the professionals' body length of 180.0-202.0cm: see Table 3.

Most of the young professionals (40%) are 190-199.9cm tall, 9% are 200+cm tall, and 27.2% are 180-185cm tall; whilst the selected beginners are forecasted to grow 180-185cm tall by this age. As

**Table 2.** *The 13-15 year-old swimmers' body mass and length test data, n=24*

| Test data | Mean | Minimal | Maximal | Standard deviation |
|---|---|---|---|---|
| Body length | 170,7677 | 154,5000 | 185,9000 | 7,393979 |
| Body mass | 60,4194 | 43,0000 | 77,5000 | 9,512358 |
| BMI | 20,6009 | 15,8327 | 24,6470 | 1,979767 |
| Forecast length | 182,0581 | 176,5700 | 186,9960 | 3,013831 |
| Forecast mass | 74,6438 | 72,3937 | 76,6684 | 1,235671 |
| Forecast BMI | 22,5263 | 21,9256 | 23,2203 | 0,373634 |
| Forecast IBM | 74,0436 | 69,9275 | 77,7470 | 2,260374 |

**Table 3**. *The 16+ years old professionals' body mass and length test data, n=47*

| Test data | Mean | Minimal | Maximal | Standard deviation |
|---|---|---|---|---|
| Body length | 189.4436 | 180.0000 | 202.0000 | 6.265182 |
| Body mass | 81.5836 | 65.0000 | 98.0000 | 8.088235 |
| BMI | 79.5827 | 72.5000 | 89.0000 | 4.698886 |
| Forecast length | 22.7202 | 16.9200 | 27.1669 | 1.816748 |
| Forecast mass | 148.5238 | 141.1200 | 158.3680 | 4.911903 |
| Forecast BMI | 154.0177 | 146.3400 | 164.2260 | 5.093593 |
| Forecast IBM | 159.1327 | 151.2000 | 169.6800 | 5.262753 |

demonstrated by the prior studies, only 1% of the junior swimmers are 191+cm tall – apparently due to the fact that the sports selectors give little if any attention to the body mass, length and their indexing analyses [7].

**Conclusion**. The study data and analysis give grounds to conclude that most of the selected beginner swimmers from Central and Southeastern Serbia will be 180-185cm tall when they are as old (16+) as the young professionals – who are largely (49%) 191+cm tall in fact. It should be emphasized that the swimming sport elite including the top-ranking competitors and champions are very tall and relatively light; and this is the reason why the 14-17 year-old swimmers in the fast growth period, when their physical strength is still insufficient, often demonstrate excellent competitive accomplishments. Our comparative analysis of the BMI in the young professional group versus the BMI forecast in the beginner swimmers showed that these test indices need to be seriously considered by the sports selectors otherwise the beginners may not be that successful in competitions.

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# Special physical fitness in mas-wrestling sport: gender group tests and analysis

UDC 796.012

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**Abstract**

**Objective of the study** was to test and analyze special physical fitness in mas-wrestling gender groups.

**Methods and structure of the study.** We sampled for the study the elite mas-wrestlers (n=23, including 10 women and 13 men) qualified Class I to Masters of Sports (men 8 and 9). The women's group was on average 57.9±7.9kg heavy, 162.3±4.2cm tall and 22.1±5.7 years old; and the men's group was 68.7±5.5kg heavy, 174.5±6.5cm tall and 19.3±1.3 years old.

We tested the special physical fitness using an AMTI dynamometric test plate in the seated straight pull test. The athletes were tested as follows: on command, the subject would pull the stick straight as strong as possible, with no side twists allowed. The dynamometric test plate data (in lbf) were fixed for 15s, with only the first 12s interval subject to analysis to produce: average per-second strength rates (F1s, F2s, ... F12s); top strength in the test (Fmax); strength intensity index (II) that is the per-second strength to top strength ratio: II = F / Fmax * 100; and endurance index (EI) that is the last-second strength to top strength ratio: EI = F12s / Fmax * 100.

**Results and Conclusion.** The men's and women's group were tested with the top strength reached at 3s (592.12±63.78 lbf and 343.40±53.99 lbf, respectively): see Table 1. Since 4s, strength was falling in both groups, with the top strength developed within the 2s-6s interval. Only woman 10 was tested with the top strength reached at 11s.

We also tested significance of the per-second strength averages versus the 3s top strengths in both groups – to find the women's group showing a statistically significant gap between the 1s/ 8s-12s and 3s test rates.

The study data and analyses give grounds to highlight the four pulling strength zones in the seated pull special physical fitness (top-strength) test of the elite mas-wrestlers that are recommended for the individual special physical fitness test systems: zone 1: first second; zone 2: 2 through 7 seconds; zone 3: 8 through 9 seconds; and zone 4: 10 through 12 seconds. We would recommend findings of the study for consideration by the mas-wrestling elite coaching community for the special physical training system design and management purposes.

***Keywords:*** *physical training, women's sport, dynamometric test plate, testing, intensity, sexual dimorphism.*

**Background.** Modern mas-wrestling sport competition is a face-to-face sitting stick pulling/ tugging event played by Madyyn's (mas-wrestlers) whose physical training systems naturally prioritize strength workouts [1, 5, 8] both in the men's and women's groups. The women's elite mas-wrestlers' anthropometric characteristics and functionality test data demonstrate that the long-term mas-wrestling trainings and competitions develop strong physique and tend to smooth down the natural dimorphic differences towards minor andromorphic elements in body builds [7].

**Objective of the study** was to test and analyze special physical fitness in mas-wrestling gender groups.

**Methods and structure of the study.** We sampled for the study the elite mas-wrestlers (n=23, including 10 women and 13 men) qualified Class I to Masters of Sports (men 8 and 9). The women's group was on average 57.9±7.9kg heavy, 162.3±4.2cm tall and 22.1±5.7 years old; and the men's group was 68.7±5.5kg heavy, 174.5±6.5cm tall and 19.3±1.3 years old.

**Table 1.** *Average per-second strength test rates in the men's (n=13) and women's (n=10) groups*

| Group | 1 c | 2 c | 3 c | 4 c | 5 c | 6 c | 7 c | 8 c | 9 c | 10 c | 11 c | 12 c |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Men | 369,57 | 562,30 | ***592,12*** | 591,20 | 590,63 | 581,79 | 574,85 | 566,26 | 564,43 | 550,24 | 542,15 | ***536,48*** |
| Women | 258,27 | 334,56 | ***343,40*** | 340,44 | 334,72 | 328,87 | 324,56 | 312,65 | 302,91 | 291,96 | 291,92 | ***290,26*** |
| Gap, lbf | 111,31 | 227,74 | ***248,72*** | 250,76 | 255,91 | 252,92 | 250,29 | 253,61 | 261,52 | 258,28 | 250,23 | ***246,22*** |
| Gap, % | 30,12 | 40,50 | ***42,00*** | 42,42 | 43,33 | 43,47 | 43,54 | 44,79 | 46,33 | 46,94 | 46,15 | ***45,90*** |

We tested the special physical fitness using an AMTI dynamometric test plate in the seated straight pull test. The athletes were tested as follows: on command, the subject would pull the stick straight as strong as possible, with no side twists allowed. The dynamometric test plate data (in lbf) were fixed for 15s, with only the first 12s interval subject to analysis to produce: average per-second strength rates (F1s, F2s, ... F12s); top strength in the test (Fmax); strength intensity index (II) that is the per-second strength to top strength ratio: II = F / Fmax * 100; and endurance index (EI) that is the last-second strength to top strength ratio: EI = F12s / Fmax * 100.

**Results and discussion.** The men's and women's group were tested with the top strength reached at 3s (592.12±63.78 lbf and 343.40±53.99 lbf, respectively): see Table 1. Since 4s, strength was falling in both groups, with the top strength developed within the 2s-6s interval. Only woman 10 was tested with the top strength reached at 11s.

We also tested significance of the per-second strength averages versus the 3s top strength in both groups – to find the women's group showing a statistically significant gap between the 1s/ 8s-12s and 3s test rates. The women's group top strength (Fmax) was tested 42% lower than the men's one, with the shortest and largest intergroup strength gaps tested at 1s (30.12%) and 10s (46.94%), respectively, whilst the last-second (F12c) strength gap made up 45.90%.

The per-second strength to top strength ratio helped profile the individual strength control intensity. The profiles showed the women's group faster losing intensity than the men's one, with the groups strength falling by the last second to 84.5% and 90.6% of the top levels, respectively. These intensity profiles made it possible to rate the individual special endurances.

Leading in the men's group on the top strength (Fmax = 685 lbf) and intensity index (II = 90.5%) scales was the mas-wrestling National Champion, Master of Sport; followed by one more Master of Sport who was tested with Fmax = 674.2 lbf and II = 91.1%. These test data show that the top-ranking Madyns are the best in developing the top strength and keeping the strength intensity above 90% of the top level for 12s. Leading in the women's group were two Candidate Masters of Sport with the top strength tested at 419.7 lbf and 403.7 lbf. The gender group leaders' top-strength gap was estimated at 40.0%.

Sports experts report the highest gender gaps for the speed-strength-intensive sports with major contributions of the upper-limb muscles, plus the sports where women are less experienced [2, 4]. Thus a comparative analysis of the top competitive accomplishments of the gender groups in weightlifting sport shows the gender performance gaps depending on the weight classes and competitive events. In the same weight class (69 kg), for instance, the gender gaps are the following: snatch: 22.43%; clean and jerk; 20.21%; and combined: 21.12% [3]. We would mention in this context that the female mas-wrestlers generally have larger resource for progress in the strength training.

We also tested significance of the per-second strength averages versus the 3s top strengths in both groups – to find the women's group showing statistically significant gap between the 1s/ 8s-12s and 3s test rates. The group 2s, 4s, 5s, 6s and 7s test rates were found insignificantly different from the top 3s test rate ($p > 0.05$).

The men's group was tested with the 1s/ 2s strength test rates significantly lower than the top 3s second test rate ($p < 0.01$). The low 2s strengths tested in the group may be explained by the fact that the subjects were instructed to reach the top strength in the test rather than do it as fast as possible. The men's group 4s, 5s, 6s and 7s test rates were tested fairly close to the top level followed by a significant drop at 8s – as is the case in the women's group as well. Both groups were tested with the significant pulling strength drops at 10s of the test.

**Conclusion**. The study data and analyses give grounds to highlight the four pulling strength zones in the sitting pulling special physical fitness (top-strength) test of the elite mas-wrestlers that are recommended for the individual special physical fitness test systems: zone 1: first second; zone 2: 2 through 7 seconds; zone 3: 8 through 9 seconds; and zone 4:

10 through 12 seconds. We would recommend findings of the study for consideration by the mas-wrestling elite coaching community for the special physical training system design and management purposes.

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# Monitoring of physical and functional state of elite basketball players in covid-19 pandemic

UDC 612.766.1

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**Abstract**

**Objective of the study** was to experimentally substantiate the method of control of the physical and functional state of highly-qualified basketball players amidst the COVID-19 pandemic.

**Methods and structure of the study.** Subject to the experiment were 11 basketball players of the BC Rostov-Don-UFU. The female athletes' functional state was tested from September 2020 through January 2021 using Polar H10 heart-rate monitor, Polar VantageV watch, and Polar Flow program. The data obtained were processed and analyzed by the coaches to find the right training-rest balance, organize a painless and effective recovery from COVID-19.

**Results and conclusions.** Daily monitoring of the subjects' functional state using Polar H10 heart-rate monitor, Polar Vantage V watch, and Polar Flow program made it possible to constantly adjust the training loads based on the condition of the female basketball players, which affected the team's performance. Despite the fact that during the COVD-19 pandemic, several of the regular players came down with the disease, the BC Rostov-Don-UFU continues to hold the leading position in the Russian Superleague-1 Championship and performs in the 2020-2021 season without losing.

The application of modern digital equipment, multifunctional complexes allowing remote access to telemedical health care service, snap analysis, and interpretation of the data obtained in the female athletes made it possible to optimize the training process, make timely adjustments to the training loads, get the basketball players rehabilitated and further improve their performance.

**Keywords:** *COVD-19 pandemic, functional state, basketball, digital equipment in sports, rehabilitation after COVD-19.*

**Background.** Among the measures to safeguard against the COVID-19 infection is the suspension of all sports events. This situation has raised the question of how to organize the athletic training process amidst the pandemic and arrange rehabilitation of athletes after COVID-19.

Physical activity modulates the immune system functions (Nieman D.C., Wentz L.M., 2019). According to some authors (Burtscher J., Millet G.P., Burtscher M., 2020), the beneficial effect of regular physical exercise on the immune function of the body is mediated by mitochondrial adaptation. Mitochondria are the power generators of the cell; they regulate the metabolic processes and are actively involved in the antiviral response of the body (Burtscher J., Cappellano G., Omori A. et al., 2020). One of the most important components of innate immune protection is the mitochondrial antiviral-signaling protein (Burtscher J., Millet G.P., Burtscher M., 2020).

Elite sports are associated with extreme physical loads and overloading, which, in turn, leads to mitochondrial dysfunction and weakening of the immune system. The study found that overtraining and high cardio load values may become an important risk factor amidst the COVID-19 pandemic.

**Objective of the study** was to experimentally substantiate the method of control of the physical and functional state of highly-qualified basketball players amidst the COVID-19 pandemic.

**Table 1.** *Results of PCR-based diagnostics for Coronavirus (SARS-CoV-2) and IgG/IgM antibody test (SARS-CoV-2)*

| Rostov-Don-UFU players | Positive COVD-19 test | Test date | IgM | IgG |
|---|---|---|---|---|
| K. K. | 14.10.2020 | 05.11.20 | 1.82 | 26.47 |
| P. V. | 18.11.2020 | 05.01.21 | 1.57 | 15.21 |
| G. L. | 21.10.2020 | 05.11.20 | 1.34 | 5.46 |
| Sh.A. | 16.11.2020 | 05.01.21 | 0.87 | 13.42 |
| V. E. | 17.11.2020 | 05.01.21 | 0.92 | 14.52 |
| G. E. | 28.10.2020 | 05.11.20 | 0.95 | 1.33 |
| G. Yu. | 08.10.2020 | 05.11.20 | 0.48 | 23.96 |
| Z. A. | Negative | 05.11.20 | 0.60 | 12.78 |
| P. D. | Negative | 05.11.20 | 0.93 | 12.51 |
| M. A. | Negative | 05.02.21 | 0.58 | 12.63 |

**Methods and structure of the study.** Subject to the experiment were 11 female basketball players of the BC Rostov-Don-UFU, including 3 Masters of Sport and 8 Candidate Masters of Sport (mean age – 22.9±2.8 years, average length of sports experience – 12±1.4 years). The female athletes' functional state was tested from September 2020 through January 2021 using Polar H10 heart-rate monitor, Polar Vantage V watch, and Polar Flow program.

During the 28-day test period, an individual normal range of heart rate variability (RMMS) was formed for the subjects. The orthostatic test rates were displayed in the Polar Flow program, which, based on the comparison of these test rates with the baseline ones, determined whether the subject's cardiovascular system had recovered or not. The data obtained allowed the coaches to find the right training-rest balance, organize a painless and effective recovery from COVID-19.

**Results and discussion.** Since the start of the competitive matches, the female basketball players have been systematically tested for infection. Between October and December 2020, 7 athletes were diagnosed with COVD-19. Being tested positive for COVID-19, the subjects stopped training immediately and were quarantined. On the whole, the disease followed without any pronounced symptoms (low temperature, weakness, loss of smell). The players were allowed to train given that they had received two negative test results, had no symptoms of the disease and stable well-being. The first training sessions were draw-in and were conducted according to an individual training plan. When ready, the athletes began to get involved in the team training mode.

All the female basketball players, who had come through the coronavirus disease, were found to have high cardio load values. The software package detected overtraining on the 3rd-5th week on average, depending on the severity of the disease, while the rest of the team effectively performed the same load and their cardio load values were within the normal range (see Table 1).

The analysis of the subjects' cardio load diagrams revealed that the coronavirus symptoms were present in those, who had been in the overtraining phase prior to the disease, which resulted in the weakening of the immune system against the background of mitochondrial dysfunction. Those female athletes, whose cardio load values were within the normal range, did not show any COVID-19 symptoms. However, the immunoserological study showed that all the team members had IgG antibodies to SARS-CoV-2 in their plasma.

**Conclusions.** Elite sports are associated with extreme physical loads that make the body function at its limits, which, in turn, leads to mitochondrial dysfunction and weakening of the immune system. Overtraining and high cardio load values may become an important risk factor amidst the COVID-19 pandemic.

Daily monitoring of the subjects' functional state using Polar H10 heart-rate monitor, Polar Vantage V watch, and Polar Flow program made it possible to constantly adjust the training loads based on the condition of the female basketball players, which affected the team's performance. Despite the fact that during the COVD-19 pandemic, 7 regular players came down with the disease, the BC Rostov-Don-UFU continues to hold the leading position in the Russian Basketball Super League-1 Championship and performs in the 2020-2021 season without losing.

The application of modern digital equipment, multifunctional complexes allowing remote access to telemedical health care service, snap analysis,

and interpretation of the data on the female athletes' functional state made it possible to optimize the training process, make timely adjustments to the training loads, arrange rehabilitation of the female basketball players, and further improve their performance.

*The study was carried out with funding from the Russian Foundation for Basic Research within the framework of the scientific project No. 19-313-90042 dated 23.08.2019*

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# Postural control strategies in elite freestyle wrestling

UDC УДК 796.81

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**Abstract**

**Objective of the study** was to contribute to theoretical basics of the postural control biomechanics in modern freestyle wrestling.

**Methods and structure of the study.** We made, for the purposes of the study, a theoretical analysis of the postural-control-related freestyle wrestling study reports and fight videos of the global freestyle wrestling elite. It is believed that minor fluctuations are normally controlled by an ankle control strategy i.e. the ankle joint adaptation to the minor off-balancing stresses; whilst the higher-amplitude, strong and frequent fluctuations are controlled by a hip control strategy with the special hip joints fixing and movement skill set [8]. We used a database of the freestyle wrestling elite fight videos to analyze the best postural control strategies. To underline the importance of the body mass center in postural control, we call it herein a dynamic center as different from a static center.

**Results and conclusion.** Based on the theoretical analysis with respect to the stability theory we grouped the postural control strategies into the (1) ankle control strategy; (2) hip control strategy also referred to as the dynamic center (hip mass center) controlling reverse pendulum; and (3) neutral (trunk-fixing) control strategy also referred to as the static center with a straight pendulum, changeable ground contact and pelvic control.

The study data and analyses showed the postural control skills with special static / dynamic center control being paramount for success, with the force vector generally pointed towards the static center whilst the hands fix the dynamic center. This pattern of the movement sequence was found typical for every top-ranking freestyle wrestler and may be viewed as indicative of the skill level and experience.

***Keywords:*** *sport, wrestling, maintaining balance, maintaining balance model, body mass center.*

**Background.** Special priority in the modern freestyle wrestling skill sets is given to the ability to feel and analyze the opponent's postural control strategies i.e. the body balancing patterns when opposing the attacker's off-balancing actions (thrusts, pulls, twists etc.) [6]. Objective of the study was to contribute to theoretical basics of the postural control biomechanics in modern freestyle wrestling.

**Methods and structure of the study.** We made, for the purposes of the study, a theoretical analysis of the postural-control-related freestyle wrestling study reports and fight videos of the global freestyle wrestling elite. It is believed that minor fluctuations are normally controlled by an ankle control strategy i.e. the ankle joint adaptation to the minor off-balancing stress; whilst the higher-amplitude, strong and frequent fluctuations are controlled by a hip control strategy with the special hip joints fixing and movement skill set [8]. We used a database of the freestyle wrestling elite fight videos to analyze the best postural control strategies. To underline the importance of the body mass center in postural control, we call it herein a dynamic center as different from a static center.

**Results and discussion.** Based on the theoretical analysis with respect to the stability theory [1, 5, 7, 8, 9], we grouped the postural control strategies into (1) ankle control strategy; (2) hip control strategy also referred to as the dynamic center (hip mass center) controlling reverse pendulum; and (3) neutral (trunk-fixing) control strategy also referred to as the static center with a straight pendulum, changeable ground contact and pelvic control.

The study of the back throw biomechanics by Master of Sports PhD C.T. Ivankov found the attacker's shoulder girdle and head leading accelerations of the throwing bodily elements, with the pelvis/ legs speed being much slower. The shoulder girdle speed was tested to peak in the late phase 1 when the pelvis/ leg speeds fall to the minimum; followed by some speed-up of the pelvis at the start of phase 2. In phase 3, the shoulder/ head speeds were tested still growing, whilst the pelvis/ leg speeds falling down and stabilizing [3].

Within the static / dynamic center terms and meanings, we would say that the chest static center rotation speed and force are leading in the above sequence followed by the shoulders and head as the associating bodily segments. In phase 2, when the attacker strives to off-balance the joint (both fighters') body mass center, a special role is played by the dynamic center (with the pelvis speed growing), since the joint body mass center is composed of the attacker's and defender's body mass centers [2, 4]. When the joint system tips over, the move is heavily contributed by attacker's pelvis as the segment closest to the joint body mass center.

"Movement dynamics analysis shows the attacker's TTA designed to off-balance the joint body mass center by pulling the opponent onto or ducking under (with the latter meaning the attacker's body mass center moved under the defender's)" [2, 4]. Note than in both cases the pelvic dynamic center is critical for success of the joint body mass center off-balancing move. "The EMG analysis shows the shoulder muscles being activated first as their electrical activity by far exceeds that of the lower limb muscles; with the efforts and contributions of the shoulder muscles being paramount for the goals of the throw" [3, 4].

In terms of the static center concept, leadership of the shoulder muscles in the freestyle wrestling actions appears typical of every attack/ defense action: see Figures 2, 3.

**Figure 2.** *Pull-in by the shoulder girdle with a twist around the static center Figure 3. Defense plus counterattack by pull-in and twist around the static center*

**Figure 3.** *Defense plus counterattack by pull-in and twist around the static center*

**Figure 4.** *Attack vector redirection by Kyle Dyck*

Figure 2 shows the Khadzhimurat Magomedov's defending from a dangerous grip by pulling-in the shoulder girdle with a twist around the static center to win the Olympic Champion's title. Figure 3 demonstrates the Nachyn Kuular's defense and counterattack by pull-in and twist around the static center.

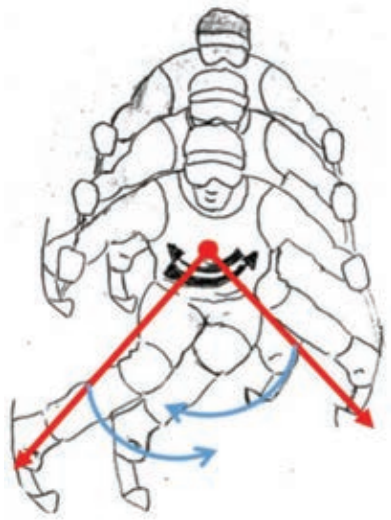

**Рис. 1.** *13-сегментная биомеханическая модель*

**Figure 5.** *Attack by Haji Aliyev*

Figures 4, 5 hereunder show the attack vector redirected from dynamic center via static center versus the both wrestlers' body mass center.

Kyle Dyck from the US first strives to push behind the static center (phase 1); then changes the direction (phase 2 in between the static and dynamic center); and then controls the static center by the shoulders and head and dynamic center by hands: Figure 4. And Figure 5 shows an attack by the three-time World Champion Haji Aliyev (Azerbaijani) who controls the both centers by pushing the chest static center and fixing the pelvis.

Conclusion. The study data and analyses showed the postural control skills with special static / dynamic center control being paramount for success, with the force vector generally pointed towards the static center whilst the hands fix the dynamic center. This pattern of the movement sequence was found typical for every top-ranking freestyle wrestler and may be viewed as indicative of the skill level and experience.

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# Benefits of ethnic games and sports for coordination skills in beginner rifle shooting sport

UDC 796.012

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**Abstract**

**Objective of the study** was to test and analyze benefits of a coordination skills building model for beginner shooters with elements of ethnic games and sports.

**Methods and structure of the study.** Progress of the sample in coordination skills and physical fitness was tested in the experiment by a standard test toolkit including the 4x9m shuttle cubes-carrying sprint test, Romberg's test and Yarotsky's test. We used SKATT shooting simulator to rate individual progress by the practical rifle shooting tests. We sampled for the coordination skills building model testing experiment the 11-14 year-old beginner shooters (n=14) with 1-2-year training records and split them up into EG and RG. The EG was trained as required by the new coordination skills training model with the ethnic sports elements, whilst the RG training was standard. We selected the following ethnic sports elements for the coordination skills training in the EG:

– "Lean Cow Raise" to build leg strength, coordination and balance;
– "Oybontonuulaain" (Watering) to excel coordination skills, joint motility and dexterity; and
– "Tutumergir" (Spinner) to train flexibility, coordination skills and grip strength;

The trainings were complemented with the table folk game "Khabylyk" (Chips), one of the most ancient ones played with splinters used by every Yakut family to make fire, and known to excel eye accuracy, thinking skills and fine finger movements; and "Khaamiska" (Pebbles) game with "five pebbles" popular the world over in different versions with the only local difference that the 1x1.5cm wooden cubes are used instead of natural pebbles.

**Results and Conclusion.** The new coordination skills building model for beginner shooters with elements of ethnic sports and games was tested beneficial for the theoretical and practical trainings. Prudently designed and managed ethnic sports elements are recommended for application in shooting sports as they help excel coordination skills, discipline, diligence, dedication, endurance and perseverance. The ethnic sports and games are highly effective for physical activation in idle times, mental health protection and improvement and healthy lifestyle cultivation purposes, with special benefits for easily trained coordination skills, provided the training systems are well designed and managed on a progress-customized basis. The pre- versus post-experimental tests in the EG and RG found the ethnic sports elements being highly beneficial for beginner rifle shooters as verified by the fast and stable progress in practical shooting tests.

**Keywords:** *rifle shooting, beginner rifle shooters, coordination skills, ethnic games and competitions.*

**Background.** Indigenous nations of the Russian Far North take pride in their ethnic education traditions very specific in every method, tool, element and culture on the whole – that has helped the local people to survive in the harsh climate [2] where winters last for at least eight months a year to expose people to multiple mental and physical health risks. The original and unique ethnic sports, health practices and games are known to comprehensively develop many physical qualities (strength, speed, endurance, dexterity etc.) plus excellent willpower and ethics with the relevant aesthetical and communal values. The traditional ethnic sports are highly dynamic, accessible for everybody, very practical and easy for mastering – as they have always been used to make children highly fit for difficult local life-

style and develop the key qualities and skills critical for hunting, reindeer/ animal breeding and surviving [3]. This is the reason why the sports experts and trainers in every sport discipline practiced in the Republic of Sakha (Yakutia) have to make resort to the traditional ethnic culture in the attempts to excel their training systems and progress test toolkits [1].

Objective of the study was to test and analyze benefits of a coordination skills building model for beginner shooters with elements of ethnic games and sports.

**Methods and structure of the study.** Progress of the sample in coordination skills and physical fitness was tested in the experiment by a standard test toolkit including the 4x9m shuttle cubes-carrying sprint test, Romberg's test and Yarotsky's test. We used SKATT shooting simulator to rate individual progress by the practical rifle shooting tests. We sampled for the coordination skills building model testing experiment the 11-14 year-old beginner shooters (n=14) with 1-2-year training records and split them up into EG and RG. The EG was trained as required by the new coordination skills training model with the ethnic sports elements, whilst the RG training was standard. We selected the following ethnic sports elements for the coordination skills training in the EG:

– "Lean Cow Raise" to build leg strength, coordination and balance;

– "Oybontonuulaain" (Watering) to excel coordination skills, joint motility and dexterity; and

– "Tutumergir" (Spinner) to train flexibility, coordination skills and grip strength;

The trainings were complemented with the table folk game "Khabylyk" (Chips), one of the most ancient ones played with splinters used by every Yakut family to make fire, and known to excel eye accuracy, thinking skills and fine finger movements; and "Khaamiska" (Pebbles) game with "five pebbles" popular the world over in different versions with the only local difference that the 1x1.5cm wooden cubes are used instead of natural pebbles.

**Results and discussion.** The pre- versus post-experimental coordination skills / physical fitness tests in the EG and RG found the group progresses in the dexterity-rating 4x9m shuttle cubes-carrying sprint test virtually identical at 0.98s in the EG. The coordination skills rating special-difficulty Romberg test found the EG and RG making progresses of 15.7s and 0s, respectively. And the vestibular analyzer functionality rating Yarotskiy's test rated the EG progress at 0.79s, with the RG lagging 0.66s behind the EG in the test.

On the whole, the pre- versus post-experimental EG/ RG tests found the ethnic sports elements being highly beneficial for the 10m pneumatic rifle shooting as verified by the fast and stable progress of the EG in practical shooting tests. It should be also mentioned that the EG was tested fresh and free of fatigue after the practical shooting tests with multiple settings for shooting and excellent results. The digitalized SCATT simulator assisted tests found the EG shooting profiles being free of lapses of concentration and fluctuations. As a result, the EG showed a faster and more stable progress in practical shooting tests estimated at 36.4 points on average. The RG was tested with a notable albeit in significant progress of 20.2 points.

**Conclusion.** The new coordination skills building model for beginner shooters with elements of ethnic sports and games was tested beneficial for the theoretical and practical trainings. Prudently designed and managed ethnic sports elements are recommended for application in shooting sports as they help excel coordination skills, discipline, diligence, dedication, endurance and perseverance. The ethnic sports and games are highly effective for physical activation in idle times, mental health protection and improvement and healthy lifestyle cultivation purposes, with special benefits for easily trained coordination skills, provided the training systems are well designed and managed on a progress-customized basis. The pre- versus post-experimental tests in the EG and RG found the ethnic sports elements being highly beneficial for beginner rifle shooters as verified by the fast and stable progress in practical shooting tests.

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# Ski jumpers' physical fitness test toolkit for staged progress tests in yearly training cycle: benefits analysis

UDC 796.012

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**Abstract**

**Objective of the study** was to test benefits of a physical fitness progress test toolkit for training stages in an annual training cycle.

**Methods and structure of the study.** We sampled for the physical fitness progress test toolkit piloting experiment the third-year junior ski jumpers (n=18) from "Aist" CYORSS in Nizhny Tagil and split them up into EG and RG of 9 people each. The pre-experimental physical fitness tests found insignificant intergroup differences if any. Both groups were trained as required by the yearly training plan that totals 828 academic hours accumulated by six 3-hour trainings (18 hours in total) a week. The group trainings were different in the general and special physical fitness workouts and intensity in the following four training stages in the yearly training cycle.

Stage 1 (May through June) was dominated (75-80%) by the body conditioning tools for progress in general physical fitness, motor qualities and coordination skills, with the complementary technical tools geared to master some ski jumping elements and adapt to the equipment and gear. Stage 2 (July through September) included special preparatory trainings with the ski jumping technique excellence on ramps with artificial snow. Stage 3 (October – early December) is the transitional/ preparatory training period with the physical fitness rated at 55–65% of the total time to focus on the speed-strength workout making up 50% of the physical fitness, plus speed and coordination skills trainings; and the ski jumping technique excellence trainings on ramps, with the equipment and gear adaptation elements. And Stage 4 (January through March) makes a special emphasis on the ski jumping technique excellence on the ramp, with the special physical fitness and technical trainings making up around 35% and 65%, respectively.

The group physical fitness progress test set included the most reliable, efficient/ informative and accessible tests run every 28-39 days, with every physical fitness / technical deviation found by the tests immediately addressed by the training system revisions in scheduling, timing and intensity.

**Results and Conclusion.** The staged physical fitness progress test toolkit was tested beneficial for the progress rating and training system customizing purposes in the annual youth ski jumping training cycle. The physical fitness progress test toolkit may be recommended for application in the youth ski jumping sport for the individual progress profiling and training system management purposes in every training period and yearly cycle on the whole.

***Keywords:*** *monitoring, physical fitness, training stage of long-term training, ski jumper.*

**Background.** Well-managed physical fitness is known to be critical for competitive performance in modern ski jumping, with the competitive performance and physical fitness correlation known to grow with age in the quantitative and qualitative terms, with a growing contribution of the movement coordination skills [1, 3]. The youth ski jumping training systems give a special priority to the general and special physical fitness training tools, with specific workouts being prudently designed and managed at the training stages and yearly cycles versus the progress test data.

**Objective of the study** was to test benefits of a physical fitness progress test toolkit for training stages in an annual training cycle.

**Methods and structure of the study.** We

**Table 1.** *Averaged EG physical fitness test data for the preparatory training stages, M±m*

| Tests | Training stages and tests | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Stage 1 | | Stage 2 | | Stage 3 | | Stage 4 | |
| | Test 1 | Test 2 | Test 1 | Test 2 | Test 1 | Test 2 | Test 1 | Test 2 |
| 30m sprint, s | 4,77±0,36 | 4,55±0,31 | 4,58±0,28 | 4,46±0,23 | 4,37±0,21 | 4,26±0,27 | 4,23±0,28 | 4,22±0,23 |
| Standing long jump, cm* | 216±22 | 224±21 | 223±24 | 237±18 | 236±20 | 245±16 | 243±12 | 239±18 |
| Standing high jump, cm* | 51,72 ±7,11 | 52,88 ±8,18 | 53,06 ±7,18 | 55,88 ±6,97 | 57,00 ±11,53 | 59,88 ±6,13 | 59,55 ±5,45 | 57,97 ±5,18 |
| Pistol jump, count* | 19,60 ±3,13 | 21,40 ±2,29 | 23,90 ±2,30 | 25,78 ±2,45 | 25,10 ±2,23 | 29,03 ±2,62 | 29,20 ±2,11 | 26,55 ±2,31 |
| Figure-of-eight, s* | 19,23 ±1,18 | 19,05 ±1,26 | 18,71 ±1,06 | 18,21 ±1,33 | 17,81 ±1,22 | 17,54 ±1,29 | 17,33 ±1,07 | 17,00 ±0,95 |
| Sit and reach, cm | 9,71 ±0,39 | 10,12 ±0,43 | 10,30 ±0,45 | 11,03 ±0,53 | 11,86 ±0,50 | 12,17 ±0,67 | 12,66 ±0,60 | 13,27 ±0,88 |

*Note: * significant (p≤0.05) progress in the EG*

sampled for the physical fitness progress test toolkit piloting experiment the third-year junior ski jumpers (n=18) from "Aist" CYORSS in Nizhny Tagil and split them up into EG and RG of 9 people each. The pre-experimental physical fitness tests found insignificant intergroup differences if any. Both groups were trained as required by the yearly training plan that totals 828 academic hours accumulated by six 3-hour trainings (18 hours in total) a week. The group trainings were different in the general and special physical fitness workouts and intensity in the following four training stages in the yearly training cycle.

Stage 1 (May through June) was dominated (75-80%) by the body conditioning tools for progress in common physical fitness, motor qualities and coordination skills, with the complementary technical tools geared to master some ski jumping elements and adapt to the equipment and gear. Stage 2 (July through September) included special preparatory trainings with the ski jumping technique excellence on ramps with artificial snow. Stage 3 (October – early December) is the transitional/ preparatory training period with the physical fitness rated at 55–65% of the total time to focus on the speed-strength workout making up 50% of the physical fitness, plus speed and coordination skills trainings; and the ski jumping technique excellence trainings on ramps, with the equipment and gear adaptation elements. And Stage 4 (January through March) makes a special emphasis on the ski jumping technique excellence on the ramp, with the special physical fitness and technical trainings making up around 35% and 65%, respectively.

The group physical fitness progress test set included the most reliable, efficient/ informative and accessible tests run every 28-39 days, with every physical fitness / technical deviation found by the tests immediately addressed by the training system revisions in scheduling, timing and intensity.

**Results and discussion.** Benefits of the general/ special physical fitness tests and the test data analyses were rated, among other things, by the test data correlation analysis and individual scores for the test jumps. We selected the following most effective physical fitness tests (with the test ef-

**Table 2.** *Averaged pre- versus post-experimental group physical fitness test data, M±m*

| Tests | EG, n=9 | | RG, n=9 | |
|---|---|---|---|---|
| | Pre-exp. | Post-exp. | Pre-exp. | Post-exp. |
| Speed rating 30m sprint, s | 4,77±0,36 | 4,22±0,23 | 4,69±0,31 | 4,44±0,25 |
| Speed-strength rating standing long jump, cm* | 216±22 | 239±18 | 213±25 | 229±23 |
| Jumping endurance rating pistol jump, reps* | 19,60±3,13 | 26,55±2,31 | 21,00±3,42 | 23,75±3,20 |
| Coordination-skills-rating figure-of-eight, s* | 19,23±1,18 | 17,00±0,95 | 18,92±1,32 | 18,10±1,12 |
| Flexibility rating sit and reach, cm | 9,71±0,39 | 13,27±0,68 | 10,10±0,45 | 12,35±0,56 |

*Note: * significant (p≤0.05) intergroup difference*

ficiency and dependability ratios in excess of 0.70 and 0.92, respectively): (1) speed rating 30m sprint; (2) speed-strength rating standing long jump and standing high jump; (3) jumping endurance rating pistol jumps and 10 hurdles jumps; (4) coordination rating figure-of-eight-bending; and 3x10m shuttle sprint versus 30m straight sprint; and (5) flexibility rating sit and reach test.

We also used the following standard tests: strength rating prone push-ups; total endurance rating 1000m race; and the strength endurance rating sit-up tests from the valid Federal Sports Training Standard for youth ski jumping sport applied for qualification/ upgrade purposes, albeit low efficient in fact, with the efficiency rations varying at 0.15-0.62. We selected the most informative (beneficial), dependable, time-efficient and accessible tests for the group physical fitness progress rating purposes. Given in Table 1 hereunder are the averaged EG physical fitness test data for the preparatory training stages.

Given in Table 2 hereunder are the pre- versus post-experimental group physical fitness test data.

The pre- versus post-experimental group physical fitness test data and analyses showed the test toolkit being beneficial physical fitness the staged physical fitness progress profiling purposes in the trainings dominated by the body conditioning tools at the general preparatory stage; speed-strength and speed trainings complemented by the coordination skills and flexibility workouts in the special preparatory and transitional stages; and the physical fitness excellence and retention in the competitive stage.

**Conclusion**. The staged physical fitness progress test toolkit was tested beneficial for the progress rating and training system customizing purposes in the annual youth ski jumping training cycle. The physical fitness progress test toolkit may be recommended for application in the youth ski jumping sport for the individual progress profiling and training system management purposes in every training period and yearly cycle on the whole.

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# General physical fitness model methdoilogy for beginner judokas

UDC 796.853.23

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**Abstract**

**Objective of the study** was to develop and test benefits of a new body conditioning model for beginner judo groups.

**Methods and structure of the study.** The new body conditioning model testing experiment was run in Berezniki city at the local Youth Olympic Reserve Sports School in November 2019 through February 2020. We sampled the 7-8-year-old male beginners (n=30) and split them up into Experimental and Reference Groups (EG, RG) of 15 boys each.

**Results and conclusion.** The new body conditioning model includes the following elements:

1. Body conditioning methods designed on a uniform, variable, repetitive and interval bases; with circuit, competitive and team sporting formats; strength training tools (sub-maximal, dynamic and isometric ones); and difficulty-stepping formats with the execution complicating/ simplifying cycles.

2. A range of exercises with specific body conditioning goals in athletics, gymnastics, acrobatics, weightlifting, training machines assisted workouts, relay races, active team sports etc.

3. Trainings varied in intensity, volume and priority goals.

4. Basic physical fitness progress tests to identify individual strengths and weaknesses and adjust the training service correspondingly for progress.

5. Training service customizing based on the body conditioning test data, with the service adjustments prioritizing the training service times, intensities and formats, and with the individualized training service adjusted to the current strengths and weaknesses.

6. The body conditioning service was formatted as provided in Table 1, with the 1.5-hour trainings run three times a week to secure the body conditioning practices averaging 60% of the total training time.

The new body conditioning model for the 7-8 year-old beginner judo groups was tested beneficial due to the following elements: (1) special training methods; 2) sports elements with specific training task goals; (3) training service design and management provisions; (4) customized body conditioning service formats, times and intensities; (5) individualized training service elements; (6) basic physical fitness progress tests to help customize the training service; and (7) pre- versus post-experimental basic physical fitness tests. The latter showed significant progress in the EG versus RG in every basic physical fitness test, that is indicative of the new body conditioning model being beneficial.

***Keywords:*** *judo, judokas, body conditioning, beginner judo training, GTO Complex test, training service methodology.*

**Background.** Lately the national judo sport community reports have reported regress in the basic physical fitness of entrants to the beginner (7-8-year-old) judo groups and, hence, welcomes new body conditioning methods beneficial for the first-year beginner training service [1-3, 6].

**Objective of the study** was to develop and test benefits of a new body conditioning model for beginner judo groups.

**Methods and structure of the study.** The new body conditioning model testing experiment was run in Berezniki city at the local Youth Olympic Reserve Sports School in November 2019 through February 2020. We sampled the 7-8-year-old male beginners (n=30) and split them up into Experimental and Reference Groups (EG, RG) of 15 boys each.

**Results and discussion.** The new body conditioning model includes the following elements:

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6. The body conditioning service was formatted as provided in Table 1, with the 1.5-hour trainings run three times a week to secure the body conditioning practices averaging 60% of the total training time.

7. Eight body conditioning progress tests (see Table 2) recommended by the Federal Sports Training Standards for the 7-10-year-old judokas (qualification and promotion tests) and the GTO Complex tests for the 6-8 year-old boys [4, 5].

The group basic physical fitness test data analysis showed the EG making statistically significant ($p < 0.05$) progress versus the RG in every test. The group progresses were additionally tested by the post-experimental GTO Complex tests (see Figure 2) with qualifications for the GTO Gold, Silver and Bronze badges [4].

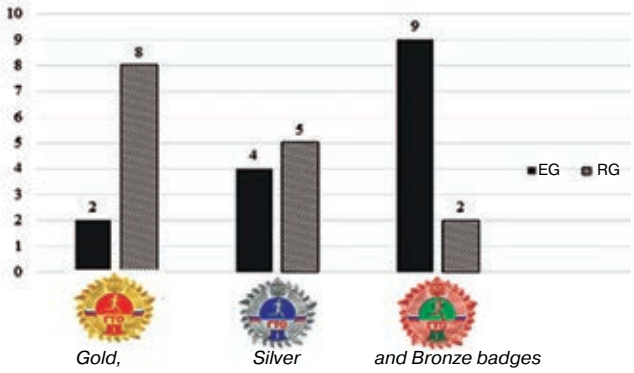


**Figure 2**. *Post-experimental GTO Complex test with the group successes in qualifications for the GTO*

The EG and RG showed significantly different success in the post-experimental GTO Complex tests,

**Table 1.** *Standard body conditioning weekly cycle for beginner judo groups*

| Days | Training formats | Training elements, exercises and goals |
|---|---|---|
| Monday | • Uniform<br>• Alternating<br>• Circuit<br>• Sub-maximal | ➢ Track and field athletics<br>➢ Gymnastics<br>➢ Acrobatics<br>➢ Training machines assisted practices<br>➢ Workouts with own weight<br>➢ Team sports |
| Wednesday | • Uniform<br>• Repetitive<br>• Competitive<br>• Dynamic<br>• Difficulty-stepping | ➢ Track and field athletics<br>➢ Gymnastics<br>➢ Acrobatics<br>➢ Workouts with own weight<br>➢ Relay races |
| Friday | • Uniform<br>• Interval<br>• Team sporting<br>• Isometric<br>• Difficulty-easing | ➢ Track and field athletics<br>➢ Gymnastics<br>➢ Acrobatics Workouts with own weight<br>➢ Active games |

**Table 2.** *Basic physical fitness pre- versus post-experimental test data of the 7-8 year-old sample*

| Basic physical fitness tests | | Pre-exp., X ± σ | Post-exp., X ± σ | ± Δ | Δ % | p |
|---|---|---|---|---|---|---|
| *Strength* | | | | | | |
| Prone push-ups, reps | RG | 11,2±2,9 | 13,4±2,7 | 2,2 | 19,6 | < 0,05 |
| | EG | 11,4±3,1 | 17,3±2,9 | 5,9 | 51,8 | < 0,05 |
| Prone pull-ups on the 90cm-high bar, reps | RG | 11,6±3,5 | 12,8±2,8 | 1,2 | 10,3 | > 0,05 |
| | EG | 12,3 ± 2,9 | 15,2 ± 2,1 | 2,9 | 23,6 | < 0,05 |
| 1-min sit-ups, reps | RG | 23,3 ± 4,5 | 26,2 ± 4,2 | 2,9 | 12,4 | > 0,05 |
| | EG | 24,5 ± 4,1 | 34,6 ± 4,3 | 10,1 | 41,2 | < 0,05 |
| *Speed* | | | | | | |
| 30m sprint test, s | RG | 6,7 ± 0,6 | 6,4 ± 0,5 | 0,3 | 4,5 | < 0,05 |
| | EG | 7,2 ± 0,7 | 6,1 ± 0,4 | 1,1 | 15,3 | < 0,05 |
| *Speed-strength* | | | | | | |
| Standing long jump, cm | RG | 125,7 ± 4,7 | 132,9 ± 4,8 | 7,2 | 5,7 | > 0,05 |
| | EG | 123,3 ± 4,3 | 141,9 ± 4,4 | 18,6 | 15,1 | < 0,05 |
| *Endurance* | | | | | | |
| 1000m cross-country race, time | RG | 6,31 ± 0,39 | 6,18 ± 0,33 | 0,13 | 2,1 | > 0,05 |
| | EG | 6,36 ± 0,28 | 5,33 ± 0,31 | 1,06 | 16,7 | < 0,05 |
| *Coordination* | | | | | | |
| 3x10m shuttle sprint, s | RG | 10,1 ± 0,5 | 9,7 ± 0,6 | 0,4 | 4 | > 0,05 |
| | EG | 10,2 ± 0,4 | 9,3 ± 0,5 | 0,9 | 8,8 | < 0,05 |
| *Flexibility* | | | | | | |
| Bench standing lean test, cm | RG | 2,6 ± 0,7 | 4,2 ± 0,9 | 1,6 | 61,5 | < 0,05 |
| | EG | 2,3 ± 0,6 | 7,1 ± 0,7 | 4,8 | 208,7 | < 0,05 |

with 8, 5 and 2 boys in the EG versus 2, 4 and 9 boys in the RG winning the GTP Gold, Silver and Bronze badges, respectively.

**Conclusion.** The new body conditioning model for the 7-8 year-old beginner judo groups was tested beneficial due to the following elements: (1) special training methods; 2) sports elements with specific training task goals; (3) training service design and management provisions; (4) customized body conditioning service formats, times and intensities; (5) individualized training service elements; (6) basic physical fitness progress tests to help customize the training service; and (7) pre- versus post-experimental basic physical fitness tests. The latter showed significant progress in the EG versus RG in every basic physical fitness test, that is indicative of the new body conditioning model being beneficial.

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# Postural control training model for elite judokas: tests and analysis

UDC 796.01:61/796.8

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**Abstract**

**Objective of the study** was to analyze benefits of the special postural control training model of our design for elite judokas.

**Methods and structure of the study.** The new postural control training model testing experiment was run at "Snezhinka" Federal Winter Sports Training Center under control of the Tchaikovsky State Institute of Physical Culture team. We sampled for the study the 17-19 year-old judokas qualified Candidate Masters of Sports and Masters of Sports (CMS, MS) and split them up into Reference and Experimental Group (RG, EG) of 14 people each. Their postural control skills were tested by Stabilan-01-02 Computerized Test System with a balance plate and biofeedback capacity to read the body mass center fluctuations across the ground support spot to produce the high-precision static/ dynamic body balancing patterns with the total body mass center travel zone; front/ back/ right/ left deviations; postural control function quality; and fast redirection ratio. The stabilometric tests were dominated by the quiescent-state ones.

In the postural control training model testing experiment, both groups trained for 90 minutes five times a week for three months. The EG training was complemented by the postural-control-building exercises including Tetris, Rectis, Alpine Skiing and Arkanoid with a special emphasis on the top-amplitude sagittal and frontal body mass center movement balancing elements. The postural control progress was rated by the 40-minute Stabilan CTS tests three times a week. The total group progresses were rated by the post-experimental tests.

**Results and conclusion.** The new postural control training model testing experiment showed the elite judokas (CMS, MS) in the EG making faster progress than the RG in every postural control aspect test. The Stabilan CTS tests and analyses were found beneficial for the individual progress rating and training system customizing aspects to facilitate the technical and competitive progress of elite judokas.

***Keywords:*** *judo, postural control, skill level, stabilometry.*

**Background.** Since the modern best athletic training methods with their theoretical and practical provisions and cutting-edge technologies and tools are increasingly accessible for the sports communities the world over, no wonder that many elite athletes are virtually the same in every physical and technical aspect, with such parity heavily restraining their fighting activity. Of special importance in this context are the technical mastery test and analyses making it possible to rate and fully mobilize the individual physical and functional resources in an energy-efficient manner [8, 9]. Postural control in judo is ranked high among the progress-facilitating qualities testable by the ground contact spot variations, body mass center movement across the ground contact spot, shoulder axis travel versus the ground contact, body mass center fluctuations on the move, muscle sensitivity, vestibular function etc. [6].

We would prioritize the following factors of influence on technical progress in judo: postural control, feel of the laws of motion, moments of force, force jointing and coupling logics, impulse of force, individual flexibility, gravity, etc., with the postural control skills ranked among the key ones. Postural control may be defined as the body balancing (equilibrium) skills/ qualities testable in opposition to external off-

**Table 1.** *Judo elite's' pre- versus post-experimental postural control test data,*

| Tests | | Pre-experimental | Post-experimental |
|---|---|---|---|
| Front deviation, mm | RG | 61,3 ±10,0 | 63,2 ± 9,8 |
| | EG | 53,4 ± 8,3 | 58,3 ± 8,1*** |
| Back deviation, mm | RG | 64,1 ± 6,4 | 65,8 ± 6,1 |
| | EG | 67,1 ± 6,8 | 72,2 ± 6,8* |
| Right deviation, mm | RG | 97,8 ± 10,5 | 99,6 ± 10,0 |
| | EG | 80,9 ± 12,4 | 85,5 ± 12,1*** |
| Left deviation, mm | RG | 89,2 ± 10,5 | 91,8 ± 10,0 |
| | EG | 90,8 ± 7,8 | 96,4 ± 7,8*** |
| Body mass center travel zone, $mm^2$ | RG | 12167,1 ±1473,6 | 12860,9 ± 1499,7 |
| | EG | 11438,9 ± 2220,4 | 13059,7 ± 2354,4*** |
| Postural control function quality, % | RG | 29,4 ± 2,1 | 29,4 ± 2,1 |
| | EG | 27,9 ± 1,5 | 28,4 ± 1,5** |
| FRDR,% | RG | 7,0± 0,4 | 6,9 ± 0,5 |
| | EG | 8,5± 0,6 | 7,7 ± 0,6* |

*Note: FRDR - fast redirection ratio; *p<0.05; ** p<0.05 for intergroup difference*

balancing stressors [1, 2]. Our analysis of the relevant study reports shows that the judo sport communities give a growing priority to the body balancing/ postural control qualities and skills in the technical training systems as they are known to heavily contribute to the individual competitive fitness [1, 6].

**Objective of the study** was to analyze benefits of the special postural control training model of our design for elite judokas.

**Methods and structure of the study.** The new postural control training model testing experiment was run at "Snezhinka" Federal Winter Sports Training Center under control of the Tchaikovsky State Institute of Physical Culture team. We sampled for the study the 17-19 year-old judokas qualified Candidate Masters of Sports and Masters of Sports (CMS, MS) and split them up into RG and EG of 14 people each. Their postural control skills were tested by Stabilan-01-02 Computerized Test System with a balance plate and biofeedback capacity to read the body mass center fluctuations across the ground support spot to produce the high-precision static/ dynamic body balancing patterns [3-5, 7] with the total body mass center travel zone; front/ back/ right/ left deviations; postural control function quality; and fast redirection ratio (FRDR). The stabilometric tests were dominated by the quiescent-state ones.

In the postural control training model testing experiment, both groups trained for 90 minutes five times a week for three months. The EG training was complemented by the postural-control-building exercises including Tetris, Rectis, Alpine Skiing and Arkanoid with a special emphasis on the top-amplitude sagittal and frontal body mass center movement balancing elements. The postural control progress was rated by the 40-minute Stabilan CTS tests three times a week. The total group progresses were rated by the post-experimental tests.

**Results and discussion.** Given in Table hereunder are the pre- versus post-experimental postural control test data.

The stabilometric test data analysis helped profile the individual postural control progress in the sample, with a special attention to the vestibular function ratings. This function is known to facilitate many vital functions including the muscle tone regulatory one. Thus the EG was tested with the average progress in multidirectional deviations and body mass center travel square by 4.4 mm and 1621 mm2, respectively, versus 2 mm and 694 mm2 in the RG. This progress is indicative of improvements in the body balancing, spatial orientation and dynamic movement control under pressure.

The postural control function tests rate the dynamic components of the individual vertical postural control skills i.e. the spatial orientation aspect. The EG was tested with 0.5% average progress in the postural control function test – versus no progress in the RG. It should be noted that this test profiles to a degree the individual energy efficiency indicative of the psychophysiological functionality on the whole.

The fast redirection ratio (FRDR) is indicative of the individual fluctuations in technical execution i.e. energy resource management efficiency, with multiple fluctuations interpreted as the performance being energy-inefficient. The EG and RG were tested with 1%

and no progress in the FRDR tests, respectively – that may be interpreted as the better energy efficiency and fatigue tolerance in the EG developed by the experimental training.

The intergroup test data differences were significant ($p < 0.05$), with the EG tested better than RG in every postural control test. Therefore, we have grounds to state that the new postural control training model is beneficial and may be recommended for technical trainings of judo elite. The postural control model secures good progress in the technical execution fluency, speed and quality and, hence, may be beneficial for competitive progress.

**Conclusion.** The new postural control training model testing experiment showed the elite judokas (CMS, MS) in the EG making faster progress than the RG in every postural control aspect test. The Stabilan CTS tests and analyses were found beneficial for the individual progress rating and training system customizing aspects to facilitate the technical and competitive progress of elite judokas.

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# Technical errors in elite ski jumping: classification attempt

UDC 796.925

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**Abstract**

**Objective of the study** was to analyze and classify technical execution errors in the modern elite ski jumping sport.

**Methods and structure of the study.** We have collected, for three competitive seasons, the formal training logs and competitive records of the World Ski Jumping Cup events to mine detailed data on the in-run speed, jump distance and technical execution errors. On the whole we have analyzed 863 jumps on different ramps for the three seasons, both in the winter and summer events (on artificial hills). The ski jumping data were produced by the relevant metering tools including speed sensors, video captures, Dartfish statistical processing system, and expert valuations.

**Results and conclusion.** We found none elite ski jumper immune to the jump phase execution errors in fact, with the in-run and landing phases by far leading in the numbers of errors.

We found no significant differences of the national elites in the in-run and take-off errors, with the latter clearly dominating in the error statistics.

Modern elite ski jumpers have developed multiple errors-correcting tools and skills – that may be trained by a range of special technical execution adjustment exercises. The error-correction skills will be mastered with due sensitivity to the technical error origin. The origin is often found in the poorly designed training systems.

Technical and distance scores in the modern elite ski jumping sport are highly sensitive to the technical errors in every jump phase. We found the Russian team's errors dominated by the cyclic (rollover) errors that snowball in the later jump phases. Efforts to eliminate such errors as early as possible will help seriously scale down the subsequent error rates and improve the techniques on the whole with the obvious benefits for the technical and distance scores.

***Keywords:*** *technique, ski jumping, phase structure, cyclic errors.*

**Background.** Modern ski jumping sport is a technically difficult sport discipline that requires high-precision execution of every element in the relatively standard settings including the ground and aerial/air flow control phases. Presently the ski jumping sports elite gives a special priority to the take-off/ jump element [1, 4] deemed critical for the distance score. We believe, however, that the excessive focus on a single element appears too simplistic as it limits the causes and effects of the complex system exposed to multiple factors of influence [2, 4, 6].

When a goal of every elementary action in some movement phase is attained in a harmonic manner, it guarantees a favorable setting for success of the next phase, albeit a single minor error may snowball in the subsequent phases [2]. This may be the key reason for the above excessive concentration on the take-off phase – since the skier immediately after enters the aerial phase with the posture set as close to the optimal as possible. No wonder that every minor take-off error may complicate the efforts to take the kinematically optimal aerial position and compromise execution of the next movement phases. Such errors are commonly referred to as the cyclic or rollover errors. An

error-free execution of every element in a harmonized sequence is deemed most beneficial for success, although almost never achievable in real practice, since any mechanical system of that kind is always exposed to multiple external factors of influence [6, 8]. The most beneficial option in this case is to learn to correct the cyclic errors in the bud to prevent their rollover to the next phases. As mentioned above, no one is immune to technical errors although every skilled ski jumper has to master the cyclic errors control/ mitigation techniques. This is the key reason why we see the ski jumping sport leaders now and then getting "out of the woods", even when the jump goes wrong in the early stage.

**Objective of the study** was to analyze and classify technical execution errors in the modern elite ski jumping sport.

**Methods and structure of the study.** We have collected, for three competitive seasons, the formal training logs and competitive records of the World Ski Jumping Cup events to mine detailed data on the in-run speed, jump distance and technical execution errors. On the whole we have analyzed 863 jumps on different ramps for the three seasons, both in the winter and summer events (on artificial hills). The ski jumping data were produced by the relevant metering tools including speed sensors, video captures, Dartfish statistical processing system, and expert valuations.

**Results and discussion.** We found none elite ski jumper immune to the jump phase execution errors in fact, with the in-run and landing phases by far leading in the numbers of errors: see Table 1 hereunder.

We found no significant differences of the national elites in the in-run and take-off errors, with the latter clearly dominating in the error statistics. Since the setting phase, the Russian ski jumping team is significantly different in the error rates from the other competitors: see Figure 1. Knowing that the jump scores are closely and negatively correlated with the error rates, we recommend special efforts being taken to control and mitigate the technical / cyclic errors otherwise there are no chances for success in the top-ranking international competitions.

Of special interest, as we believe, is the following consideration: the later is the error moment from the jump start, the higher is the error contribution to the jump score (mostly to the distance score), all other things being equal. For example, an in-run error may be corrected in the next phase, although a flight control error may virtually never be offset. Special efforts need to be taken in this context to scale down the most critical cyclic errors in the flight phase.

Cyclic errors made by the Russian ski jumping elite deserve special attention. These are the early-phase

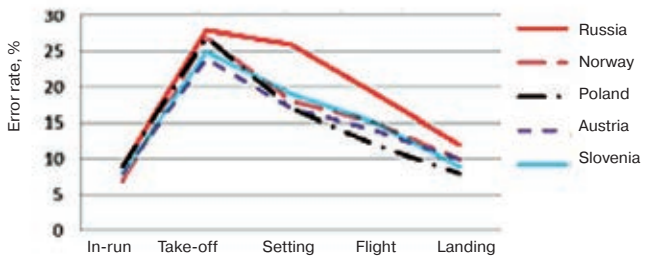


**Figure 1.** *Average technical errors classified by the jump phases and competing nations*

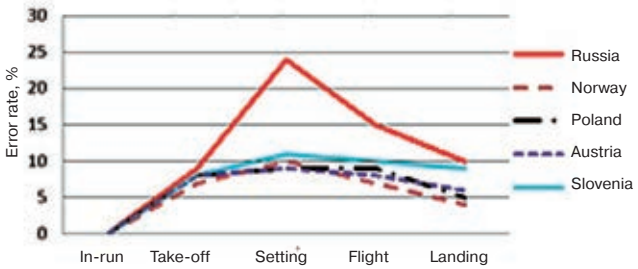


**Figure 2.** *Average cyclic errors classified by the jump phases and competing nations*

**Table 1**. *Average technical and cyclic execution errors in the summer Grand Prix events of the World Ski Jumping Cup, %*

| Jump phase | Technical (cyclic) errors rates, % | | | | |
|---|---|---|---|---|---|
| | Russia | Norway | Poland | Austria | Slovenia |
| In-run | 9 | 7 | 9 | 8 | 8 |
| Take-off | 28 (9) | 27 (7) | 27 (8) | 24 (8) | 25 (8) |
| Setting-for-flight | 26 (24) | 18 (10) | 17 (9) | 17 (9) | 19 (11) |
| Flight | 19 (15) | 15 (7) | 12 (9) | 14 (8) | 15 (10) |
| Landing | 12 (10) | 10 (4) | 8 (5) | 10 (6) | 9 (9) |

Note: *cyclic errors rates in brackets*

errors that snowball in the following phases: see Figure 2. It should be emphasized that the Russian elite makes largely the same cyclic errors in the take-off phase as the others, but virtually unsuccessful in the attempts to correct them, and let them roll over to the next phases. Polish and Austrian competitors, for instance, are much more successful in correcting the take-off errors later on. The take-off errors in the other teams were found fast offset in the setting phase – in contrast to the Russian team that is too tolerant and exposed, as we feel, to the cyclic errors.

Note that the Russian team leads in the cyclic errors as provided by the above Table in brackets. Moreover, 93% of the in-run errors in the team were tested to roll over to the take-off phase – versus only 46% and 44% (!) in the Austrian and Polish teams, respectively.

If we now compare Figures 1 and 2, it turns obvious that the Russian team's errors since the setting-for-flight phase are rooted in the earlier phases as the cyclic errors. This means that they should be scaled down as a matter of top priority to drastically improve the ski jumping technique and distance score. Typical setting execution errors include: short or excessive transverse twist; no synch in the skies setting for the flight; body mass center falling backwards; too aggressive ski attack angle; too early V-shaping of the skies; failures in keeping the right/ left feet horizontal; excessive setting (aerodynamic pose taking) time, etc. As a result, the jumper loses horizontal speed and fails to develop good lifting force – and no wonder that the setting execution errors seriously reduce the total score.

Modern elite ski jumpers have developed multiple errors-correcting tools and skills – that may be trained by a range of special technical execution adjustment exercises – including, e.g., stepped-difficulty, surprise/ novelty, re-sequencing and other practices. The error-correction skills will be mastered with due sensitivity to the technical error origin. The origin is often found in the poorly designed training systems. As a result, the athlete gets used to the specific kinematic cycle (movement sequence) with the relevant error-fixing muscular sensations, being confident that the movement is perfect. We found the present ski jumping sport leaders virtually immune to such growth errors – in contrast to the Russian elite. Therefore, we underline the need for the further trainings to be designed and updated with a top priority to the technical errors correction elements and skills to prevent them evolving into the cyclic errors.

We have omitted herein a range of random errors due to external/ unpredictable factors as they are less controllable – in contrast to the "standard" common technical errors that need to be rooted out as early as possible in the trainings to prevent their evolution into the cyclic errors detrimental to competitive progress.

**Conclusion.** Technical and distance scores in the modern elite ski jumping sport are highly sensitive to the technical errors in every jump phase. We found the Russian team's errors dominated by the cyclic (rollover) errors that snowball in the later jump phases. Efforts to eliminate such errors as early as possible will help seriously scale down the subsequent error rates and improve the techniques on the whole with the obvious benefits for the technical and distance scores.

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https://en.wikipedia.org/wiki/Ski_jumping#Techniques

Each jump is divided into four parts: in-run, take-off (jump), flight, and landing.

By using the V-style, firstly pioneered by Swedish ski jumper Jan Boklöv in the mid-1980s,[12] modern skiers are able to exceed the distance of the take-off hill by about 10% compared to the previous technique with parallel skis.[citation needed] Previous techniques included the Kongsberger technique, the Däescher technique and the Windisch technique.[12] Until the mid-1960s, the ski jumper came down the in-run of the hill with both arms pointing forwards. This changed when the Däscher technique was pioneered by Andreas Däscher in the 1950s, as a modification of the Kongsberger and Windisch techniques. A lesser-used technique as of 2017 is the H-style which is essentially a combination of the parallel and V-styles, in which the skis are spread very wide apart and held parallel in an “H” shape. It is prominently used by Domen Prevc.

Skiers are required to touch the ground in the Telemark landing style (Norwegian: telemarksnedslag), named after the Norwegian county of Telemark. This involves the landing with one foot in front of the other with knees slightly bent, mimicking the style of Telemark skiing. Failure to execute a Telemark landing leads to the deduction of style points, issued by the judges

# Level of physical activity and sedentary lifestyle of children and young people aged 7-18 as a social problem of the 21st century

UDC 796.01;316

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**Abstract**

**Objective of this paper** was to determine the level of physical activity of children and young people based on the MVPA index, number of steps, as well as sedentary time to analyze the young people's lifestyles and make them aware of whether the level of physical activity is sufficient, or whether action should be taken in order to make children and young people more active in this respect.

**Study methods and structure.** A diagnostic test of physical activity of pupils and students aged 7-18 was conducted in the School Complex in Zarzecze (Podkarpackie Province, southern Poland) in 2018, from April to June 2018, with the written consent of the parents and the children themselves. 108 pupils and students (49 girls and 59 boys) took part in the study. Regular school attendance, teaching results, observations, interviews and teachers' opinions were taken into account as a basis for setting up the group. The criterion for a pupil or a student to be included in the project was regular attendance at all classes during the week. Within the framework of the study, anthropometric measurements were made, which took place between 8:00 and 10:00 am. The ActiGraph WGT3X-BT accelerometer (Pensacola, USA), which is a 3-axis accelerometer, was used in this study. Nowadays, these accelerometers are used for the purpose of conducing analyses of physical activity levels. The study subjects were instructed to wear the accelerometer for seven subsequent days, 24 hours a day. They were also informed that they must not use the accelerometers for spraying or water-related activities, as it must not come into contact with moisture. The ActiGraph data was analyzed using Actilife 6.0 software. In addition, the values of weight and height were measured and the Body Mass Index (BMI) was calculated by squaring the body size (kg / m2) BMI (kg/m2). The following parameters were analyzed: BMI, Sedentary, MVPA (Moderate-to-Vigorous Physical Activity) and number of steps.

**Results and Conclusions.** For many generations, there have been changes in the course of the population's somatic development and these changes have been steadily speeding up. They are called 'secular trends'. One of their signs is the acceleration of biological development and adolescence period. These changes are primarily related to the constantly improving social and economic situation and the improvement of the population's standard of living. These factors are, among others: change of eating habits, an improvement in environmental conditions, an increase in the level of education and better quality of health care. Monitoring the physical activity of children and young people is the main indicator of health sustainability. Basic physical activity calculated by means of simple indicators in representative samples of children and young people should be the basis for health analysis. The relationship between physical activity and a sedentary lifestyle seems to be insufficiently researched, which is particularly unfavourable, among others, due to the significant increase in the number of young people with obesity. The analysis of the number of steps provides an objective assessment of the current state of physical activity of children and young people and is the basis for promoting daily physical activity among young people.

***Keywords:*** *physical activity, accelerometery, children, young people, sedentary lifestyle.*

**Introduction.** An important part of the people's lifestyle is regular physical activity. A wide number of epidemiological studies have confirmed that regular physical activity has a positive impact on reducing mortality and incidence of various diseases [5,6,16]. Participating in physical activity is the basis for maintaining health of children and young people who are at a critical stage of their physical and mental development [29].

According to the World Health Organisation (WHO) documentation, with regard to children and young people aged 5-17, it is recommended to take up at

least 60 minutes of daily Moderate-to-Vigorous Physical Activity (MVPA) for the purpose of meeting basic development and health needs [12, 13, 29].

Taking all levels of physical activity intensity into consideration, MVPA has been best studied and, on the basis of these studies, MVPA is considered to be essential for health promotion and disease prevention [19]. The analyses conducted suggest that 4/5 of the world's population of young people does not reach the MVPA [10] level recommended by WHO. The reason is that many children spend most of their time in a sitting position [8] and that this time has been longer for the past 10 years [21].

Monitoring physical activity by means of an accelerometer provides a reasonable compromise between accuracy and feasibility and increases the reliability of the daily MVPA level [11, 25]. As a result, the use of accelerometers has become a reliable and correct method for the purpose of estimating children's physical activity [15, 18].

**Objective of this paper** was to determine the level of physical activity of children and young people based on the MVPA index, number of steps, as well as sedentary time. This is aimed at analysing the young people's lifestyles and make them aware of whether the level of physical activity is sufficient, or whether action should be taken in order to make children and young people more active in this respect.

**Study methods and structure**. A diagnostic test of physical activity of pupils and students aged 7-18 was conducted in the School Complex in Zarzecze (Podkarpackie Province, southern Poland) in 2018, from April to June 2018, upon receipt of the written consent of the parents and the children themselves. 108 pupils and students (49 girls and 59 boys) took part in the study. Regular school attendance, teaching results, observations, interviews and teachers' opinions were taken into account as a basis for setting up the group. The criterion for a pupil or a student to be included in the project was regular attendance at all classes during the week. Within the framework of the study, anthropometric measurements were made, which took place between 8:00 and 10:00 am. The ActiGraph WGT3X-BT accelerometer (Pensacola, USA), which is a 3-axis accelerometer, was used in this study. Nowadays, these accelerometers are used for the purpose of conducing analyses of physical activity levels [14]. In order for a given day of research to be included in the statistics, the accelerometer wearing time is assumed to be ≥ 500 minutes/day and ≥ 4 days as criteria for a valid 7-day data collection period [24]. According to the WHO guidelines, 60 minutes of MVPA per day [29] is a minimum.

The study subjects were instructed to wear the accelerometer for seven subsequent days, 24 hours a day. They were also informed that they must not use the accelerometers for spraying or water-related activities, as it must not come into contact with moisture. The ActiGraph data was analysed using Actilife 6.0 software (ActiGraph LLC, Pensacola, FL, USA). In addition, values of weight and height were measured and the Body Mass Index (BMI) was calculated by squaring the body size (kg / m2) BMI (kg/m2).

The following parameters were analysed: BMI, Sedentary, MVPA (Moderate-to-Vigorous Physical Activity) and number of steps.

**Results and discussion.** In table no 1, BMI is divided into four age groups. The average BMI value of the sample group was 20.45 (minimum: 13.8 – maximum: 30.7), which is a very good result in each age group. In comparison with the Raustorp study [20], the average BMI value was 16.10-20.00 (group aged 8-14). In Russia, the average BMI value of two sample groups (sports and non-sports aged 6-10) was between 14.9-17.6 [1]. With regard to young people (15-18 years old), the average BMI value was 20.52-21.92 [9].

In table no 2, the sedentary index indicating the time spent in lying, sitting or standing position - without body activity - was presented, which was 1167.4 minutes per day on average (minimum: 951.3 – maximum: 1335.1). From the aforementioned result obtained, about 8 hours of sleep (1167-480=687 minutes) should be subtracted, which means that the sample

**Table 1.** *BMI divided into four age groups.*

| age | average | standard deviation | minimum | maximum | median | coefficient of variation |
|---|---|---|---|---|---|---|
| 7 – 9 | 19.97 | 3.40 | 15.00 | 28.30 | 19.80 | 17.0 |
| 10 – 12 | 20.01 | 4.53 | 13.80 | 29.10 | 19.65 | 22.7 |
| 13 – 15 | 21.33 | 3.92 | 15.60 | 30.70 | 21.80 | 18.4 |
| 16 - 18 | 21.03 | 2.94 | 16.70 | 27.20 | 20.90 | 14.0 |
| Total | 20.45 | 3.87 | 13.80 | 30.70 | 20.05 | 18.9 |

*Source: Based on author's own research.*

**Table 2.** *Sedentary index divided into four age groups*

| age | average | standard deviation | minimum | maximum | median | coefficient of variation |
|---|---|---|---|---|---|---|
| 7 – 9 | 1142.88 | 87.05 | 971.38 | 1335.12 | 1128.75 | 7.6 |
| 10 – 12 | 1135.09 | 65.22 | 951.29 | 1224.02 | 1145.46 | 5.7 |
| 13 – 15 | 1230.69 | 56.88 | 1088.95 | 1328.95 | 1237.19 | 4.6 |
| 16 - 18 | 1185.10 | 60.09 | 1099.45 | 1308.33 | 1171.69 | 5.1 |
| Total | 1167.46 | 80.08 | 951.29 | 1335.12 | 1170.86 | 6.9 |

*Source: Based on author's own research.*

**Table 3.** *Total MVPA index divided into four age groups.*

| age | average | standard deviation | minimum | maximum | median | coefficient of variation |
|---|---|---|---|---|---|---|
| 7 – 9 | 56.42 | 21.41 | 18.98 | 113.10 | 53.64 | 37.9 |
| 10 – 12 | 55.36 | 16.74 | 20.36 | 92.98 | 54.77 | 30.2 |
| 13 – 15 | 46.54 | 19.30 | 20.67 | 96.50 | 44.10 | 41.5 |
| 16 - 18 | 82.28 | 30.25 | 22.24 | 133.64 | 81.74 | 36.8 |
| Total | 56.73 | 22.96 | 18.98 | 133.64 | 53.69 | 40.5 |

*Source: Based on author's own research.*

**Table 4.** *Number of steps divided into four age groups.*

| age | average | standard deviation | minimum | maximum | median | coefficient of variation |
|---|---|---|---|---|---|---|
| 7 – 9 | 7796.33 | 2758.21 | 2630.29 | 13800.00 | 7645.29 | 35.4 |
| 10 – 12 | 8564.96 | 1844.40 | 5814.29 | 11955.71 | 8275.64 | 21.5 |
| 13 – 15 | 6986.14 | 2213.80 | 3577.14 | 12393.00 | 6929.29 | 31.7 |
| 16 - 18 | 12046.76 | 3600.18 | 4770.57 | 19132.43 | 11594.29 | 29.9 |
| Total | 8347.38 | 2877.80 | 2630.29 | 19132.43 | 8061.86 | 34.5 |

*Source: Based on author's own research.*

group spent only 273 minutes on average during a day on being active (walking, running, doing exercises). It should be mentioned that this index is increasingly being analysed in various studies on the whole world. In Aggio and research collaborators study [2], sedentary time of children and young people (group aged 5-15) was 354 minutes. In the subsequent studies (group aged 8-15) this time was 471-559 minutes per day [3]. In turn, according to the studies carried out in Germany (group aged 9-14), the average sedentary time was 561 minutes. [23]. According to Pfeifer and Rütten [17], maximum 2 hours of sedentary time for children and young people aged 6 - 18 are recommended. However, it should be mentioned that sedentary lifestyle becomes intensified at the time of puberty. Therefore, this is the period during which we need to pay particular attention to make young people more active. Minimising sedentary lifestyle is of key importance in preventive health strategies aimed at dealing with obesity and chronic diseases in children and young people.

Table no 3 presents one of the most important MVPA indices. The average value is 56.7 minutes (minimum: 19 – maximum: 133.6). This value corresponds to the WHO recommendation, that is at least 60 minutes of physical activity a day. The lowest MVPA average is at the age of 13-15 years (46.5 minutes), while the highest at 16-18 years (82.3 minutes). In Baskin and research collaborators studies [4], the sample group (aged 12-16) had an MVPA index of 40.4 minutes. On the other hand, in Aggio and research collaborators studies [2], the average MVPA index was 33 minutes. In a large-scale study conducted in 2017 (N=4123 study subjects aged 5-17 years), the average MVPA time was 53.5 minutes [22].

In relation to children and young people, Moderate-to-Vigorous Physical Activity (MVPA) has a positive impact on their physical and mental health in the short and long term [7, 13], so the analyses carried out are especially important for analysing physical inactivity.

In table 4, the number of steps were indicated. The average value in this table is 8347 steps (minimum: 2630 – maximum: 19132). The analysis carried out by Vincent and Pangrazi [28] was one of the first studies assessing a large group of pupils aged 6-12 (N = 711). As a basis for physical activity, the authors suggested

at least 11 000 steps for girls and 12 000 steps for boys. On the other hand, Tudor-Locke and research collaborators [27], suggested at least 12 000 steps for children aged 6-11 for girls and 15 000 steps for boys and for young people aged 12-19: 10 000– 11700 steps / day [26]. By comparison, the studies conducted by Tudor - Locke [25] indicated that children and young people made 9000 steps on average.

**Conclusions**. For many generations, there have been changes in the course of the population's somatic development and these changes have been steadily speeding up. They are called 'secular trends'. One of their signs is the acceleration of biological development and adolescence period. These changes are primarily related to the constantly improving social and economic situation and the improvement of the population's standard of living. These factors are, among others: change of eating habits, an improvement in environmental conditions, an increase in the level of education and better quality of health care. Monitoring the physical activity of children and young people is the main indicator of health sustainability. Basic physical activity calculated by means of simple indicators in representative samples of children and young people should be the basis for health analysis. The relationship between physical activity and a sedentary lifestyle seems to be insufficiently researched, which is particularly unfavourable, among others, due to the significant increase in the number of young people with obesity. The analysis of the number of steps provides an objective assessment of the current state of physical activity of children and young people and is the basis for promoting daily physical activity among young people.

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# Negative mindsets in sports: neurosensory correction method

UDC 159.9.072.53: 159.913

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**Abstract**

**Objective of the study** was to test benefits of a negative mindsets correction method to control the sports-specific regressive psychoemotional experiences and conditions.

**Methods and structure of the study.** The study was run at the Saint-Petersburg Research institute for Physical Culture's Sports Physiology Department. We sampled for the study the 28±5 year-old elite athletes (n=10, Masters of Sport and World Class Masters of Sports, 4 males and 6 females) diagnosed with 'unstable psycho-emotional health issues' detrimental to their competitive progress in spite of hard trainings and progress-verifying tests. The method was used to cure/mitigate the sports-related mental traumas (n=6) and high anxiety and emotional instability (n=4), on an informed written consent of the subjects. Individual progress was rated in the experiment on a 10-point scale with 1 point meaning no complaints; and 10 points high pains, anxiety, fears, apathy, etc., complemented by the galvanic skin response tests. Every negative mindset correction session took 40-90 minutes.

**Results and conclusion.** The new negative mindset correction method was tested to successfully desensitize the traumatizing experiences and reduce the related reported psychoemotional discomfort by 78% on average. Since the method is fairly simple, accessible and proved beneficial, we have good grounds to recommend it for application in the individual and team sports for psychoemotional issues correction purposes, particularly in cases of traumatizing experiences (including losses). The group negative mindset correction service to activate the "mechanism of mirror neurons" with the associating growths of empathy – was tested to effectively cure or mitigate a variety of mental issues triggered by the traumatizing experiences to develop fair psychoemotional control and teamwork skills.

***Keywords:*** *express method, psychoemotional control, bilateral stimulation, galvanic skin response, negative mindsets.*

**Background.** Modern sports expose athletes to many traumatizing situations, with such hurting experiences giving rise to negative mindsets with fears of strong rivalry, injuries, etc.) that may seriously hamper progress in the individual and team sports. The negative mindsets imply a range of traumatizing emotions with avoidance of traumatic reminders, growing anxiety, emotional failures and negative expectations which manifest themselves automatically when the similar situation occurs [3]. The traumatizing memories include multisensory images, negative sentiments and experiences with the associating unhealthy physical conditions that tend to evolve into destructive behavior in everyday life. Health services geared to mitigate the traumatizing experiences are normally designed to: identify the negative emotions and mindsets triggered by the traumatizing events; and offer a mental control method to correct the mindset and mobilize healthy individual resource for recovery [1, 2, 4, 5].

**Objective of the study** was to test benefits of a negative mindsets correction method to control the sports-specific regressive psychoemotional experiences and conditions.

**Methods and structure of the study.** The study was run at the Saint-Petersburg Research institute for Physical Culture's Sports Physiology Department. We sampled for the study the 28±5-year-old elite athletes

(n=10, Masters of Sport and World Class Masters of Sports, 4 males and 6 females) diagnosed with 'unstable psycho-emotional health issues' detrimental to their competitive progress in spite of hard trainings and progress-verifying tests. The method was used to cure/ mitigate the sports-related mental traumas (n=6) and high anxiety and emotional instability (n=4), on an informed written consent of the subjects. Individual progress was rated in the experiment on a 10-point scale with 1 point meaning no complaints; and 10 points high pains, anxiety, fears, apathy, etc., complemented by the galvanic skin response tests. Every negative mindset correction session took 40-90 minutes.

**Results and discussion.** The Table hereunder gives the individual progress test data in the negative mindsets therapy course indicative of the group progress averaging 78%.

**Table 1.** *Pre- versus post experimental negative mindset test rates: discomfort on a 10-point scale (1- no discomfort, 10 – high discomfort)*

| Respondents | Pre-exp. | Post-exp. | Progress (%) |
|---|---|---|---|
| A | 10 | 2 | 80 |
| L | 9 | 3 | 67 |
| K | 9 | 2 | 78 |
| B | 8 | 2 | 75 |
| J | 7 | 1 | 86 |
| V | 10 | 3 | 70 |
| M | 8 | 1 | 88 |
| T | 8 | 2 | 75 |
| E | 9 | 2 | 78 |
| G | 7 | 1 | 86 |
| Average | 8,5 | 1,9 | 78 |

Given hereunder are the more detailed individual progress records of two subjects to demonstrate benefits of the negative mindset correction therapy.

The galvanic skin response variation curve (Fig. 1) shows a 230 kOhm peak attained for 6 min indicative of the full relaxation (AB interval) followed by stabilization around the 3-min point (BC interval). The trigger words related to traumatizing situation were responded with phased varied-intensity reactions to every stimulus i.e. varied-severity emotional responses (CD interval). The tonic component showed the resistance falling for about 9 minutes indicative of activation and general emotional sensitivity to the pool of negative stimuli.

Then goes a tonic response stabilization interval indicative of adaptation to the negative stimuli and fitness for the next stage with constructive verbal background (words pool, interval EF) to expand the semantic field of the traumatizing situation and mobilize alternative responses to counter and undermine the dominant stereotypes. In this stage the galvanic skin response was tested to grow by 120 kOhm and stay at this level for 10 min till the end. The final psycho-emotional state was tested to come back to the initial level.

The M's individual progress record (female athlete) reports the prior precompetitive panic and high anxiety. After the first negative mindset correction session, she reported "absolute calm, empty head, pleasant relaxation all over the body; and it was a pleasure for me to dive in the training for the first time in seven years". The post-therapy report reads: "I've got euphoric feeling no more fears and no more need for sedatives; no more uncontrollable panic".

Phase response variations with the stimuli (trigger words) show the negative mindset severity falling. The pre-experimental subjective negative psychoe-

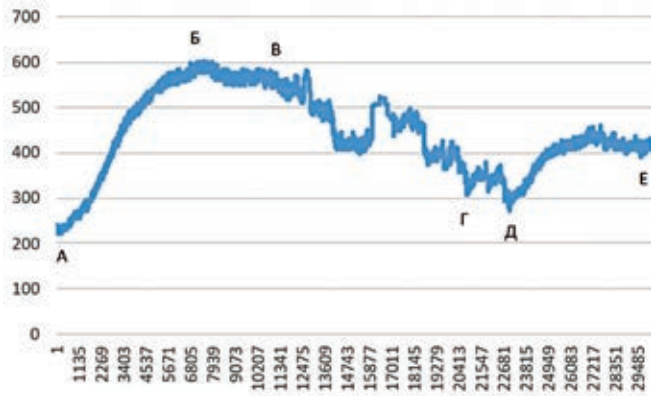


**Figure 1.** *Individual galvanic skin response test data in a negative mindset correction session*

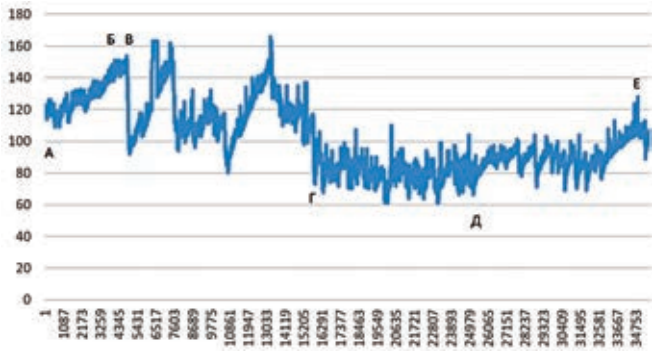


**Figure 2**. *Individual (athlete A) galvanic skin response variation in the negative mindset correction session*

motional condition rated by 9 points was tested to fall to 3 points in the post-experimental test to make the athlete fit for competitions that ended up by winning a medal.

The individual (athlete A) galvanic skin response variation in the negative mindset correction session shows a 34 kOhm growth indicative of relaxation in 4 minutes (AB interval), followed by stabilization around the 1-min point (BC interval). The curve shows responses to the trigger words related to the traumatizing situation (CD interval). The tonic component shows the resistance falling for 9 minutes – indicative of activation with the high emotional response to the negative trigger words. Then the curve shows stabilization of the tonic responses (DE interval) followed by a new pool of triggers (EF interval).

After the first sessions, athlete A reported responses to the traumatizing situation by muscle sensations and psycho-emotional feelings well known in trainings and competitions, that totally disappeared by the end of the negative mindset correction session associated with calmness and drowsiness. At the end of the course (4th session), athlete A reported the muscles being free of pains; he reported feeling healthy for the first time, calm, confident and fit for competition – that he won as a result.

The individual emotional discomfort was rated by 10 points in the pre-experimental test on a ten-point scale, versus only 2 points in the post-experimental test – and this progress helped balance the mental health, get fit for and calm in the precompetitive period and even improve the personal best. In response to the triggers, the athletes reported minor sentiments related to the traumatic experiences countered by positive emotional feeds from the past competitive successes to the upcoming events.

**Conclusion.** The new negative mindset correction method was tested to successfully desensitize the traumatizing experiences and reduce the related reported psychoemotional discomfort by 78% on average. Since the method is fairly simple, accessible and proved beneficial, we have good grounds to recommend it for application in the individual and team sports for psychoemotional issues correction purposes, particularly in cases of traumatizing experiences (including losses). The group negative mindset correction service to activate the “mechanism of mirror neurons” with the associating growth of empathy – was tested to effectively cure or mitigate a variety of mental issues triggered by the traumatizing experiences to develop fair psychoemotional control and teamwork skills.

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# Interethnic tolerance cultivation model for adolescent sports communities

UDC 37.035.6+796-053.2

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**Abstract**

**Objective of the study** was to test benefits of an interethnic tolerance building model for adolescent sports communities in the national physical education and sports sector.

**Methods and structure of the study.** Prior to the model piloting experiment, we run a Tolerance Indexing Questionnaire Survey at Sports School in Pyt-Yakh city in Yugra [2] complementary to the regular training process. We sampled for the survey the sporting adolescents (n=40) including 12 Russians, 2 Tatars; 4 Lezgins; 2 Chechens; 2 Ukrainians; 12 Kumyks; 2 Bashkirs; 2 Chuvash; and 2 Moldovans. Prior to the interethnic tolerance model piloting experiment, we analyzed the school service records and interviewed the school teachers, managers and sporting students. Based on the prior data, we split up the sample into ethnically equal Experimental and Reference Groups (EG, RG) of 20 people each including martial artists and futsal players. Both groups were trained in September 2019 to March 2020 as planned by the school management. The group training was complemented by our interethnic tolerance building model on a group-specific basis. The group interethnic tolerance models were the same in the prime mission although somewhat different in the goals and interethnic tolerance tools applied. Thus the discussion "We are children of same mother country" was designed to broaden the knowledgebase of the key issues of ethnic cultures and traditions to develop healthy moral and cultural values, mitigate aggression and scale down the potential ethnic conflicts and frictions.

**Results and conclusion.** The new interethnic tolerance building model piloted in the adolescent sports community at Pyt-Yakh Sports School in Yugra was tested beneficial as verified by the pre-versus post-experimental questionnaire surveys that found progress in the interethnic tolerance in the RG and the EG. The new set of interethnic tolerance building tools including target conversations, discussions, flash mob, quest games and interethnic tolerance trainings were of high interest for the adolescent sports community. The study found statistically significant difference of the pre- versus post-survey interethnic tolerance test data in the EG ($x2 = 9.336$, $p < 0.01$) indicative of the interethnic tolerance building model being beneficial for adolescent sports communities.

***Keywords:*** *tolerance, adolescent athletes, educational process, tolerance building measures.*

**Background.** Since the modern Russian Federation is a multinational home for about 200 ethnic groups, the federal and regional governments, including the KhMAO-Yugra regional government, have always given a special priority to interethnic respect and tolerance as a basis for the national progress and success. The growing migration statistics in the country on the whole and Yugra in particular urge the local ethnic and cultural communities to improve their social interactions, cooperation and friendship, with a high attention to the mutual tolerance.

An analysis of the tolerance building issues and experiences shows that this notion may have somewhat different meanings and interpretations in different contexts. Thus R.G. Apresyan argues that "tolerance may be defined as the social value critical for interpersonal relationship", and further details that "tolerance manifests itself in the ability to consciously suppress potential negative attitudes to other people with realizing the own stereotypes and acknowledging the other people's right for their own ones, as well as deeply respect their identity" [1].

We agree with the above with some reservations, since tolerance, as we believe, is primarily a moral quality that largely determines the individual attitudes to the other people's agendas, interests, beliefs, traditions and behavior. On a more specific basis, we share the Y.V. Filippov's (2015) concern about the still limited efforts to build interethnic tolerance in adolescent sports [3]. The available study reports give a few basic

**Table 1**. *Detailed interethnic tolerance building tools piloted at the Pyt-Yakh Sports School*

| RG | EG |
|---|---|
| Conversation 'Russia is our motherland' | Discussion 'We are children of the same mother country' |
| Lecture 'Road Safety Rules' | 'Yugra power is in ethnic unity' training |
| Meeting the local sports celebrities 'Our Champions' from Pyt-Yakh | |
| Conversation 'Rules of behavior in anti-terror operations' | Conversation 'Yugra sports celebrities of different ethnic origins' |
| Conversation 'International and interfaith cooperation: the meaning of ethnic tolerance' | 'Tolerance Planet' flash-mob with a multimedia coverage |
| Lecture 'No to unhealthy habits' | 'Unity Roads' quest game |
| Conversation 'Safe behaviors on the streets' | Visit to the Local Environmental History Museum |

recommendations on specific interethnic tolerance building methods and tools for adolescent sports, and we believe that these issues deserve more systemic and specific research.

**Objective of the study** was to test benefits of an interethnic tolerance building model for adolescent sports communities in the national physical education and sports sector.

**Methods and structure of the study.** Prior to the model piloting experiment, we run a Tolerance Indexing Questionnaire Survey at Sports School in Pyt-Yakh city in Yugra [2] complementary to the regular training process. We sampled for the survey the sporting adolescents (n=40) including 12 Russians, 2 Tatars; 4 Lezgins; 2 Chechens; 2 Ukrainians; 12 Kumyks; 2 Bashkirs; 2 Chuvash; and 2 Moldovans. Prior to the interethnic tolerance model piloting experiment, we analyzed the school service records and interviewed the school teachers, managers and sporting students. Based on the prior data, we split up the sample into ethnically equal Experimental and Reference Groups (EG, RG) of 20 people each including martial artists and futsal players. Both groups were trained in September 2019 to March 2020 as planned by the school management. The group training was complemented by our interethnic tolerance building model on a group-specific basis: see Table 1 hereunder. The group interethnic tolerance models were the same in the prime mission although somewhat different in the goals and interethnic tolerance tools applied. Thus the discussion "We are children of same mother country" was designed to broaden the knowledgebase of the key issues of ethnic cultures and traditions to develop healthy moral and cultural values, mitigate aggression and scale down the potential ethnic conflicts and frictions.

The 'Yugra power in ethnic unity' training was intended to unite the sports community and foster the team spirits and teamwork by building mutual respect and understanding. The 'Yugra sports celebrities of different ethnic origins' conversation was designed to expand the knowledge about the Yugra sports history and illustrate it by the success stories of the local sports celebrities. And the 'Unity Roads' quest game was intended to facilitate universal human values formation in the adolescent sports community, with mutual understanding and solidarity in the individual creative resource mobilizing contexts.

**Results and discussion.** The post-experimental survey tested only 2 and 1 individuals in the RG and EG (respectively) with the still intolerant attitudes to the other people; 14 and 6 individuals with moderate tolerance – that often means tolerance in some social situations and intolerance in the others; and 4 and 13 individuals in the RG and EG (respectively) were tested with a high tolerance in every situation.

**Conclusion**. The new interethnic tolerance building model piloted in the adolescent sports community at Pyt-Yakh Sports School in Yugra was tested beneficial as verified by the pre-versus post-experimental questionnaire surveys that found progresses in the interethnic tolerance in the RG and the EG. The new set of interethnic tolerance building tools including target conversations, discussions, flash mob, quest games and interethnic tolerance trainings were of high interest for the adolescent sports community. The study found statistically significant difference of the pre-versus post-survey interethnic tolerance test data in the EG ($x2 = 9.336$, $p < 0.01$) indicative of the interethnic tolerance building model being beneficial for adolescent sports communities.

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# Coach-trainee communication as a basis for adolescent deviant behavior controls

UDC 796.01:159.9

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**Abstract**

**Objective of the study** was to rate and analyze the coaches' communicative skills in the adolescent deviant behavior control context and offer the adolescent deviant behavior control recommendations for the training and competitive service.

**Methods and structure of the study.** In our analysis of the practical experiences of the coaches successful in the adolescent deviant behavior control aspects we have given a special priority to the coach-trainee communication building skills. We sampled for the study Sports School coaches (n=6) and tested them by the V.V. Boyko Empathy Test; A.V. Karpov Reflexivity Test Method and the K. Jung Personality Questionnaire.

**Results and Conclusion.** The empathy test rated two subject low (21 points) and poor (13 points); and the other four moderate (22-29 points) on the empathy scale – to conclude that most of the sample is inclined for understanding and empathy in relationship.

The reflexivity test showed the sample being able to analyze own feelings versus other people's ones.

And the Jung Personality Questionnaire rated 50% of the sample as extroverts prone to healthy leadership, easy-going in the interpersonal relations and able to persuade; 30% as Introverts and 20% as ambiverts (with extrovert and an introvert qualities) with fairly good communication skills.

Therefore, the above tests found most of the sample having the key qualities for successful communication as required by the coaching service, albeit clearly needing special psychological support and consulting service to develop good adolescent deviant behavior control skills critical for their training and competitive services.

Coaching services to the adolescent-deviant-behavior-prone teams are recommended to be designed and managed with a special attention to the personality qualities of the coach and trainees. It is very important for the coach to be sensitive to the individual progress needs, gifts and resources of young athletes to develop encouraging team climate, supportive and friendly relationships as a basis for the personality progress agendas. Such coach-trainee relationships help motivate the adolescent athletes for progress and success.

***Keywords:*** *adolescents with deviant behavior, communication, coaches, psychological support of training and competitive process.*

**Background.** Active competitive sports are presently ranked among the best methods to control adolescent deviant behavior in trainees. Practical experiences have demonstrated that due competitive motivations, interest in sports and positive emotional success-focused team climates are beneficial for the adolescent deviant behavior control purposes in many cases, including dysfunctional families, as trainings and competitions effectively relieve mental stresses and facilitate the individual progress agendas [4, 5]. It should be mentioned, however, that not every coach is actually prepared to cope with the adolescent deviant behavior related issues in teenage teams that demonstrate high psychological lability associated with the need for an adult role model [3].

On the whole, a coach must have certain personal merits and qualities to win respect in the adolescent-deviant-behavior-prone teams and effectively build up communication using:

– Appealing psychological qualities (benevolence, responsiveness, sensitivity, sincerity, etc.) to effectively control every action and verbal contact with the teenage athletes;

– Good communication skills to establish own image, moral values, sociability, etc.; and, as a matter of priority

– Sensitivity to the adolescent trainee's personality traits and needs to successfully cope with the potential psychological barriers and mental control issues.

**Objective of the study** was to rate and analyze the coaches' communicative skills in the adolescent deviant behavior control context and offer the adolescent deviant behavior control recommendations for the training and competitive service.

**Methods and structure of the study. I**n our analysis of the practical experiences of the coaches successful in the adolescent deviant behavior control aspects we have given a special priority to the coach-trainee communication building skills. We sampled for the study Sports School coaches (n=6) and tested them by the V.V. Boyko Empathy Test; A.V. Karpov Reflexivity Test Method and the K. Jung Personality Questionnaire.

Results and discussion. Given on Figure 1 hereunder are the V.V. Boyko Empathy Test data of the sample.

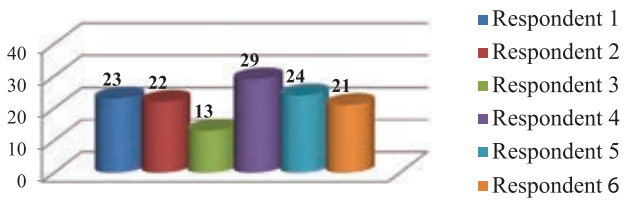


**Figure 1.** *Empathy test data of the sample, points*

The empathy test rated two subject low (21 points) and poor (13 points); and the other four moderate (22-29 points) on the empathy scale – to conclude that most of the sample is inclined for understanding and empathy in relationship. The A.V. Karpov Reflexivity Test rated five of six coaches moderate and one high on the reflexivity test scale: see Figure 2.

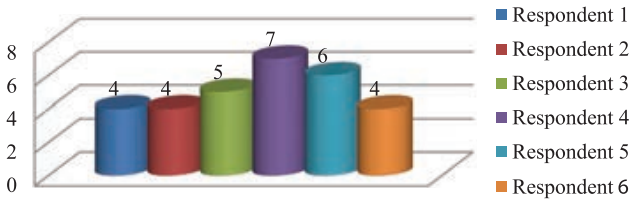


**Figure 2.** *Reflexivity test data of the sample (0 to 10 stens)*

The reflexivity test showed the sample being able to analyze own feelings versus other people's ones i.e. to anticipate, feel and understand; and this quality is known to be highly important for the adolescent deviant behavior control purposes.

And the Jung Personality Questionnaire rated 50% of the sample as extroverts prone to healthy leadership, easy-going in the interpersonal relations and able to persuade; 30% as Introverts and 20% as ambiverts (with extrovert and an introvert qualities) with fairly good communication skills.

Therefore, the above tests found most of the sample having the key qualities for successful communication as required by the coaching service, albeit clearly needing special psychological support and consulting service to develop good adolescent deviant behavior control skills critical for their training and competitive services. We would offer the following coach-trainee communication improvement recommendations to facilitate the adolescent deviant behavior control agenda.

Practical coaching service will give a special priority to the psychological settings for communication that may either encourage or discourage the interpersonal relations [1, 2], with a special role played by humor as the tension-relieving quality. Humor is known to largely scale down anxiety and cope with the training process monotony, with jokes, funny stories, proverbs etc. being often indispensable in stressful, boring or draining settings. However, awkward humor may unexpectedly hurt a teenage trainee and even provoke a conflict. Knowing that, both should keep within certain standards and ethical norms to avoid some team member being mocked at; never tolerate vulgarity, never ridicule clumsiness/ still poor skills, involuntary errors etc. [6].

Coach should always bear in mind that teenagers are emotionally volatile and, hence, easily suggested (that implies special effort to establish good team climate), anxious, with still feeble mental self-control and other issues that may be prevented and mitigated by prudent self-suggestion trainings. It should also be emphasized that frustrated adolescents' nervous systems are rather weak to easily expose them to depression, anxiety, inferiority complexes, feels of guilt etc., regardless of their actual success in competitive sports. These and other mental health issues may suddenly force a teenager quit the trainings and competitions and often fall into depression after that. Frustration at the early stages may bring multiple problems due to, among other things, habitual poor moods. Such health is-

sues may undermine interest in and motivations for sports and everyday living, with the relevant cognitive and motivational disorders and, consequently, self-identification problems [8]. These are the reasons why timely and well-designed mental control tests and services are highly recommended for early diagnostics of the potential health issues to effectively stabilize moods and climates in the adolescent teams.

The above symptoms may be effectively controlled by the relevant psychological training practices geared to relieve tension and anxiety and encourage success motivations (such as "Glass", "Poisonous River", etc.); with such mental workouts recommended in the rest breaks in trainings. Every such practice will be followed by a reflection session to analyze: What helped or hampered the practices? What were your feelings when practicing? How can we use this practical experience in everyday life? [7]. These and other psychological training practices have proved beneficial in practical psychological support service.

**Conclusion.** Coaching services to the adolescent-deviant-behavior-prone teams are recommended to be designed and managed with a special attention to the personality qualities of the coach and trainees. It is very important for the coach to be sensitive to the individual progress needs, gifts and resources of young athletes to develop encouraging team climate, supportive and friendly relationships as a basis for the personality progress agendas. Such coach-trainee relationships help motivate the adolescent athletes for progress and success.

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# School physical education: young teachers' adaptation survey

UDC 796.011.3

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**Abstract**

**Objective of the study** was to survey the young school physical education teachers' progress encouragement initiatives and analyze their practical benefits.

**Methods and structure of the study.** We analyzed, for the purposes of the study, the relevant available study reports and run a questionnaire survey of 50 school principals from St. Petersburg and schoolchildren covered by the HBSC research program. We selected three most promising young school physical education teacher encouragement options from the following nine ones offered by the respondents: (1) special progress facilitating environments for the young teacher; (2) analysis of the young teacher's social, personal and psychological traits, ambitions and needs; (3) young teacher associations; (4) innovative domains for the young teacher's creativity and progress; (5) special provisions to facilitate the young teacher careers; (6) young teacher contests supported by the municipal and regional authorities; (7) success histories and experiences of the best young teachers; (8) professional synergy of the best pedagogical practices for the young teacher's progress; and (9) modern mentoring service sensitive to the individual gifts and ambitions to facilitate the young teacher growth with the growing appreciation from the students of their physical education service.

**Results and conclusion.** We found no significant intergroup differences in the reported physical activity.

The questionnaire survey data and analyses found the school principles giving the key role to the welcoming and supportive school climates for the young teacher, with the innovative domains for their creativity and ambitions to facilitate engagement of the schoolchildren to the physical education service. These initiatives will be designed to encourage the young teacher's professional progress agendas and mitigate the high emotional stressors to avoid overstrain and burnouts not unusual in the maiden periods and secure good adaptation to the teaching staff and school community on the whole. The young teacher's adaptation options found by the questionnaire survey has been proved beneficial.

***Keywords:*** *adaptation, young teacher, continuous professional development.*

**Background.** Young physical education teachers' progress at schools has been encouraged by the priority national educational policies as provided by the National Education Project [1], regional Future Teacher Project [3, 4] and the valid Professional Pedagogical Service Standards [2]; with every initiative corrected based on the practical service experience and using the traditional institutional and practical support toolkit for the young teacher to contribute to progress of the relevant educational institutions. The educational system, however, has reported deficiencies in the future teachers' professional commitments, since many physical education graduates are hesitant to face the adaptation challenges in new teams where they have to cooperate with much more experienced partners with different approaches and values systems. They also doubt they will be offered good progress opportunities to fully mobilize their creativity, and these and other doubts and concerns often force them to retire. The schools in their turn are often reluctant to address the specific problems faced by the young teachers – referred herein as the beginners with at most three-year experiences.

Objective of the study was to survey the young school physical education teachers' progress encouragement initiatives and analyze their practical benefits.

**Methods and structure of the study.** We analyzed, for the purposes of the study, the relevant available study reports and run a questionnaire survey of 50 school principals from St. Petersburg and schoolchildren covered by the HBSC research program. We selected three most promising young school physical education teacher encouragement options from the following nine ones offered by the respondents: (1) special progress facilitating environments for the young teacher; (2) analysis of the young teacher's social, personal and psychological traits, ambitions and needs; (3) young teacher associations; (4) innovative domains for the young teacher's creativity and progress; (5) special provisions to facilitate the young teacher careers; (6) young teacher contests supported by the municipal and regional authorities; (7) success histories and experiences of the best young teachers; (8) professional synergy of the best pedagogical practices for the young teacher's progress; and (9) modern mentoring service sensitive to the individual gifts and ambitions to facilitate the young teacher growth with the growing appreciation from the students of their physical education service.

**Results and discussion.** The sample emphasized every of the above options being important for the young teacher adaptation although the special progress facilitating environments and peer support for the young teacher were ranked on top (72%). Ranked second was the innovative domain for the young teacher's creativity (68%) followed in the third place by the physical education progress agendas sensitive provisions to facilitate the young teacher's growth with the students' growing appreciation of the school physical education service (60%).

To rank the potential benefits of the above young teacher's adaptation options, we surveyed the school students (1) from the physical education classes served by the young teacher subject to these options (Teacher A); and (2) served by the more experienced (having three-plus-year experiences) school physical education teachers (Teacher B). The survey was designed to rate the students' appreciation of the physical education service, physical activity and teacher's support. Groups A and B were tested significantly ($p<0.05$) different in responses to the question "Do you like the physical education classes?" (Figure 1) and opting for "I do trust my teachers" (Figure 2).

We found no significant intergroup differences in the reported physical activity ($p<0.05$).

Conclusion. The questionnaire survey data and analyses found the school principles giving the key role to the welcoming and supportive school climates for the young teacher, with the innovative domains for their creativity and ambitions to facilitate engagement of the schoolchildren in the physical education service. These initiatives will be designed to encourage the young teacher's professional progress agendas and mitigate the high emotional stressors to avoid overstrain and burnouts not unusual in the maiden periods and secure good adaptation to the teaching staff and school community on the whole. The young teacher's adaptation options found by the questionnaire survey has been proved beneficial.

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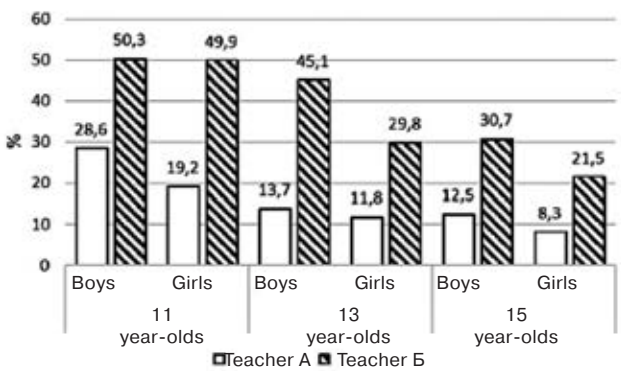


**Figure 1.** *Shares highly appreciating the physical education services by Teachers A and B*

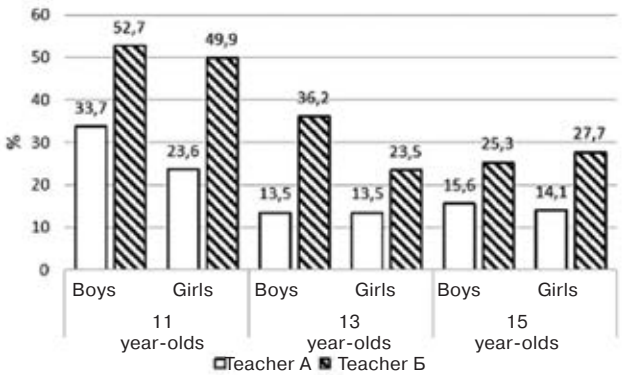


**Figure 2.** *Shares highly trusting Teachers A and B*

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# School-aged children's healthy lifestyle and physical activity survey with correlation analysis

UDC 37.062.5

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**Abstract**

**Objective of the study** was to survey and analyze the school-aged children's lifestyles, diets, oral hygiene and physical activity.

**Methods and structure of the study** Saint-Petersburg Physical Culture Research Institute (SPPCRI) contributes to the international Health Behavior in School-aged Children (HBSC) program and formally leads this project in the Russian Federation. The participating countries are expected to contribute to the ongoing international research under the HBSC program by anonymous surveys of the 11/ 13/ 15 year-old school population run once in four years. The SPPCRI team has developed a special web service with an authorized access for the regional groups with a Russian version of the international questionnaire survey. The web service offers an accessible online survey form with the reported data stored in database, grouped, processed and analyzed. This study presents and analyzes the survey data of 2017-18.

The WHO offers the MVPA (moderate to vigorous physical activity) survey toolkit to rate group physical activity levels versus the minimal physical activity benchmarks, with the recommended minimal daily physical activity for school-aged children making one hour. The actual physical activity reported by school-aged children was rated versus the WHO minimum by the question how many days per week the children are physically active for at least 60 minutes a day.

We sampled for the questionnaire survey the 11/ 13/ 15 year-old schoolchildren (n=4765) of both sexes. The sample was split up into two groups based on the reported physically active days per week with the physical activity equal or exceeding the MVPA minimum of 60 minutes a day. The MVPA3 and MVPA7 groups included the students reporting physically active for the 60+min 3 days and 7 days a week, respectively. This grouping assumed that MVPA3 basically means three school physical education classes a week; and MVPA7 complements the school physical education classes with extra/ off-class sports/ physical activity forms.

We analyzed intergroup differences in the reported dieting habits, oral hygiene and healthy physical activity on age and gender bases.

**Results and conclusion.** The survey data and analyses found high contributions to the health culture of school-aged children from such healthy lifestyle elements as the healthy diets, good physical activity and commitment for physical education and sports in every age and gender subgroup. This finding may be interpreted as indicative of the school sample acknowledging the key healthy lifestyle elements due to, apparently, the role models provided by their families showing healthy living habits and cultures. We recommend further surveys to analyze the potential contribution of school teachers and peers in the healthy lifestyle cultivation in the age and gender groups.

***Keywords:*** *school-aged children, level of physical activity, diets, oral hygiene, physical activity, healthy lifestyle.*

**Background.** One of the key goals for the physical activation efforts is to offer new ways to lure school-aged children into habitual physical education and sports [5, 6]. The national government and society give a special priority to the physical education and sport services to school-aged children, and the national physical education and sport system for the age group is persistently advanced with a special priority to the group health programs on the whole and healthy lifestyle cultivation in particular [1, 2].

**Objective of the study** was to survey and analyze the school-aged children's lifestyles, diets, oral hygiene and physical activity.

**Methods and structure of the study** Saint-Petersburg Physical Culture Research Institute (SPPCRI) contributes to the international Health Behavior in School-aged Children (HBSC) program [5] and formally leads this project in the Russian Federation. The participating countries are expected to contribute to the ongoing international research under the HBSC program by anonymous surveys of the 11/ 13/ 15 years old school population run once in four years. The SPPCRI team has developed a special web service with an authorized access for the regional groups with a Russian version of the international questionnaire survey. The web service offers an accessible online survey form with the reported data stored in database, grouped, processed and analyzed [3]. This study presents and analyzes the survey data of 2017-18.

The World Health Organization (WHO) offers the MVPA (moderate to vigorous physical activity) survey toolkit to rate group physical activity levels versus the minimal physical activity benchmarks, with the recommended minimal daily physical activity for school-aged children making one hour [3]. The actual physical activity reported by school-aged children was rated versus the WHO minimum by the question how many days per week the children are physically active for at least 60 minutes a day.

We sampled for the questionnaire survey the 11/ 13/ 15 year-old schoolchildren (n=4765) of both sexes. The sample was split up into two groups based on the reported physically active days per week with the physical activity equal or exceeding the MVPA minimum of 60 minutes a day. The MVPA3 and MVPA7 groups included the students reporting physically active for the 60+min 3 days and 7 days a week, respectively. This grouping assumed that MVPA3 basically means three school physical education classes a week; and MVPA7 complements the school physical education classes with extra/ off-class sports/ physical activity forms.

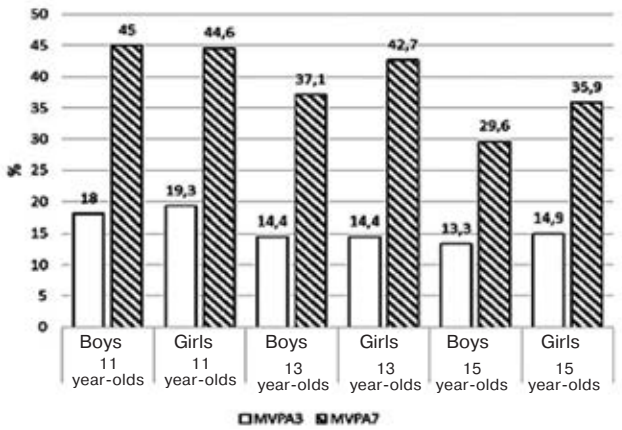


**Figure 1.** *Age and gender shares reporting 1+ fruit meals every day in MVPA3 and MVPA7 groups*

We analyzed intergroup differences in the reported dieting habits (with a special attention to fruits and vegetables), oral hygiene and healthy physical activity on age and gender bases.

**Results and discussion.** Given on Figure are the age and gender shares reporting 1+ fruit meal every day in MVPA3 and MVPA7 groups, and found a clear domination of MVPA7 group on the fruit consumption scale.

The MVPA3 versus MVPA7 difference on the fruit consumption scale for 11-year-old boys was 18% versus 45% and peer girls 19.3% versus 44.6%; for the 13-year-old boys 14.4% versus 37.1% and peer girls 14.4% versus 42.7%; and for the 15-year-old boys 13.3% versus 29.6% and peer girls 14.9% versus 35.9%, respectively; with all the above age and gender intergroup differences tested significant ($p < 0.05$).

Furthermore, we rated the age and gender shares reporting 1+ vegetable meal every day in MVPA3 and MVPA7 groups, and found a clear domination of MVPA7 group on this scale. The MVPA3 versus MVPA7 difference on the vegetables consumption scale for 11-year-old boys was 12.5% versus 32.5% and peer girls 16.5% versus 34.5%; for the 13-year-old boys 15.1% versus 28.2% and peer girls 14.1% versus 34.7%; and for the 15-year-old boys 12.4% versus 31.8%, and peer girls 14.3% versus 35.9%, respectively; with all the above age and gender intergroup differences tested significant ($p < 0.05$).

Then we analyzed the group oral hygiene for compliance with the health standards, and rated the age and gender shares reporting 1+ teeth brushing procedures every day in MVPA3 and MVPA7 groups, to find a clear domination of MVPA7 group on this scale. The MVPA3 versus MVPA7 difference on the teeth brushing scale for 11-year-old boys was 46.9% versus 67.1% and peer girls 64.5% versus 74.3%; for the 13-year-old boys 34.8% versus 60.2% and peer girls 64.7% versus 68%; and for the 15-year-old boys 35.5% versus 53.6%, and peer girls 66% versus 69.6%, respectively; with all the above age and gender intergroup differences tested significant ($p < 0.05$).

And we also analyzed the group shares committed for daily physical education and sports practic-

es in MVPA3 and MVPA7 groups, and found a clear domination of MVPA7 group on this scale. The MVPA3 versus MVPA7 difference on the physical education and sports commitment scale for 11-year-old boys was 58.4% versus 82.5% and peer girls 56.6% versus 84.3%; for the 13-year-old boys 46.8% versus 79%, and peer girls 51.2% versus 68.5%; and for the 15-year-old boys 50.3% versus 76.2%, and peer girls 51.5% versus 76.5%, respectively; with all the above age and gender intergroup differences tested significant ($p < 0.05$).

**Conclusion.** The survey data and analyses found high contributions to the health culture of school-aged children from such healthy lifestyle elements as the healthy diets, good physical activity and commitment for physical education and sports in every age and gender subgroup. This finding may be interpreted as indicative of the school sample acknowledging the key healthy lifestyle elements due to, apparently, the role models provided by their families showing healthy living habits and cultures. We recommend further surveys to analyze the potential contribution of school teachers and peers in the healthy lifestyle cultivation in the age and gender groups.

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# Covid-19 pandemic effects on popular physical education and sports in russia

UDC 316.422

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**Abstract**

**Objective of the study** was to survey the COVID-19 pandemic effects on the popular physical education and sports in Russia by the population groups and health categories.

**Methods and structure of the study.** We surveyed, for the purposes of the study, different population groups using CATI (Computer Assisted Telephone Interview) and CAWI (Computer Assisted WEB Interview) technologies, plus focused interviews with elements of the modern facial scanning technology in 16 focus group discussions for the gender, age and population groups. We sampled 85 regions of the Russian Federation representing different economic/ cultural zones and rural/ urban communities to survey 11,964 people in total, including families with 3-5 year-olds (n =1325); 6-12 and 13-29 year-olds (n=4881); 30-50 year-olds (n=3314); and 60+ year-olds (n=2444). The study was run under the federal contract of the Ministry of Sports with the Federal Science Center of Physical Culture and Sport (VNIIFK) supported by the Russian State Social University experts to advance the National "Demography" Project and federal "Sports as the Life Norm Project

**Results and conclusion.** The survey found one of three respondents seeing no changes in their physical education and sports activity, including 40.1% of the families with 3-5 year-olds; 30.2% of the 13-29 year-olds; 35.6% of the 30-59 year-olds; and 34.2% of the 60+ year-olds. However, the modern digital technologies showed low physical activity (1.2-3.7%) in every population group – explainable by the limited access to the health technologies or the technologies being poorly customizable for the individual needs and user skills of the population groups.

The survey confirmed the need for serious revision of the theoretical attitudes to the social barriers for physical education and sports, their communal and individual benefits, physical education and sport service toolkit improvement, customizing and modeling issues, as well as the physical education and sports advocacy system. It should be mentioned that the survey data should be perceived and analyzed conservatively, with further surveys recommended to correct and complement the data by sound empirical and theoretical contents.

***Keywords:*** *questionnaire survey, COVID-19 pandemic, physical education, people's physical activity.*

**Background.** One of the key national physical education and sport sector progress objectives, as set by the relevant regulatory documents, is to expand the population groups engaged in physical education and sports on a habitual basis by to 70% of the total by 2030 [1,3,4]. In the early 2020, however, the progress was stalled by the COVID-19 pandemic with the related disease-control limitations including temporary isolation, lockdowns, access restrictions, prohibitions of mass cultural/ physical education and sports events, limitations of the fitness club/ sports trainings and other services, etc. We believe it may be beneficial in this context to analyze the pandemic-related situation in the national popular physical education and sport sector by the population groups and health categories [2].

**Objective of the study** was to survey the COVID-19 pandemic effects on the popular physical education and sports in Russia by the population groups and health categories.

**Methods and structure of the study.** We surveyed, for the purposes of the study, different population groups using CATI (Computer Assisted Telephone Interview) and CAWI (Computer Assisted WEB Interview) technologies, plus focused interviews with elements of the modern facial scanning technology in 16 focus group discussions for the gender, age and population groups. We sampled 85 regions of the Russian Federation representing different economic/ cultural zones and rural/ urban communities to survey 11,964 people in total, including families with 3-5 year-olds (n =1325); 6-12 and 13-29 year-olds (n=4881); 30-50 year-olds (n=3314); and 60+ year-olds (n=2444). The study was run under the federal contract of the Ministry of Sports with the Federal Science Center of Physical Culture and Sport (VNIIFK) supported by the Russian State Social University experts to advance the National "Demography" Project and federal "Sports as the Life Norm Project

Results and discussion. The survey found one of three respondents seeing no changes in their physical education and sports activity, including 40.1% of the families with 3-5 year-olds; 30.2% of the 13-29 year-olds; 35.6% of the 30-59 year-olds; and 34.2% of the 60+ year-olds. However, the modern digital technologies (JustDance, VR, AR, etc.) showed low physical activity (1.2-3.7%) in every population group – explainable by the limited access to the health technologies or the technologies being poorly customizable for the individual needs and user skills of the population groups.

The self-isolation period reportedly has not changed the traditional physical-education-and-sports-related information flows for the 60+ year-olds that were found still relying on the traditional TV broadcasts (36.3%), radio (16.2%), and newspapers/ magazines (19.4%); with the local corporate/ home communities being the least popular among the physical education and sports information sources.

The empirical survey data gives grounds for a few theoretical findings and practical recommendations. The theoretical analysis shows the popular physical education and sports being influenced by the objective factors related to the physical education and sports conditions and subjective factors including the popular physical education and sports motivations in the contest of the relevant group values (health, communication, recreation, etc.) and their rankings in the group values hierarchy.

The COVID-19 pandemic seriously affected the above factors related to physical education and sports as such and the physical education and sports motivations/ attitudes. First of all, the sample reported barriers for physical education and sports in limited spaces and mass recreational/ physical education and sports events with the popular communication, fun, leisure-time activities etc. These difficulties forced changes in the habitual group physical activity, with the regular physical education and sport share contracting and the everyday home physical activity expanding (home chores, jobs etc.). It should be mentioned, however, that such home physical activity is virtually never beneficial enough for the individual physical progress/ health agendas and may be even detrimental to a degree.

The survey found a few popular biases as to the barriers for physical education and sports and their communal and individual benefits. Home self-reliant physical education and sports practices with online consulting and support, for example, have no chances, as the respondents believe, to substitute the fully-fledged traditional physical education and sports at regular sports facilities. The sample acknowledged, however, that now they realize that the pre-COVID physical education and sport service was very good in fact.

One of the key disincentives for physical education and sports, as reported by the sample, is the habitual physical inactivity and laziness, with the desires to relax after jobs, fatigues, burnouts, poor wellbeing, health issues, etc. These passive attitudes have been regretfully fueled by the biased mass media outlets and many theorists arguing that the popular physical inactivity/ physical education and sports disincentives are due to the poor provisions for physical education and sports / physical activity, with the physical perfection and health improvement being viewed as the only goals of popular physical education and sport systems.

**Conclusion.** The survey confirmed the need for serious revision of the theoretical attitudes to the social barriers for physical education and sports, their communal and individual benefits, physical education and sport service toolkit improvement, customizing and modeling issues, as well as the physical education and sports advocacy system. It should be

mentioned that the survey data should be perceived and analyzed conservatively, with further surveys recommended to correct and complement the data by sound empirical and theoretical contents.

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# Rating people's functional fitness for physical education and sports activity within GTO complex implementation

UDC 796.011

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**Abstract**

**Objective of the study** was to rate and analyze the gender- and age-specific physical fitness and functionality prior to and by the GTO Complex tests.

**Methods and structure of the study.** The physical fitness and functionality tests prior to and under the GTO Complex service included the R.M. Bayevsky adaptability tests [1]. We sampled for the tests the 25-plus year-olds (n=451, including 257 women and 194 men).

**Results and conclusion.** The age- and gender-specific GTO Complex tests were found increasingly challenging for the 40-plus-year-olds due to the physical adaptability sags and poorer physical fitness and working capacity hampering active physical education and sports practices. The test data and analyses demonstrated the need for the GTO Complex test standards being updated on a more age- and gender-sensitive basis.

***Keywords:*** *cardiovascular system, adult population, men, women, GTO Complex, GTO tests, adaptability.*

**Background.** The national health policies including those set by the National Demography Project – that requires the habitual physical education and sports service covering 70% of the nation al population by the project deadline – give a special priority to the grassroots physical education and sports initiatives for adults [2].

**Objective of the study** was to rate and analyze the gender- and age-specific physical fitness and functionality prior to and by the GTO Complex tests.

**Methods and structure of the study.** The physical fitness and functionality tests prior to and under the GTO Complex service included the R.M. Bayevsky adaptability tests [1]. We sampled for the tests the 25-plus year-olds (n=451, including 257 women and 194 men).

**Results and discussion.** The tests found the 25-29 year-olds in both gender groups fit for physical education and sports without restrictions and qualified them with Health Group 1 as well-adaptable to physical stress. The 30-39 year-olds were tested still mostly high on the functionality scale, with 67% and 33% qualified with Health Groups 1 and 2, respectively, as fairly adaptable to physical stressors. The 40-44 year-old women were tested with a higher cardiovascular system adaptability, with 74% and 26% qualified with Health Groups 1 and 2, respectively; versus their male peers grouped virtually even.

The 45-plus-year-olds were tested with expressly growing dysfunctions and lowering physical education and sports fitness and qualified with Health Groups 2 and 3 due to the physical adaptability issues. Thus 18%, 46% and 36% of the 45-49 year-olds in the both gender groups were qualified with Health Groups 1, 2 and 3. Note that only 10%

and 90% of the 65-plus-year-old men qualified with Health Groups 2 and 3, respectively; versus 6% and 94% in the peer women's group.

Conclusion. The age- and gender-specific GTO Complex tests were found increasingly challenging for the 40-plus-year-olds due to the physical adaptability sags and poorer physical fitness and working capacity hampering active physical education and sports practices. The test data and analyses demonstrated the need for the GTO Complex test standards being updated on a more age- and gender-sensitive basis.

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# Physical rehabilitation and social adaptation benefits of aerial gymnastics project for children with cerebral palsy

UDC 796.011.3

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**Abstract**

**Objective of the study** was to test benefits of a new aerial gymnastics (wind tube) project for physical rehabilitation and social adaptation of cerebral-palsy-diagnosed children.

**Methods and structure of the study.** Aerodynamic gymnastics may be defined as the wind tunnel application method for physical training of the cerebral-palsy-diagnosed children conditional on sensitive customizing to the individual health conditions and progress needs by varied wind speeds, flows and training intensities. Special physical practices in wind tunnel are known to help relieve muscle tension, build up physical endurance, stretch muscles, mitigate muscle spasms and cramps, train strength, movement coordination and spatial orientation skills.

We summarized practical experience of the cerebral-palsy-diagnosed children's physical activating aerodynamic gymnastics practices in the Fly Station wind tunnel in Saint Petersburg and Miass (Chelyabinsk Oblast) cities to develop a new aerodynamic gymnastics model complementary to the standard adaptive physical education service under the interregional Fly With Me Project for the underage cerebral-palsy-diagnosed groups. The Project facilitates the joint efforts of experts and families to improve the life quality of the children with cerebral palsy in four pilot cities of the Russian Federation (Moscow, St. Petersburg, Chelyabinsk and Ulyanovsk) where we sampled for the aerodynamic gymnastics model piloting experiment the local 5-14 year-old cerebral-palsy-diagnosed children (n=120).

The sample is being tested in the Project by the medical, psychological and pedagogical diagnostics interdisciplinary expert team including a neurologist, rehabilitation therapist, psychologist and an adaptive physical education instructor.

The aerodynamic gymnastics service in the project was individualized for the actual needs in physical practices for the key muscle groups within the regular adaptive physical education service and based on the mental/ physical health rates and current recommendations from the attending neurologist.

**Results and conclusion.** Our practical experience of the aerodynamic gymnastics service complementary to the standard adaptive physical education methods showed the long-term aerodynamic gymnastics service being beneficial for the cerebral-palsy-diagnosed children's mental and physical health to facilitate their progress in every aspect including social adaptation.

***Keywords:*** *aerodynamic gymnastics, muscle tone normalization, increase in joint mobility.*

**Background.** For the last few decades, many nations, including Russia, have reported growth in the cerebral palsy incidence rates [1, 3, 4]. Modern cerebral palsy therapy offers a wide variety of comprehensive high-quality physical rehabilitation methods and tools that should be prudently selected, designed and customized for success, with the aerodynamic gymnastics toolkit rapidly winning popularity as complementary to the traditional adaptive physical education service in Europe and the world over (Brussels, France, Iceland, Liechtenstein, North Macedonia, Norway, USA, etc.) [2].

Objective of the study was to test benefits of a new aerial gymnastics (wind tube) project for physical rehabilitation and social adaptation of cerebral-palsy-diagnosed children.

**Methods and structure of the study.** Aerodynamic gymnastics may be defined as the wind tunnel application method for physical training of the cerebral-palsy-diagnosed children conditional on

sensitive customizing for the individual health conditions and progress needs by varied wind speeds, flows and training intensities. Special physical practices in wind tunnel are known to help relieve muscle tension, build up physical endurance, stretch muscles, mitigate muscle spasms and cramps, train strength, movement coordination and spatial orientation skills.

We summarized practical experience of the cerebral-palsy-diagnosed children's physical activating aerodynamic gymnastics practices in the Fly Station wind tunnel in Saint Petersburg and Miass (Chelyabinsk Oblast) cities to develop a new aerodynamic gymnastics model complementary to the standard adaptive physical education service under the interregional Fly With Me Project for the underage cerebral-palsy-diagnosed groups. The Project facilitates the joint efforts of experts and families to improve the life quality of the children with cerebral palsy in four pilot cities of the Russian Federation (Moscow, St. Petersburg, Chelyabinsk and Ulyanovsk) where we sampled for the aerodynamic gymnastics model piloting experiment the local 5-14 year-old cerebral-palsy-diagnosed children (n=120).

The sample is being tested in the Project by the medical, psychological and pedagogical diagnostics interdisciplinary expert team including a neurologist, rehabilitation therapist, psychologist and an adaptive physical education instructor. The tests are designed to produce a range of mental and physical health rates, individualize the aerodynamic gymnastics service and monitor progress of every child in the Project. The children were sampled conditional on the prior expert 'no contraindication' findings, with every qualifier documented by a diagnostic card, anthropometric data list for the equipment and outfits individualizing purposes; pre-flight health card with the psychologist's recommendations; and a family-kept diary of the child's health.

The tests are supported by a diagnostic/ consulting day service to the parents/ guardians documented in the above mental and physical health and progress test file. The aerodynamic gymnastics service in the project was individualized for the actual needs in physical practices for the key muscle groups within the regular adaptive physical education service and based on the mental/ physical health rates and current recommendations from the attending neurologist. The adaptive physical education sessions are run twice a week and followed by the aerodynamic gymnastics practices to make every child mentally and physically fit for the aerodynamic gymnastics.

**Results and discussion.** The aerodynamic gymnastics project objective is to facilitate the mental and physical health progress of the sample by the synergized rehabilitation service under control of health specialists who set individualized progress goals to normalize muscle tone, improve motor skills and joint mobility, build up strength and strength endurance in the key muscle groups, and prevent/ mitigate the muscle spasticity. The adaptive physical education service is designed for the neuromuscular processes activation to:

1. Stimulate cerebellar function by the postural control/ BMC fixing practices geared to improve the equilibrium, stability, etc.;

2. Activate the key analyzer systems: visual analyzer with the oculomotor muscle strength exercises; auditory analyzer, etc.;

3. Mobilize the core body segments – to improve the thoracic/ shoulder blade mobility; vestibular-cervical reflexes; limb control; feet functionality to contribute to the postural control, etc.;

4. Develop specific physical qualities, muscle groups and skills – strength, endurance, coordination, postural control muscles, motor dexterity; throwing, dropping, rolling, pushing skills etc.;

5. Activate the key neurological functional patterns including the breathing and diaphragm afferenting ones; improve the receptor sensitivity; body mapping and control skills with the relevant proprioceptive sensations, etc.; and

6. Improve respiratory system health by strengthening the respiratory muscles; activate the intercostal muscles; and establish healthy breathing patterns.

In the aerodynamic gymnastics practices, the air flow makes it easier for the child to control the body, master and excel the key motor skills to facilitate their consolidation by the further standard adaptive physical education trainings. The wind tunnel practices are also beneficial due to the positive emotions they generate. The flying feelings make the child happy being carried into a bright palette of emotions that facilitate the mental and physical health improvement process. Aerodynamic gymnastics is known to speed up the rehabilitation and social adaptation processes and make the physical trainings more effective.

Based on the individual anthropometric characteristics, every child is dressed and equipped for the wind tube flight, with the gear including a closed helmet, buff scarf, overalls with grips, shoes with a flat sole, and earplugs – under control of the interdisciplinary team of health experts working in close cooperation with the wind tube operators and instructors. Every instructor is certified by the RSSU for operation of wind tunnels and aerodynamic gymnastics service within the standard adaptive physical education service package.

Benefits of the aerodynamic gymnastics service complementary to the standard adaptive physical education are tested by the stabilometry (balance plate) tests; walking quality video analyses; trunk control motor skills tests on the GMFCS scale; hand functionality tests recommended by the MACS; postural control tests using the SATco method; Hare/Hallet sitting postural control tests; Reimers indices; muscular system tone tests; muscle spasticity tests using the Ashworth Scale (MMAS); and goniometry tests.

**Conclusion.** Our practical experience of the aerodynamic gymnastics service complementary to the standard adaptive physical education methods showed the long-term aerodynamic gymnastics service being beneficial for the cerebral-palsy-diagnosed children's mental and physical health to facilitate their progress in every aspect including social adaptation.

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# Post-isometric exercises and their effect on physical fitness of female students with vertebro-genic dorsopathy

UDC 796.011.3

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**Abstract**

**Objective of the study** was to assess the role of post-isometric physical exercises in pain management and improvement of physical fitness of female students with vertebrogenic dorsopathy engaged in health and fitness activities within a special health group.

**Methods and structure of the study.** The study was carried out at the premises of the Sur-gut State University and involved the Bachelor's and Specialist's degree course female students aged 19.8±3.5, who had been attributed to the special health group (n=31). The girls were divided into two groups: Experimental Group (n=15) and Control Group (n=16). All subjects were diag-nosed with vertebral osteochondrosis accompanied by vertebrogenic dorsopathy.

The pain syndrome intensity and subjective sensations of the female students were estimated using the Oswestry Disability Index (ODI); their physical fitness was rated in the tests developed for the special health group students and accepted at the Department of Physical Education. The descriptive statistics was collected using the Statistica V.10.0 package ($p<0.05$ was taken as a statistically significant difference).

The educational experiment was based on the analysis and evaluation of the organizational and methodological conditions for physical education of the special health group female students, as well as the effect of post-isometric physical exercises on their physical fitness rates.

The methodology of application of post-isometric physical exercises in EG (hereinafter, PIPE) was designed in such a way that the main load-related risks were eliminated during the train-ing sessions: excess systolic and diastolic blood pressure – above 150 mmHg and 90 mmHg, respec-tively; increased heart rate.

During the exercises, the following were excluded: breath holding, sharp, maximum straining and simultaneous inclinations and circular movements in the cervical and lumbar spine, excessive motion amplitude and stretching of the active muscles

**Conclusions.** The findings proved the benefits of post-isometric physical exercises for pain management in application to the female students of the special health group. Pain relief made it possible to improve the trainees' physical fitness level. The physical fitness rates in the Experimental Group after the experiment differed statistically significantly from the baseline in terms of three out of five indicators.

***Keywords:*** *special health group, female students, vertebrogenic dorsopathy, post-isometric physical exercises.*

**Background.** The World Health Organization reports that up to 80% of the world population suffers from various locomotor diseases and that the number of young people with various functional and spine disorders has increased to 67% [1, 2]. Vertebrogenic dorsopathy is a pain syndrome in the spine region caused by functional and degenerative-dystrophic changes in the spine and intervertebral disks. All its manifestations entail intolerable physical and emotional suffering for young people, as well as considerable material expenses involved in long-term rehabilitation [4]. The etiology and pathogenesis of vertebrogenic dorsopathy in adults have been studied well enough; there are standard diagnostic algorithms, combination treatment protocols, orthopedic alignment and operative treatment methods [2]. However, back pain in student youth is still poorly studied and there is a lack of systematic monitoring from the perspective of physical rehabilitation.

**Objective of the study** was to assess the role of post-isometric physical exercises in pain management and improvement of physical fitness of female students with vertebrogenic dorsopathy engaged in health and fitness activities within a special health group.

**Methods and structure of the study.** The study was carried out at the premises of Surgut State University and involved the Bachelor's and Specialist's degree course female students aged 19.8±3.5, who had been attributed to the special health group (n=31). The girls were divided into two groups: EG (n=15) and CG (n=16). All subjects were diagnosed with vertebral osteochondrosis accompanied by vertebrogenic dorsopathy.

The pain syndrome intensity and subjective sensations of the female students were estimated using the Oswestry Disability Index (ODI); their physical fitness was rated in the tests developed for the special health group students and accepted at the Department of Physical Education. The descriptive statistics was collected using the Statistica V.10.0 package ($p<0.05$ was taken as a statistically significant difference).

The educational experiment was based on the analysis and evaluation of the organizational and methodological conditions for physical education of the special health group female students, as well as the effect of post-isometric physical exercises on their physical fitness rates.

The methodology of application of post-isometric physical exercises in EG (hereinafter, PIPE) was designed in such a way that the main load-related risks were eliminated during the training sessions: excess systolic and diastolic blood pressure - above 150 mmHg and 90 mmHg, respectively; increased heart rate [5].

During the exercises, the following were excluded: breath holding, sharp, maximum straining and simultaneous inclinations and circular movements in the cervical and lumbar spine, excessive motion amplitude and stretching of the active muscles [3]. In other words, the exercises were designed so that not to provoke pain and to reduce the possibility of aggravation of the chronic disease. The total duration of the PIPE series to be performed during the training session was 25 minutes, the exercises were included in the main part of the lesson and applied as a single set in such a way that all the muscle groups susceptible to vertebrogenic dorsopathy were developed sequentially. Given in Table 1 is a suggested list of PIPE.

**Table 1.** *Suggested list of post-isometric physical exercises for pain management*

| Initial position | Content of the routine | Load dosage |
|---|---|---|
| I.P. – sitting position, straight back, legs closed, feet together, arms resting straight on legs. | Glute squeezes. | 6-8 reps |
| I.P. – sitting position, left foot pressed outside right knee, foot pressed flat on floor, hands on nape, elbows sideways. | Maximum body twisting leftwards. Switching legs, body twisting rightwards. | 4-6 reps |
| I.P. – sitting position, 90° bend at knees, arms forward. | Tilting back as much as possible without lifting feet, while keeping head in a vertical position. | 4-6 reps |
| I.P. – sitting position, legs apart. | «Hand sliding» along right leg, maximum bending, while reaching knee with chin. | 4-6 reps |
| I.P. – sitting position, legs closed, hands placed on floor near buttocks. | Seated glute elevations. | 6-8 reps |
| I.P. – lying flat on back, toes pulled towards ankle, hands on nape, elbows sideways | Bending head forward as much as possible to touch chest with chin, stretching neck muscles | 8-10 reps |
| I.P. – lying flat on back, hands under buttocks, palms up, fingers under gluteal fold. | Maximum glute squeezes, while simultaneously pulling them apart with the hands. | 8-10 reps |
| I.P. – lying flat on back, arms along trunk, shoulder blades and heels pressed flat on floor. | Bottom lifts (arch). | 8-10 reps |
| I.P. – lying flat on back, knees bent at a 90° angle, arms along trunk. | Pressing head to shoulder with right hand, while drawing hand aside as much as possible, with left hand placed under left glute. | 6-8 reps |
| I.P. – lying on the side | Raising straight leg at a 45 angle, while pressing it with arm (closer to knee), thus, counteracting its raising. | 8-10 reps |
| I.P. – knee-wrist initial position (legs and hands perpendicular to floor, arms shoulder width apart, chin held against chest) | Breathing in, then arching backward as much as possible with a sharp exhalation through mouth, while simultaneously vigorously bending lower back and touching chest with chin. | 8-10 reps |

**Results and discussion.** The application of the Oswestry Low Back Pain Questionnaire made it possible to determine the degree of disability caused by the back problems and pain intensity. According to the questionnaire survey results, out of 15 EG female students, 40% had "severe" pain, 27% - "very intense" pain, 20% - "moderate" pain, 13% - "mild" pain (see the figure).

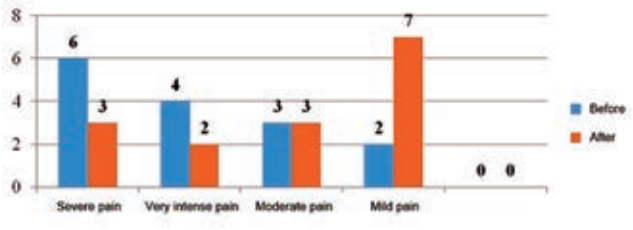


**Fig. 1.** *Dynamics of pain sense in EG based on Oswestry Low Back Pain Questionnaire before and after experiment (n=15)*

The situation changed with the introduction of the PIPE series in EG. Out of the total number of female students, 20% reported "severe" pain, 13% – "very intense" pain, 20% – "moderate" pain, while the number of trainees with "mild" pain increased significantly – 47% of the sample.

Thus, it can be argued that the post-isometric physical exercises had a pain relieving effect. It should be noted, however, that such an outcome can only be achieved if the exercises are performed correctly.

Given in Table 2 are the physical fitness rates of the girls participating in the experiment.

The results obtained in the three following tests indicated statistically significant changes in EG ($p<0.05$): keeping the legs straight at a 45° angle in the initial back-lying position leaning on the bent arms – the result increased from 64.9±18.7 to 81.8±13.5 sec; arching backward from the front-lying position – the result increased from 134.7±18.7 to 152.3±21.4 sec; sit-ups with the knees bent and arms crossed on the chest – the result increased from 36.6±11.5 to 48.7±2.8 reps (statistically significant at $p<0.05$). Other criteria for the assessment of the female students' physical fitness level also improved, though slightly. In CG, all but two test rates increased; however, the changes were not statistically significant.

On average, all the studied indicators complied with the program-methodical requirements and corresponded to the "good-excellent" mark, which indicated a fairly high physical fitness level of the female students attributed to the special health group.

**Conclusions.** The findings proved the benefits of post-isometric physical exercises for pain management in application to the female students of the special health group. Pain relief made it possible to improve the trainees' physical fitness level. The physical fitness rates in EG after the experiment differed statistically significantly from the baseline in terms of three out of five indicators.

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**Table 2.** *Dynamics of physical fitness rates in female students throughout experiment (M±δ)*

| Tests | Before the experiment | | After the experiment | |
|---|---|---|---|---|
| | EG (n=15) | CG (n=16) | EG (n=15) | CG (n=16) |
| Keeping the legs straight at a 45° angle in the initial back lying position leaning on the bent arms, sec | 64.9±18.7 | 68.6±20.1 | 81.8±13.5* | 75.3±29.1 |
| Arching backward from the front lying position, sec | 134.7±18.7 | 135.6±19.7 | 152.3±21.4* | 148.0±61.7 |
| Knee push-ups, number of reps | 24.3±2.3 | 22.1±4.0 | 26.2±5.3 | 22.3±6.9 |
| Body raises in the front-lying position with the hands on the nape, number of reps | 46.6±6.9 | 45.6±6.0 | 48.9±3.6 | 45.8±15.0 |
| Sit-ups with the knees bent and arms crossed on the chest, number of reps | 36.6±11.5 | 38.1±8.6 | 48.7±2.8* | 44.8±14.2 |

** – intra-group significance of differences, $p<0.05$.*

# 6-10 year-old boys' morphology, functionality and physical fitness variations with age and physical activity

UDC 796.01:61

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**Abstract**

**Objective of the study** was to test and analyze the morphofunctional development and physical fitness variations in the 6-10 year-old boys with age and physical activity.

**Methods and structure of the study.** We used for the purposes of the study a standard physical fitness / morphofunctional development test toolkit applied in preschool establishments and general education schools plus the GTO Complex physical fitness test standards for the 6-10 year-olds [4, 6] including: anthropometric characteristics, caliperometry, physiometry, heart rate / tone tests and educational surveys [1, 4, 5]. The tests were designed to rate the following: body length and mass, body mass index (BMI/ Quetelet index); chest size and excursion; limb sizes; skin fat folds; vital capacity; blood pressure, heart rate; pulse pressure; and carpal strength. The physical fitness tests included 10x3m shuttle sprint, standing long jump and flexibility-rating bench lean tests. The test data were statistically processed by the Pearson group correlation analysis in Statistica 13.0 software toolkit; with the correlations rated on the Chaddock scale [3].

We sampled for the study the 6-10 year-old boys (n=304) in the Moscow and Moscow Oblast kindergartens and schools and split them up into untrained (n=150) and trained (n=108) groups, with the trained group including martial artists (trained at the Olympic Village 80 Sports School and Judo Olympic Reserve Sports School in Moscow) plus gymnasts (n=46) trained at DMIKO in Lyubertsy, with the individual sporting experiences ranging from eight months to six years. The boys were sampled for the tests on the parental and trainers' consents and with their supervision.

**Results and conclusion.** In our ranking of the age-specific physical fitness / physical development test rates we would give a special priority to the absolute physical fitness / physical development tests indicative of the growth process including the body length, body mass, absolute muscle mass, vital capacity, carpal strength, dexterity, abdominal muscle strength, arm and shoulder girdle strength test rates. The test rates little correlated with age in the considered age interval are dominated by the morphofunctional ones indicative of the physical stress tolerance (cardiovascular system, chest excursion, relative muscle mass and fat mass tests); plus some physical fitness aspects tests in the sensitive physical development periods (e.g. leg strength and coordination tests). It should be mentioned in this context that the 6-10 year-olds' trainings should be prudently customized to the individual morphofunctional development test rates, in view of the fact that special role in this period is played by the vegetative organs/ systems regulating mechanisms.

***Keywords:*** *6-10 year-olds, physical fitness, physical development (PD), morphofunctional development, martial artists, gymnasts, untrained males.*

**Background.** Physical fitness as the individual physical qualities summarizing category is indirectly indicative of the child's developmental harmony with the cardiorespiratory, musculoskeletal, endocrine-metabolic, psychological system progress aspects; and with the physical fitness tests and analyses critical for the youth health protection systems in the context of physical education service, particularly to the 6-10 year-old preschoolers and primary students [2, 8-9]. The age-specific progress in volitional motor control is generally faster than progress of autonomic organs/ systems regulating mechanism in the ontogenetic development. Motor fitness and physical stress tolerance is known to correlate with the physical development and the cardiovascular/ respiratory system functions in the underage groups, with progress be-

ing expressly age-specific and, hence, ratable by sets of the relevant quantitative/ qualitative progress test criteria making it possible to profile the morphofunctional development and physical fitness variations with age [2, 8].

**Objective of the study** was to test and analyze the morphofunctional development and physical fitness variations in the 6-10 year-old boys with age and physical activity.

**Methods and structure of the study.** We used for the purposes of the study a standard physical fitness / morphofunctional development test toolkit applied in preschool establishments and general education schools plus the GTO Complex physical fitness test standards for the 6-10 year-olds [4, 6] including: anthropometric characteristics, caliperometry, physiometry, heart rate / tone tests and educational surveys [1, 4, 5]. The tests were designed to rate the following: body length and mass, body mass index (BMI/ Quetelet index); chest size and excursion; limb sizes; skin fat folds; vital capacity; blood pressure, heart rate; pulse pressure; and carpal strength. The physical fitness tests included 10x3m shuttle sprint, standing long jump and flexibility-rating bench lean tests. The test data were statistically processed by the Pearson group correlation analysis in Statistica 13.0 software toolkit; with the correlations rated on the Chaddock scale [3].

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**Results and discussion.** The test data correlation analysis found the age and physical fitness

**Table 1.** *Age with physical fitness / physical development correlations in the 6-10 year-old untrained (1), martial artists (2) and gymnasts (3) groups*

| Tests | Correlation rate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Very weak and weak | | | Moderate | | | High | | |
| | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| Body length | - | - | - | - | 0,67 | - | 0,79 | - | 0,82 |
| Body mass | - | - | - | 0,56 | 0,59 | - | - | - | 0,87 |
| BMI | 0,25 | 0,33 | - | - | - | 0,55 | - | - | - |
| Chest size | 0,46 | - | - | - | 0,54 | - | - | - | 0,85 |
| Chest excursion | 0,15 | 0,07 | -0,05 | - | - | - | - | - | - |
| Muscle mass, kg | - | - | - | 0,61 | 0,60 | - | - | - | 0,86 |
| Muscle mass, % | 0,06 | 0,27 | - | - | - | 0,51 | - | - | - |
| Fat mass, kg | 0,42 | 0,33 | - | - | - | - | - | - | 0,70 |
| Fat mass, % | 0,38 | 0,14 | -0,20 | - | - | - | - | - | - |
| Skin fat fold | 0,35 | 0,20 | 0,09 | - | - | - | - | - | - |
| HR | 0,05 | -0,10 | -0,39 | - | - | - | - | - | - |
| Systolic blood pressure | -0,21 | 0,38 | 0,43 | - | - | - | - | - | - |
| Diastolic blood pressure | -0,11 | 0,28 | -0,18 | - | - | - | - | - | - |
| Pulse pressure | 0,16 | 0,25 | - | - | - | 0,68 | - | - | - |
| Vital capacity | - | - | - | 0,59 | 0,55 | - | - | - | 0,73 |
| Standing long jump | 0,37 | 0,49 | 0,43 | - | - | - | - | - | - |
| Flexibility | -0,10 | -0,08 | - | - | - | 0,56 | - | - | - |
| 10x3m shuttle sprint | - | - | - | -0,58 | -0,52 | -0,69 | - | - | - |
| Carpal strength, kg | - | - | - | 0,66 | 0,64 | - | - | - | 0,81 |
| Carpal strength, % | 0,21 | 0,35 | - | - | - | 0,52 | - | - | - |
| Prone push ups, reps | -0,15 | 0,42 | - | - | - | 0,54 | - | - | - |
| Sit-ups, reps | -0,28 | - | - | - | 0,58 | - | - | - | 0,85 |

test rates being differently correlated in the physical activity groups: see Table1 hereunder. The untrained group showed very weak and weak correlations (72.7%) with a small share of high correlations (4.5%). The martial artists group was also tested with dominance of very weak and weak correlations (63.6%) albeit different from the untrained group in the moderate correlations (36.3 versus 22.8%, respectively), whilst high correlations were not found. And the gymnasts group showed a fair share of high correlations (36.3%) and equal contributions of the moderate versus very weak and weak correlations (31.8% and 31.8%, respectively).

Special role in the age-dependent tests rates with moderate and high correlations in every group is played by the growth test rates including body length, muscle mass and vital capacity plus the physical fitness rating shuttle sprint and carpal strength test rates. In the gymnasts group, a special priority is given to chest size, fat mass (kg) and abdominal muscle strength tests, with the medium correlations of BMI, muscle mass (%), pulse pressure, flexibility and carpal/ arm strength test rates with age. And in the martial artists group the age-specific progresses are tested by the carpal strength, thigh muscle mass and the abdominal muscle strength test rates.

Weak and very weak age-with-physical fitness / physical development correlations in the sample were found for the functionality test rates including the HR, blood pressure, chest excursion, muscle mass and fat mass and the standing long jump test rates. In case of untrained and martial artists groups, the above are complemented by the BMI, muscle mass (%), fat mass (kg), pulse pressure, flexibility and the relative carpal strength test rates – that are collectively indicative of individual progresses with age in many aspects including those in the regulatory mechanism on the whole and autonomic regulation ones in particular.

Benefits of high physical activity are verified by correlations between the relative carpal strength and age: very weak in the unsporting, week in the martial artists and medium in the gymnasts groups; plus moderate correlations of age with the absolute carpal strength in the untrained and martial artists groups, and high correlations in the gymnasts group. The above are complemented by very weak correlations of age with flexibility in the untrained and martial artists groups, and moderate ones in the gymnasts group; weak correlation of age with the arm/ shoulder girdle strength in the untrained and martial artists groups, and moderate correlations in the gymnasts group; low correlation of age with the abdominal muscle strength in the untrained group, moderate in the martial artists group and high in the gymnasts group. These test data and correlations need to be taken into account by the muscle-group-specific strength and flexibility training systems sensitive to age and sporting experiences to secure every bodily system being fit for progress in the strength and movement coordination qualities.

The age-specific growth and progress in different sports trainings may be additionally profiled by: very weak correlations of age with muscle mass (%) in the untrained and martial artists groups with medium correlations in the gymnasts group; weak correlation of age with fat mass (kg) in the untrained and martial artists groups with high correlation in the gymnasts group; and weak correlation of age with pulse pressure in the untrained and martial artists groups with a moderate correlation in the gymnasts group. These intergroup differences are indirectly indicative of the physical activity benefits as demonstrated by the group weekly physical activity ranging from 90min (two 45-min Physical Education classes) per week in the untrained group to four-five 2-3-hour workouts per week in the gymnasts group.

**Conclusion.** In our ranking of the age-specific physical fitness / physical development test rates we would give a special priority to the absolute physical fitness / physical development tests indicative of the growth process including the body length, body mass, absolute muscle mass, vital capacity, carpal strength, dexterity, abdominal muscle strength, arm and shoulder girdle strength test rates. The test rates little correlated with age in the considered age interval are dominated by the morphofunctional ones indicative of the physical stress tolerance (cardiovascular system, chest excursion, relative muscle mass and fat mass tests); plus some physical fitness aspects tests in the sensitive physical development periods (e.g. leg strength and coordination tests). It should be mentioned in this context that the 6-10 year-olds' trainings should be prudently customized to the individual morphofunctional development test rates, in view of the fact that special role in this period is played by the vegetative organs/ systems regulating mechanisms.

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# Indigenous yakut male athletes: sports-specific constitutions and somatic types

UDC 613.72

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**Abstract**

**Objective of the study** was to rate and analyze the sports-specific body constitutions and types in the indigenous Yakut male athletic groups.

**Methods and structure of the study.** We sampled for the study the 16-19 year-old indigenous sporting males (n=322) under the physical development profiling program with the anthropometrics, functionality, somatic typing and body constitution testing and analyzing elements. We used the standard (as provided by A.S. Shchedrin, 2001) muscle functionality tests to rate the individual reserve capacities and constitutional types on a 'stayer-sprinter' scale. Motor and sensory functional asymmetry of the brain was rated by the lead limb/ eye/ ear detection tests. Somatic typing of the sample was based on the Rees-Eisenk indexing method [1]; and we used the SOMAX toolkit for the statistical processing of the test data [2].

**Results and conclusion.** The sample was grouped into the (1) freestyle wrestling (n=137); (2) team sports (volleyball, basketball and football, n = 52); and (3) ethnic sports (stick tugging also known as mas-wrestling, Northern combined and sledge jumping, n = 64) groups; that were additionally classified by the right/ left/ mixed types of asymmetry.

The study methods and analyses using the standard body typing tests made it possible to obtain objective sports-specific morphology and functionality test data in the indigenous Yakut male sample – that lay a basis for further body typing studies. We found that the habitual active sports facilitate physical progress with no serious detriment to the historic Northern ecotype well-adapted to the harsh Yakut climate.

***Keywords:*** *physical development of young males, morpho-functional status, body constitution, somatic types.*

**Background.** Modern physical development / physical fitness test systems for young athletes make no consideration for the actual factors of influence on the morphologic and functional specifics in the genotypic (ethnic, constitutional) and phenotypic (climatic/ geographic) contexts. These factors, however, are or influence on many biological and demographic processes and, hence, important for the popular physical development / health/ age variations analyses. Genetic backgrounds and environmental conditions are known to affect the bodily variability to a degree with rather individual and unique extremes. As provided by B.A. Nikityuk (1988), modern genetic diagnostics prioritize sets of morphological criteria including the body proportions, fat mass, skeletal muscle shapes, shares of fibers in the latter etc. that collectively determine an individual somatic type – that in its turn is known to be indicative of the key physical qualities and motor resources. Somatic type may be generally defined as the broad biological concept with the relevant specific varying traits and physical development priorities [5].

Objective of the study was to rate and analyze the sports-specific body constitutions and types in the indigenous Yakut male athletic groups.

**Methods and structure of the study.** We sampled for the study the 16-19 year-old indigenous sporting males (n=322) under the physical development profiling program with the anthropometric characteristics, functionality, somatotyping and body constitution testing and analyzing elements. We used the standard (as provided by A.S. Shchedrin, 2001) muscle functionality tests to rate the individual reserve capacities

and constitutional types on a 'stayer-sprinter' scale. Motor and sensory functional asymmetry of the brain was rated by the lead limb/ eye/ ear detection tests. Somatic typing of the sample was based on the Rees-Eisenk indexing method [1]; and we used the SOMAX toolkit for the statistical processing of the test data [2].

**Results and discussion.** The sample was grouped into the (1) freestyle wrestling (n=137); (2) team sports (volleyball, basketball and football, n = 52); and (3) ethnic sports (stick tugging also known as mas-wrestling, Northern combined and sledge jumping, n = 64) groups; that were additionally classified by the right/ left/ mixed types of asymmetry: see Figure 1.

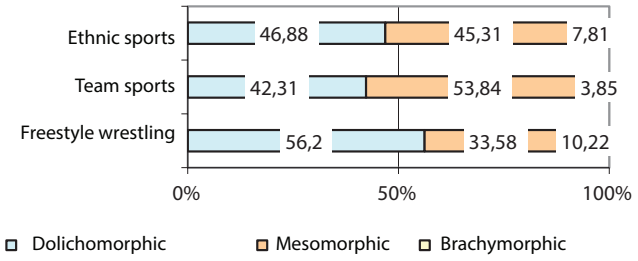


**Figure 1.** *Sports-specific functional asymmetry test data of the sample*

The motor and sensory functionality tests rated 51.24%, 40.37% and 8.39% of the sample with the right, mixed (provisionally symmetrical type referred to as the ambidexterity) and left asymmetry, i.e. dominant left, equal and dominant right brain hemispheres, respectively. Asymmetry in the unsporting subsample was rated 57.08%, 36.75% and 6.16% right, mixed and left, respectively.

Figures 1-3 show that the freestyle wrestling group showed dominance of the mesomorphic body type (56.20%); and was ranked as 'prone to sprint' or interim energy supply type on the adaptive reactions test scale (29.92%). The motor and sensory functionality tests found dominance (56.20%) of the right asymmetry typical for the prevailing left hemisphere activity.

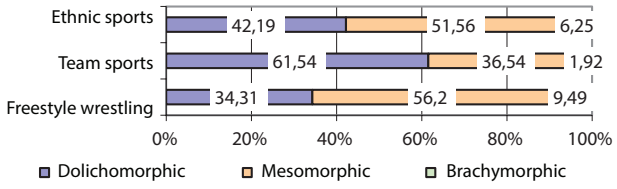


**Figure 2.** *Sports-specific body constitutions in the sample*

The team sports group was tested with dominant dolichomorphic somatic type (61.54%), plus 'prone to stayers' type of adaptive strategy (34.62%); with most of the group (53.84%) tested with symmetrical (mixed) brain activity profiles i.e. provisionally balanced hemispheric activities (ambidexterity).

And the ethnic sports group was found different from the above in the dominant mesomorphic body type (51.56%) and aerobic energy sources of 'stayer' type (32.82%); with 46.88% and 45.31% tested with the right and mixed hemispheric activities, respectively.

**Conclusion.** The study methods and analyses using the standard body typing tests made it possible to obtain objective sports-specific morphology and functionality test data in the indigenous Yakut male sample – that lay a basis for further body typing studies. We found that the habitual active sports facilitate physical progress with no serious detriment for the historic Northern ecotype well-adapted to the harsh Yakut climate.

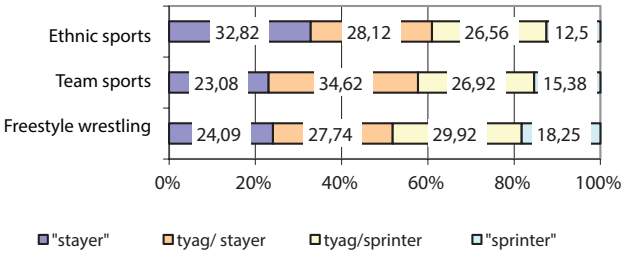


**Figure 3.** *Constitution- and sports-specific adaptive responses to static pressures in the sample*

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# Human resource supply and demand situation analyzing and forecasting system for national physical education and sports sector

UDC 796.075

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**Abstract**

**Objective of the study** was to test benefits of a new data analyzing system in application for the human resource (HR) supply and demand situation analyses and forecasts in the national physical education and sport sector by professions and regions.

**Methods and structure of the study.** The new data analyzing system concept analyzed herein was designed on a user-friendly basis, with the following data inputs:

– National statistics for the physical education and sport sector: SRF 1-PE, 5-PE, 3-APE;
– Corporate regulations in effect in the physical education and sport sector;
– Data on the federal and regional investment projects in the physical education and sport sector;
– Regional HR demand forecasts for the physical education and sport sector;
– Findings of the online HR flow profiling surveys of employers, governmental agencies, local authorities, relevant organizations, public associations and specialists interested in the professions-specific HR demand and supply situation in the physical education and sport sector; and
– Reports of the relevant recruiting agencies and employment services.

At the preliminary data flow processing stage, the system makes a primary data screening and analyses to rate the data reliability and consistency and form primary/ secondary data arrays for storage in the data analyzing system.

We gave a special priority in the study to an online questionnaire survey technology applicable by the employers, governmental agencies, local authorities, relevant organizations, public associations and specialists interested in the professions-specific HR demand and supply situation in the physical education and sport sector.

In June 2020 through April 2021 we used the data analyzing system to survey the physical-education-and-sports-controlling governmental agencies, authorities and organizations, with the two surveyed expert groups representing the local authorities and physical education and sports organizations. We sampled for the data analyzing system piloting tests officers of the relevant government agencies and authorities (n= 676) and managers of the physical education and sports organizations from the Central, Volga, Ural, Northwestern, Southern, Siberian, Far Eastern and the North Caucasian regions.

**Results and conclusion.** The HR demand and supply monitoring system for the national physical education and sport sector was tested beneficial as it offers an updatable HR database with analytical and forecast capacities to timely profile and predict the HR flows in the sector and rate efficiency of the relevant social mechanisms, initiatives, projects, governmental agencies, businesses and social interests – in the context of the HR training and employment and national physical education and sport sector progress policies and practices.

***Keywords:*** *physical education and sports human resource supply, data analyzing system (DAS), human resource demand monitoring.*

**Background.** The human resource supply and demand situation monitoring, analyzing and statistical reporting system of the national physical education and sport sector needs effective toolkits to timely rate the human resource supply and demand and process the reporting data flows from the relevant physical education and sports agencies and authorities [2-5]. Saint Petersburg Research Institute of Physical Culture has developed a data analyzing system applicable for the human resource supply and demand situation analyses and forecasts in the national physical education and sport sector.

**Objective of the study** was to test benefits of a new data analyzing system in application for the human resource supply and demand situation analyses and forecasts in the national physical education and sport sector by professions and regions.

**Methods and structure of the study.** The new data analyzing system concept analyzed herein was designed on a user-friendly basis, with the following data inputs:

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– Corporate regulations in effect in the physical education and sport sector;

– Data on the federal and regional investment projects in the physical education and sport sector;

– Regional human resource demand forecasts for the physical education and sport sector;

– Findings of the online human resource flow profiling surveys of employers, governmental agencies, local authorities, relevant organizations, public associations and specialists interested in the professions-specific human resource demand and supply situation in the physical education and sport sector; and

– Reports of the relevant recruiting agencies and employment services.

At the preliminary data flow processing stage, the system makes a primary data screening and analyses to rate the data reliability and consistency and form primary/ secondary data arrays for storage in the data analyzing system [1]. The data analyzing system will process the data to generate analytical reports by sports, specialties, regions, etc. The output data will be uploaded to the relevant websites including special interactive recruiting platforms for the physical education and sport specialists with an authorized access, plus the free-access ones.

We gave a special priority in the study to an online questionnaire survey technology applicable by the employers, governmental agencies, local authorities, relevant organizations, public associations and specialists interested in the professions-specific human resource demand and supply situation in the physical education and sport sector.

In June 2020 through April 2021 we used the data analyzing system to survey the physical-education-and-sports-controlling governmental agencies, authorities and organizations, with the two surveyed expert groups representing the local authorities and physical education and sports organizations. We sampled for the data analyzing system piloting tests officers of the relevant government agencies and authorities (n= 676) and managers of the physical education and sports organizations from the following key eight regions (n=2584): Central, Volga, Ural, Northwestern, Southern, Siberian, Far Eastern and the North Caucasian regions.

**Results and discussion.** The survey generated data on the key issues of the human resource demand in the physical education and sport sector. Given hereunder on Figure 2 is the reported human resource demands by professions and regions that make it possible to make the sports-specific demand profiles. Such profiles clearly show, on the one hand, needs of the sector for specific professions, and, on the other hand, highlight the still undemanded specialties. The undemanded specialist supply analyses are rather important since they demonstrate what physical education and sports professions are marginalized for different reasons and need, therefore, special attention, promotion or market-sensitive training service.

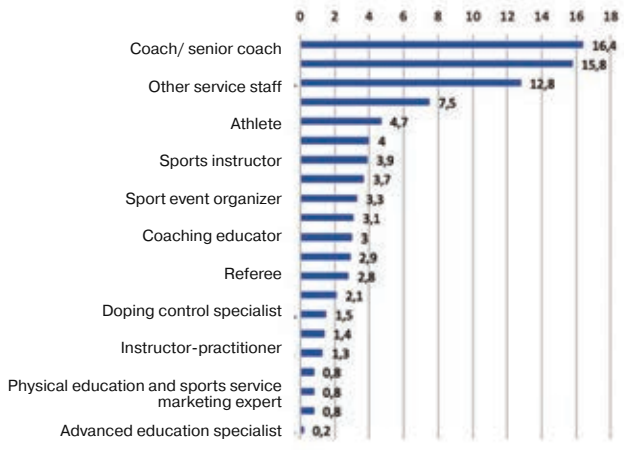


**Figure 1.** *Human resource demand situation reported by the physical education and sports organizations, %*

The system generates the human resource demand data for every region to provide a basis for the short-term forecasts of regional human resource demand and supply situations on the local labor markets. The human resource monitoring system also generates guiding mid-term (5-year in the case) HR demand forecasts. Figure 3 shows the five-year human resource demand forecast for sports and professions based on the expert survey data. Such mid-term forecasts are needed to sort out the human resource demand flows and find the most and least demanded specialties plus the regions in need of some physical education and sport specialists.

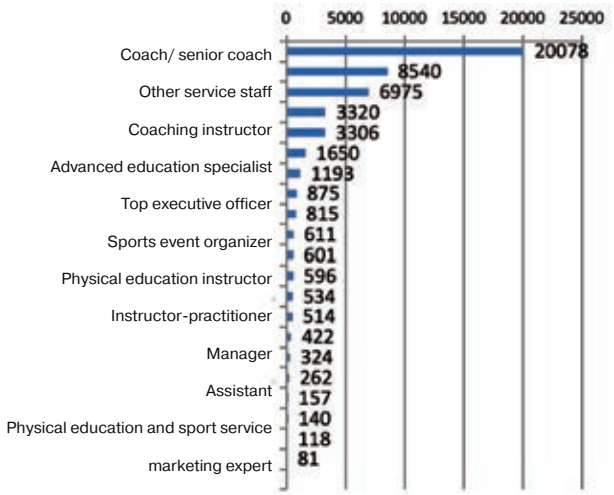


**Figure 2.** *Mid-term (five-year) human resource demand forecasts by sports and professions*

The physical education and sports human resource demand and supply monitoring system makes it possible to analyze the corporate performance in the headhunting and recruitment domains. The corporate respondents mentioned the following two key problems in the above: (1) shortage of applicants for the vacant positions (reported by 29% of the group); and (2) low wages as compared with the other employers (28%). The corporate group also emphasized the growing competition of employers (2%) in headhunting – that is quite logical in terms of the short supply. This information is rather important for the data analyzing system updating goals to excel the system headhunting capacity, provided the specialists are lured by extra incentives to the positions. Of special importance for the recruitment efforts are the competitive advantages of the specific vacancies among the other incentives.

The physical education and sports human resource demand and supply monitoring system designed on a sound theoretical and practical basis with timely customizing options in response to the expert survey data and regulatory provisions – was tested beneficial as it gives the means to accurately rate and forecast the human resource demand situations by regions, professions, professional backgrounds and competences [6].

**Conclusion.** The human resource demand and supply monitoring system for the national physical education and sport sector was tested beneficial as it offers an updatable human resource database with analytical and forecast capacities to timely profile and predict the human resource flows in the sector and rate efficiency of the relevant social mechanisms, initiatives, projects, governmental agencies, businesses and social interests – in the context of the human resource training and employment and national physical education and sport sector progress policies and practices.

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# National sports reserve training system: coaching resource flow analysis

UDC 796.071

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**Abstract**

**Objective of the study** was to analyze, on a systemic basis, the national sports reserve training system and make a coaching resource flow analysis based on [Statistical Reporting] Form No. 5-FC (FSN 5-FC) that gives averaged year-to-year national sports reserve training coaching resource flow data for the period since the National Sports Classifier effectuation in 2014.

**Methods and structure of the study.** We analyzed the national sports reserve training statistics for the project sports (under TOR- terms of reference) including cycling, swimming, rowing, kayaking and canoeing (paddling), triathlon, archery and biathlon. We made a comparative analysis of the year-to-year FSN 5-FC data and the relevant averages for 2014-2016, 2017-2019 and separately for 2020.

**Results and conclusion.** One of the key prerequisites for the coaching resource flow management efficiency, particularly in the national sports reserve training system, is the federal statistical monitoring and reporting as required by the Statistical Reporting Form No. 5-FK. The coaching resource flow reports should provide a sound basis for the national sports reserve training system operations and decision making with timely updates to the relevant national coaching resource flow management programs and concepts in the physical education and sport sector. The presently growing digital transformation trends in the physical education and sports sector should facilitate the coaching resource flow control mechanisms with contributions from the cutting-edge digital platforms to reverse the latest regress in the national sports reserve training system.

***Keywords:*** *kind of sport, sports reserve, national sports reserve training system, Federal Statistics Report, coach, National Sports Classifier.*

**Background.** Corporate and individual entities in the national physical education and sports system are governed by the relevant legal and regulatory framework that helps synergize their efforts for the physical education and sport sector progress goals; with this progress monitored, tested and analyzed on a systemic basis as required by the national physical education and sports sector development policies [2, 4]. The national policies in the national sports reserve training domain are designed based on [Statistical Reporting] Form No. 5-FC (FSN 5-FC) with the relevant regulatory provisions including those in the National Sports Classifier, Federal Sports Training Standards for different sports, calendars of the sports competitions at every physical education and sports level and other regulations [3].

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canoeing (paddling), triathlon, archery and biathlon. We made a comparative analysis of the year-to-year FSN 5-FC data and the relevant averages for 2014-2016, 2017-2019 and separately for 2020.

**Results and discussion.** We found the following most informative data sets (in a descending order): coaching staff headcounts; qualified (Class III plus) athletes' headcounts; and numbers of sports departments in the sector [5]. We have grounds to believe that the Statistical Reporting Form No. 5-FC (FSN 5-FC) gives the most accurate data and, hence, fairly reliable for the national sports reserve training situation analyses. The study reports and analyzes the NSR coaching staff numbers and flows on a yearly basis for the period, mostly mined in the Total Number of Coaches entry of the above reporting form. The coaching staff flow statistics for the period (since 2014) show a few progress vectors: see Figure 1 hereunder.

The coaching resource was tested to grow at different paces only in two sports disciplines. Thus in swimming coaching resource was reported to grow year-to-year by 80 people on average in 2014 through 2019, i.e. by 2.3% versus 2014. In 2020, the coaching resource total was reported to drop by 906 (22.8%) versus 2019. In absolute figures, the 2020 coaching resource was 458 coaches lower versus the 2014 coaching resource (3072 versus 3530, respectively).

Prior to 2019, the NRT system reported virtually a linear coaching resource growth for archery – plus 4.5 coaches per year (1.1%) on average. The year of 2020, however, marked a coaching resource drop by 96 to 2019, i.e. 22.3% drop per year and 23.4% drop for the whole period. This means that the 2020 coaching resource was 67 people (16.7%) lower than the 2014 coaching resource.

The 2014-2019 may be ranked as the relatively stable period for five of the seven sports (save for swimming and cycling) with the coaching resource variation range reported at 2.4% to 3.3%. In case of rowing, the year-to-year coaching resource was still on the fall, with no one year reporting growth since 2014. The situation was aggravated in 2017, when the kayaking and canoeing sports reported a coaching resource sagging trend.

Of special concern is the coaching resource flow situation in cycling. The sport has reported the coaching resource sagging since 2014 followed by a drastic drop in 2020. In absolute terms, the 2019 coaching resource was 164 people (17.9%) lower than the 2014 coaching resource, with the gap expanded to minus-251 (27.4%) for the whole reporting period. The coaching resource flow data reported by FSN 5-FC Form makes it possible to analyze the coaching resource flow averages for the equal times within the reporting periods: see Table 1 hereunder.

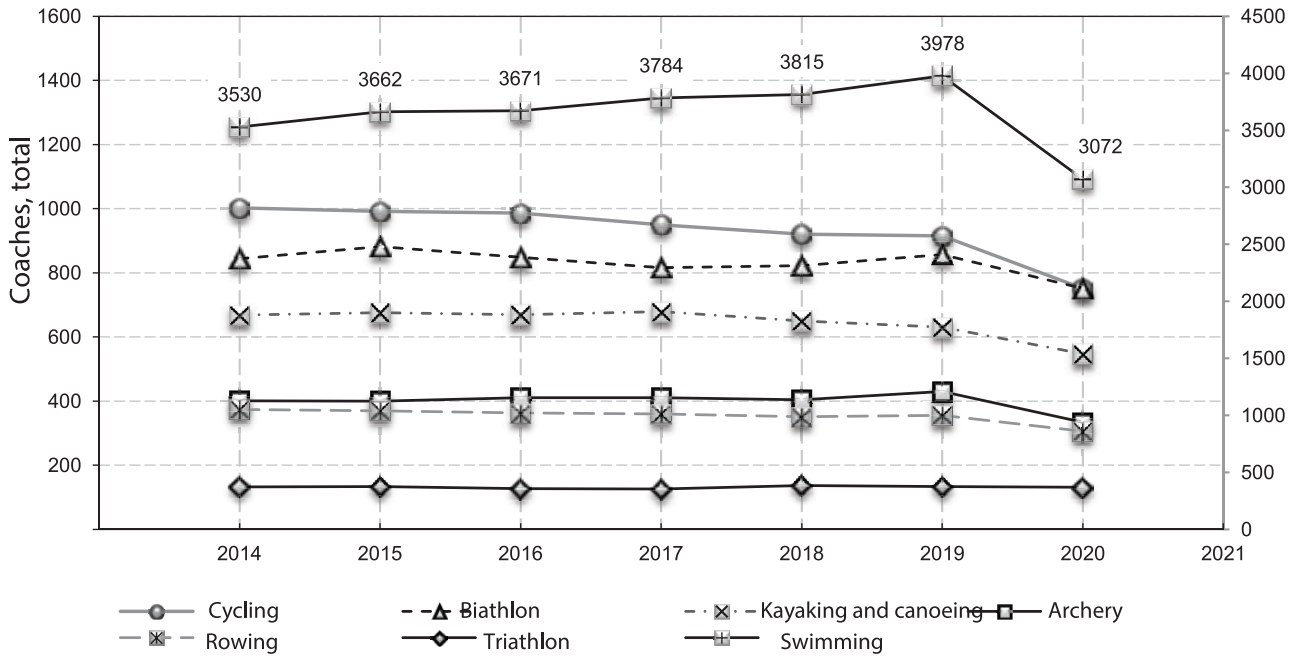


**Figure 1.** *Year-to-year coaching staff flow statistics as provided by the Statistical Reporting Form No. 5-FC (FSN 5-FC) since 2014*

**Table 1.** *Consolidated averaged coaching resource flow data since 2014 by the sports disciplines*

| Sport | Flow average in 2014-2016 and 2017-2019 | | | | Flow averages in 2020 | | |
|---|---|---|---|---|---|---|---|
| | 2014–2016 | 2017 – 2019 | Growth | % | 2020 | Growth | % |
| Swimming | 3621 | 3859 | 238 | 6,6% | 3072 | -787 | -20,4% |
| Cycling | 993 | 929 | -65 | -6,5% | 751 | -178 | -19,1% |
| Biathlon | 858 | 832 | -26 | -3,1% | 751 | -81 | -9,7% |
| K&C* | 671 | 653 | -18 | -2,7% | 547 | -106 | -16,2% |
| Archery | 404 | 415 | 11 | 2,7% | 334 | -81 | -19,5% |
| Rowing | 369 | 356 | -13 | -3,6% | 306 | -50 | -14,0% |
| Triathlon | 131 | 132 | 1 | 0,8% | 131 | -1 | -1,0% |

*Note: *Kayaking and canoeing*

The 2017-2019 to 2014-2016 coaching resource average variations were positive only for three out of seven sports, namely swimming (+238 or 6.6% growth); archery (+11, or 2.7% growth); and triathlon (+1, 0.8% growth). The other four sports reported falls in the coaching resource averages. This smooth regress was followed by dramatic falls of 14-20% in 2020 in every of the seven disciplines save for triathlon.

It should be mentioned in this context that the Coaching Resource Training Concept of the Russian Federation for the period till 2025 requires the "human resource development, particularly the coaching resource for the national sports reserve training system as its key element" [4]. Our comprehensive study of the FSN-reported coaching resource flow statistics in the national sports reserve training system has found concerning negative trends in a few progress criteria, particularly as of the late 2020. These regresses are apparently due to the national sports reserve training system instability under unexpected external pressures including those related to the COVID-19 pandemic of 2020.

**Conclusion**. One of the key prerequisites for the coaching resource flow management efficiency, particularly in the national sports reserve training system, is the federal statistical monitoring and reporting as required by the Statistical Reporting Form No. 5-FK. The coaching resource flow reports should provide a sound basis for the national sports reserve training system operations and decision making with timely updates to the relevant national coaching resource flow management programs and concepts in the physical education and sport sector. The presently growing digital transformation trends in the physical education and sports sector should facilitate the coaching resource flow control mechanisms with contributions from the cutting-edge digital platforms to reverse the latest regress in the national sports reserve training system [1].

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