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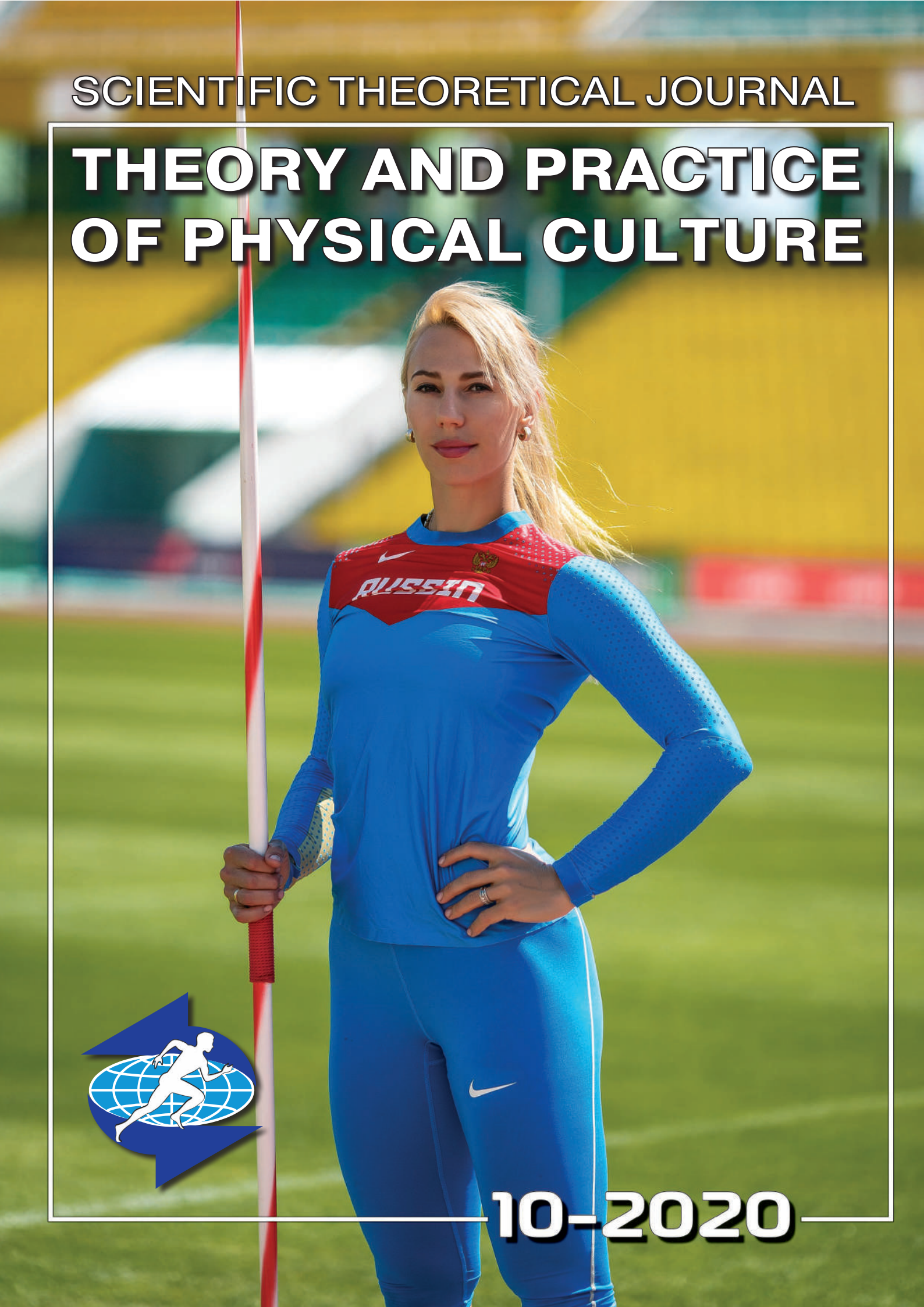

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Contents

Theory and Practice of Physical Culture

Adaptive control for athletic motor skills excellence

UDC 796.012

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Abstract

Objective of the study was to develop adaptive control software to model movement of an object from the initial phase when the execution deviates from the execution standard to the required standard state with the relevant kinematics.

Methods and structure of the study. The research methods applied during the study were as follows: system-structural analysis of movements, theory of automatic control, simulation of motions with a computer. The object of study was the adaptive control over the biomechanical system, driving the object of movement from the given startup state to the required final state. Materials: computer model of the movement, organization of research - computational experiments conducted on the basis of the original software program (algorithmic programming language VisualBasic 2010 Express, integrated programming environment - VisualStudio 2013).

Results and conclusions. The computational experiments showed that the adaptive control model built on the feedback law in the controlled phase coordinates and time successfully solves the problem of putting the object of movement with "erroneous" trajectory back on the given programmed trajectory with the achievement of the required kinematic parameters by the final time.

Keywords: *athletic performance, execution standard, execution error, motor skill, adaptive control, biomechanical system trajectory.*

Background. It is the deviation of the kinematic parameters of the current biomechanical system trajectory from the execution standard ('programmed strategy') that results in serious technical errors and, when the deviation is significant, failed athletic performance. As far as the athletic performance quality is concerned, it is the athlete who takes efforts to correct a deviation of the actual execution from the execution standard that is referred to as the execution error [2, 3]. The study considers a computerized adaptive control model to prevent potential execution error and help the subject come back to the execution standard. In contrast to the relevant prior study [4], the programmed trajectory kinematics herein include not only the subject's coordinates but also their first and second derivatives – to help synthesize a wide range of movement sequences: from striking contact to super soft touch.

Objective of the study was to develop adaptive control software to model movement of an object from the initial phase when the execution deviates from the execution standard to the required standard state with the relevant kinematics.

Methods and structure of the study. We used methods of systemic movement structure analysis, automatic control theory based methods, and movement modeling/ simulation computer methods. We used the following variables to describe the object kinematics from the initial (T_0) to final (T_k) time moments: S_0 is the initial coordinate, V_0 is the initial velocity, S_k is the final coordinate, and V_k is the final velocity.

Let us consider the case of the approach closed in time [1], with movement in the time interval [T_0 to T_k] geared to move the control object from the initial point with the phase coordinates S_0, V_0 to the final points with coordinates S_k,V_k. Let's synthesize control in acceleration units. When S is the object movement, $\ddot{S}$ the second derivative of S by time (t), then

$$\ddot{S} = u. \quad (1)$$

Programmatic control (u) under two final conditions may be described by the following function with two unknown parameters (C_0, C_1):

$$u = C_0 + C_1 t. \quad (2)$$

u is the control function; and t time.

To find the final velocity (V_k) and coordinate (S_k,) let's put (2) into (1) and by integrating it twice within the limits [T_0, T_k], arrive at

$$V_k = V_0 + C_0 T_k + \frac{C_1 T_k^2}{2}, S_k = S_0 + V_0 T_k + \frac{C_0 T_k^2}{2} + \frac{C_1 T_k^3}{6}. \quad (3)$$

Adaptive control will drive the object from the deviated trajectory (resulting from execution error) to the standard execution trajectory. Let us design the adaptive control system with a feedback capacity [1]: when the current situation (S_C, V_C) with the time tag t is initial, then

$$u = -\frac{6S}{\Delta T^2} + \frac{6S_C}{\Delta T^2} - \frac{4V}{\Delta T} - \frac{2V_C}{\Delta T}. \quad (4)$$

The current phase coordinates of the key point (S_C, V_C) before the controlled object with the time interval ΔT may be computed as recommended in [1] as follows:

$$V_C = V_0 + C_0(t+\Delta T) + \frac{C_1(t+\Delta T)^2}{2},$$

$$S_C = S_0 + V_0(t+\Delta T) + \frac{C_0(t+\Delta T)^2}{2} + \frac{C_1(t+\Delta T)^3}{6}. \quad (5)$$

The current time t varies within the frame [0, T], while C_0, C_1, knowing the initial and final coordinates and object velocity, are computed as follows

$$C_0 = -\frac{6S_0}{T^2} + \frac{6S_k}{T^2} - \frac{4V_0}{T} - \frac{2V_k}{T},$$

$$C_1 = \frac{12S_0}{T^3} - \frac{12S_k}{T^3} + \frac{6V_0}{T^2} + \frac{6V_k}{T^2}. \quad (6)$$

Let's substitute (6) into (5) with mathematical operations to arrive at the following adaptive control law:

$$u = k_0 + k_1 t + k_2 t^2 + k_3 t^3 + k_S S + k_V V. \quad (7)$$

Note that ratios (k) in equation (6) are computed once for the whole movement trajectory as follows:

$$k_0 = \frac{6S_k}{\Delta T^2} + \frac{4V_0}{\Delta T} + C_0 \quad k_1 = \frac{6V_0}{\Delta T^2} + \frac{4C_0}{\Delta T} + C_1 \quad k_2 = \frac{3C_0}{\Delta T^2} + \frac{2C_1}{\Delta T};$$

$$k_3 = \frac{C_1}{\Delta T^2}; \quad k_S = -\frac{6}{\Delta T^2}; \quad k_V = -\frac{4}{\Delta T}. \quad (8)$$

Note that ΔT (control rigidity) varies within the range of 10-25% of T_k. The shorter is ΔT, the faster the object comes back from the deviated trajectory to the standard one.

Computational experiments were run using the original basic computer software (in VisualBasic 2010 Express using VisualStudio 2013 toolkit) and were intended to rate efficiency of the software system in synthesizing the adaptively controlled object movement.

Results and discussion. We run a computational experiment to rate benefits of the software system.

1. Movement with a preset execution standard. *Initial data:* timeframe T_0 = 0, T_k = 20, ΔT = 3. Spatial-temporal variables: S_0=200, V_0=10, S_k=0. Given on Figure 1 hereunder is the visualized computation result.

2. Movement with synthesized adaptive control. For the initial time moment, the execution error i.e. the difference between the actual execution and execution standard may be discretional, e.g. ΔS_0 = 200-170=30, ΔV_0 = 10-6=4. Initial data: timeframe T_0 = 0, T_k = 20, ΔT = 3. Spatial-temporal variables: S_0 = 170, V_0 = 6, S_k = 0. As a result, the ratios (k) in the adaptive control algorithm (7) and control function (u) are as follows

$$k_0 = 51,000; \quad k_1 = -1,150; \quad k_2 = -0,420;$$

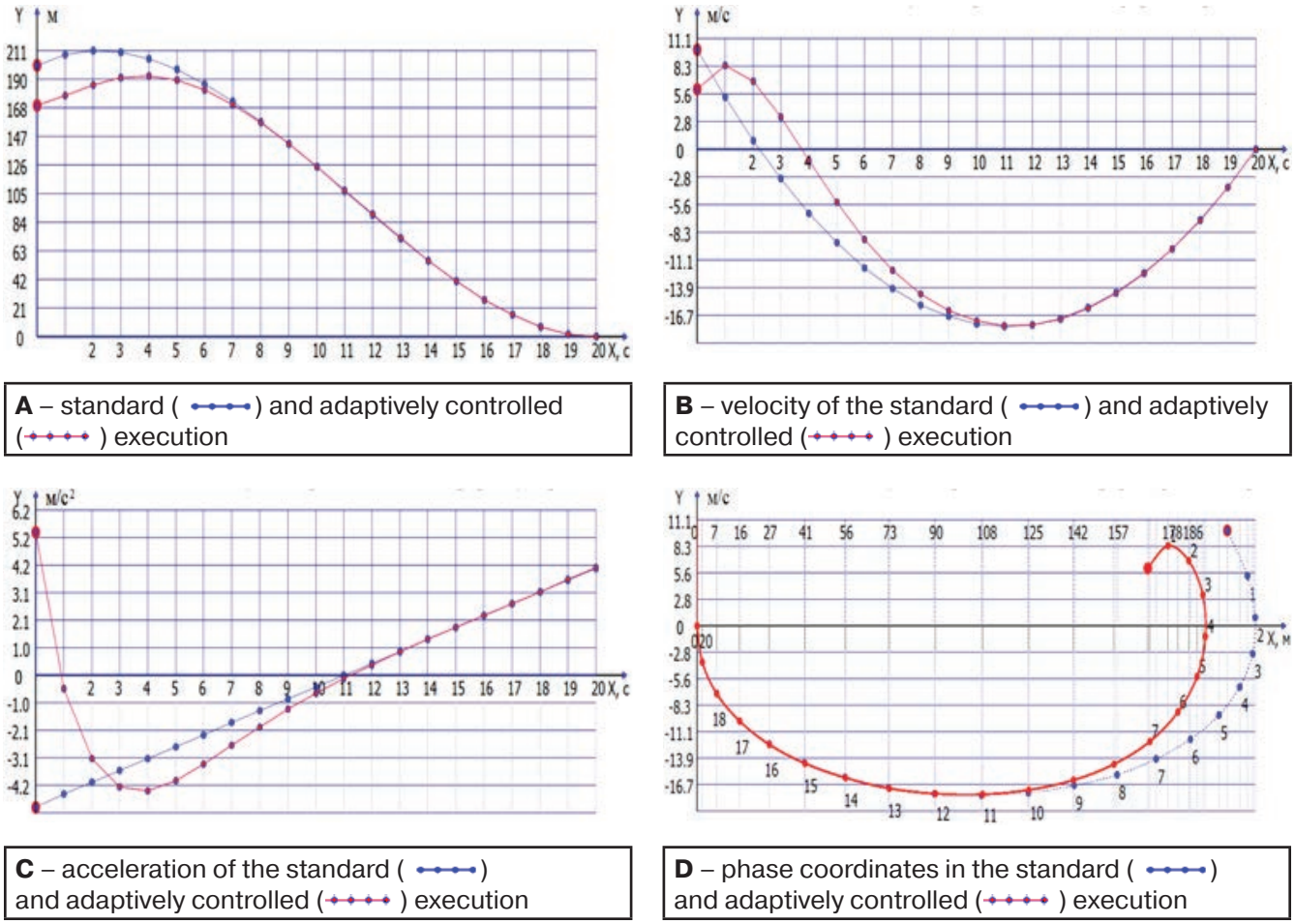
$$k_3 = 0,180; \quad k_V = -0,800; \quad k_S = -0,240$$

$$u = 51 - 1,15t - 0,41t^2 + 0,018t^3 - 0,24S - 0.8V$$

The computational experiments showed that the adaptive control with a feedback capacity designed using the phase coordinates and timeframe is highly efficient in forcing the controlled object back from the deviated/ erroneous trajectory to the execution standard with the target kinematics at the final time point (Figure 2).

Conclusion. The adaptive control law (7), was found efficient in forcing the controlled object to follow the execution trajectory within the preset timeframe [T_0,T_k] to drive it at the final phase point (S_k,V_k).

The feedback capacity with phase coordinates within the adaptive control law ensures the controlled object coming back from the erroneous trajectory (resulting from execution error) to the execution standard.



A – standard ( ) and adaptively controlled ( ) execution

B – velocity of the standard ( ) and adaptively controlled ( ) execution

C – acceleration of the standard ( ) and adaptively controlled ( ) execution

D – phase coordinates in the standard ( ) and adaptively controlled ( ) execution

Figure 1. *Trajectory (coordinates, velocities, accelerations) of the standard and adaptive control execution Standard and adaptive control execution* (A, B, C) *kinematics and synthesized movement trajectory* (D)

The adaptive control law (7) with both the feedback capacity and phase coordinates corrects every deviation of the controlled object from the execution standard, with the correction speed determined by ΔT.

Variations in the movement conditions make no changes to the adaptive control law but form a new adaptive control adjusted to the new conditions to attain the movement target by the final time point. The adaptive control with feedback capacity acts as an execution error correction tools that drives the controlled object back to the standard execution trajectory.

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Female acrobats' choreographic training model for excellence stage

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Abstract

Objective of the study was to offer and test benefits of a new female acrobats' choreographic training model for excellence stage.

Methods and structure of the study. The new choreographic training model testing experiment was run at Children and Youth Olympic Reserve Sport School (CYORSS) No. 3 in Tomsk in the 2018-19 academic year. We sampled for the study the sport excellence group trainees (n=10) split up into Experimental Group (EG, n=10) and Reference Group (RG, n=10). The pre-experimental tests found the groups virtually equal in the general and special physical fitness tests. The RG was trained as recommended by the traditional system; whilst the EG training was dominated by the new choreographic training model.

Results and conclusions. The developed methodology of complex choreographic training of female acrobats was designed for an academic year (about 74 classes) and was conducted regularly twice a week in the preparatory part and at the beginning of the main part of the training session. The peculiarity of choreographic training of female acrobats was that it was based on motor asymmetry. Each motor action in the choreographic classes was performed equally in each direction with both legs and arms. A series of exercises with a rubber band was also used, which consisted of exercises to develop in female acrobats static strength, special endurance, flexibility, and coordination skills. In the process of choreographic training, the musical and dance exercise method was used, since teaching the elements of classical and folk dance is the basis of choreographic training.

The new female acrobats' choreographic training model for the excellence stage was tested beneficial for the general and special physical fitness of the trainees.

Keywords: *acrobatics, choreographic training, motor skills, sport excellence stage, theoretical and practical trainings, physical fitness.*

Background. Competitive performance in modern acrobatics may be successful only when the routines are original and execution artistry is excellent in every element including synch with the musical illustrations – that means that every athlete shall demonstrate a high mastery in every sport-specific motor skill based on perfect physical qualities. Therefore, the key goal of a choreographic training model is to facilitate progress in expressivity and help the athlete build up the motor skill arsenal for excellent competitive performance. The choreographic training models, as provided by many sport specialists will give a special priority to progress in motor memory and movement coordination qualities on the whole and in jumping, flexibility, joint motility, elasticity, muscle strength, expressivity and artistry in particular [1-5].

Objective of the study was to offer and test benefits of a new female acrobats' choreographic training model for excellence stage.

Methods and structure of the study. The new choreographic training model testing experiment was run at Children and Youth Olympic Reserve Sport

School (CYORSS) No. 3 in Tomsk in the 2018-19 academic year. We sampled for the study the sport excellence group trainees (n=10) split up into Experimental Group (EG, n=10) and Reference Group (RG, n=10). The pre-experimental tests found the groups virtually equal in the general and special physical fitness tests. The RG was trained as recommended by the traditional system; whilst the EG training was dominated by the new choreographic training model.

Results and discussion. The pre-experimental tests found the intergroup differences being insignificant ($p>0.05$) in every general/ special physical fitness test. Based on the test data and analyses, we developed and implemented in the EG trainings the new choreographic training model that includes classical dance elements, rhythmic gymnastics, acrobatics and dance combinations, free plastic, walking and running elements, plus combinations with elastic rubber. The choreographic training model was tested for academic year (about 74 classes), with two trainings a week, and with special choreographic training workouts in the warm-up and main parts of every training class. The 60-min choreographic training trainings were designed on a time-efficient basis at no sacrifice for the core training system.

A special emphasis in the choreographic training model was made on the motor asymmetry, with every motor skill executed so as to mobilize equally the body, legs and arms using as much as possible the rubber band. The asymmetry correction set of exercises was designed to develop static strength, special endurance, flexibility and movement coordi-

Table 1. *General physical fitness test data*

Test	Pre-experimental		Post-experimental	
	RG $\overline{X} \pm \sigma$	EG $\overline{X} \pm \sigma$	RG $\overline{X} \pm \sigma$	EG $\overline{X} \pm \sigma$
20m sprint, s	4,1±0,5	4,4±0,7	4,3±0,4	4,8±0,7
Standing long jump, cm	4,2±0,4	4,5±0,3	4,4±0,3	5,0±0,2
30-s sit-ups, count	4,1±0,5	4,6±0,4	3,8±0,7	5,0±0,5*
Pull-ups, count	3,0±0,5	3,3±0,5	3,4±0,8	3,9±0,4
Handstand, s	4,2±0,7	4,5±0,3	3,7±0,4	5,0±0,0*
Prone push-ups, count	4,0±0,8	4,5±0,5	4,1±0,9	4,9±0,3*

** significance of intergroup difference,* $p<0.05$

***Table 2**. Special physical fitness test data*

Test	Pre-experimental		Post-experimental	
	RG $\overline{X} \pm \sigma$	EG $\overline{X} \pm \sigma$	RG $\overline{X} \pm \sigma$	EG $\overline{X} \pm \sigma$
Front right-leg balance, points	3,2±0,4	3,2±0,4	3,3±0,5	4,3±0,5*
Side right-leg balance, points	3,2±0,4	3,3±0,5	3,6±0,7	4,5±0,5*
Back right-leg balance, points	4,0±0,7	4,0±0,5	4,1±0,6	5,0±0,4*
Front left-leg balance, points	3,2±0,4	3,5±0,5	3,6±0,5	4,1±0,3*
Side left-leg balance, points	3,6±0,5	3,7±0,4	3,7±0,4	4,3±0,5*
Back left-leg balance, points	4,0±0,7	4,2±0,4	4,1±0,6	4,6±0,5*
Forward split leap, points	4,5±0,5	4,6±0,5	4,8±0,5	5,0±0,02
Full twisting vertical foot bounce, points	4,6±0,5	4,6±0,5	4,7±0,5	5,0±0,1

**significance of intergroup difference,* $p<0.05$

nation. The choreographic training trainings widely applied the dance elements with musical illustrations since the classical and folk dance elements are viewed as a basis of the choreographic training model [3]. Group progress was rated by the post- versus pre-experimental general/ special physical fitness tests: see the Tables hereunder.

As demonstrated by the above Table 1, the EG made signficantly higher progress in the abs/ shoulder girdle strength endurance and coordination skills tests.

As demonstrated by Table 2, the EG made a significant progress versus the RG for the experimental period in the special balancing skills tests.

Conclusion. The new female acrobats' choreographic training model for the excellence stage was tested beneficial for the general and special physical fitness of the trainees.

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Elite Kettlebell lifters' competitive success rates versus biorhythms

UDC 796.894.012.46

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Abstract

Objective of the present study was to determine the relationship between the competitive activity of elite kettlebell lifters and their biological rhythms.

Methods and structure of the study. We analyzed the biological rhythms and competitive success rates of the Honored Master of Sport of the Russian Federation in kettlebell lifting. We studied the results of the top-ranking competitions (Russian and World championships) held during the last 7 years. The subject's biological rhythms were determined using an Internet service.

Results and conclusions. Competitive progress data of the elite kettlebell lifter revealed that he was 19 years old when he made his first success in the 2012 Russian Kettlebell Lifting Sport Championship. The study found a three-year cycle in his competitive progress, with the athlete's competitive progress peaks fixed at 19, 22, 25 and 28 years of age.

During the pre-competitive and competitive activities, the changes were more of a complex nature. The analysis of the results achieved since 2012 showed a smooth growth. However, , sports results have been stabilized in recent years. Despite the change in the biological rhythms, the athlete was competent in preparing for these competitions and demonstrated a high sports result. We identified individual features of biological rhythms in the athlete. The data presented in the article reflect part of the information proving the existing periodicity in man. The cycles reviewed reflect downturns, upswings, stabilization, and achievement of the high competitive results. The selected example confirms these patterns. It is important that the observed patterns are taken into account when individualizing the athletic training process.

Keywords: *sports training, biological rhythms, individualization, competitive progress, elite athletes, kettlebell lifting sport.*

Background. Growing competitiveness of the modern sports expose the athletes to hard training and competitive workloads and stresses – which, as reported by a number of studies, may undermine immunity of the sports elite and trigger sports-related diseases [6] considered inevitable by many experts [5]. This is the reason why the sport research community gives a special priority to the physical, mental and competitive fitness tests and analyses to prevent risks for the athletes' working capacity and health standards [1, 2]. Long-term studies of the individual competitive progresses of the sports elite have found certain biological regularities determined by two- and three-year biological rhythms in females and males, respectively [4, 3]. It generally means that competitive progress peaks are normally achieved once in two and three years by the female and male athletes, respectively [7].

Objective of the study was to analyze an individual competitive progress versus biorhythmic cycles of an elite kettlebell lifter (Honored Master of Sport).

Methods and structure of the study. We made the 7-year competitive progress analysis for the top-ranking competitive events (World and Russian Cham-

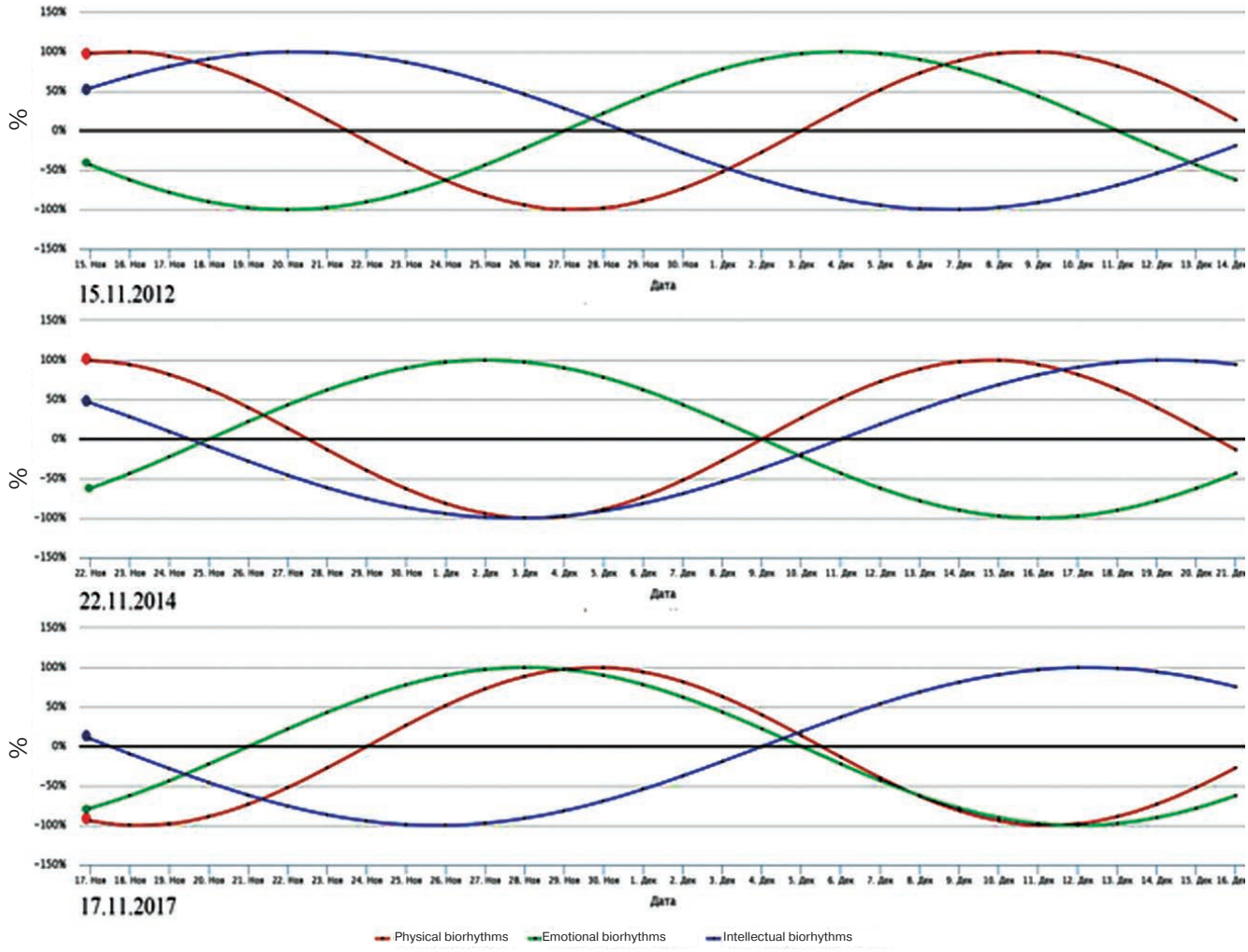

Figure 1. *Biorhythm variations in the 2012-17 World Championships*

pionships), with the event place, date and competitive success fixed and compared with the relevant biorhythm data calculated using the relevant online service tools.

Results and discussion. Given in Tables 1 and 2 hereunder are the competitive progress data of the elite kettlebell lifter who was 19 years old when made his first success in the 2012 Russian Kettlebell Lifting Sport Championship. The study found a three-year cycle in his competitive progress, with the athlete's competitive progress peaks fixed at 19, 22, 25 and 28 years of age.

The above Table gives the individual progress data in the Russian Championships. Since the places were different, the time zones were also different in a few cases, with the relevant complications for the precom-

Table 1. *Competitive progress statistics of the elite kettlebell lifting*

Year	Russian Kettlebell Lifting Sport Championship			World Kettlebell Lifting Sport Championship		
	Date	Place	Score	Date	Place	Score
2012	10.06	Orenburg	78	15.11	Latvia, Talsi	82*
2013	10.06	Omsk	81	23.11	Russia, Tyumen	84*
2014	03.06	Kirov	81	22.11	Germany, Hamburg	87*
2015	29.05	Gatchina	82	28.11	Ireland, Dublin	82
2016	03.06	Yaroslavl	84	27.10	Kazakhstan, Aktobe	85
2017	10.06	Tomsk	84	17.11	South Korea, Seoul	86
2018	25.05	St. Petersburg	84 (+1)	13.10	Latvia, Daugavpils	83

** world records*

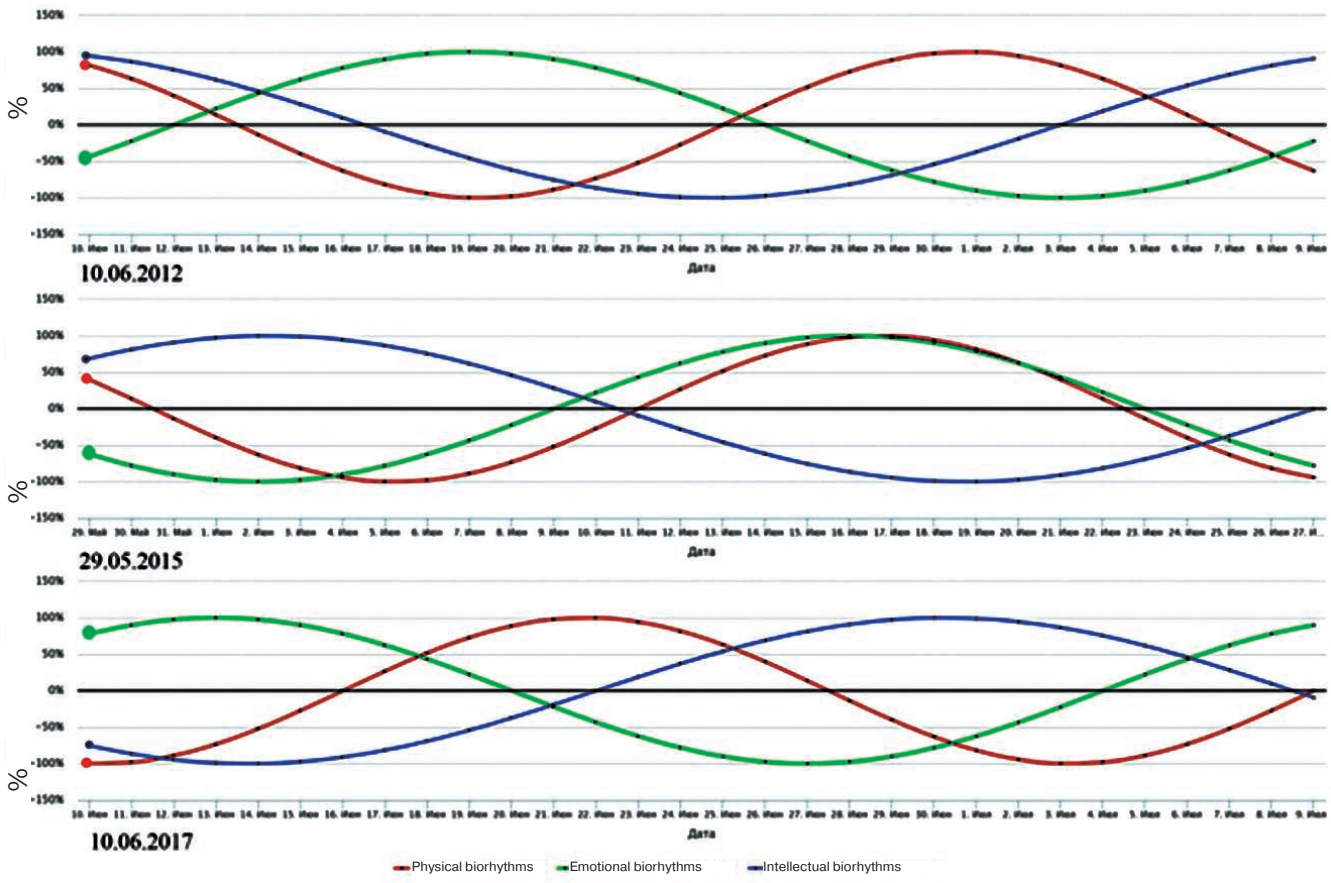

Figure 2. *Biorhythm variations in the 2012-17 Russian Championships*

petitive training cycles and competitive performance. Note that the athlete made a persistent smooth progress since 2012, with the progress somewhat stabilized for the last few years. The athlete has been successful in getting fit for every event despite the biorhythm variations. As far as the progress in the World Championships is concerned, the competitive progress was obviously cyclic, with the peak (world record) achieved in 2014 in Germany. The interviewed athlete reported being highly mentally fit for the event – he said that he neared the weight "as if it was the last try". The second individual best was made in 2017 in South Korea in the first attempt. The athlete, however, mentioned in the interview that he fell ill a week before with fever, cough and runny nose; although managed to cope with every sign of illness by the due date.

We analyzed the competitive performance versus the biological rhythm: see Figures 1, 2. Figure 1 gives the biorhythm variations in 2012, 2014 and 2017, with indications of the World Championship dates, and with the biological rhythms classified into physical (red line), intellectual (blue line) and emotional (green line).

The top diagram shows the biorhythm variations for the 2012 World Championship in Latvia. Note that the physical and intellectual biorhythms were relatively high in the first top-ranking event when the athlete sensationally made a world record and won gold. The middle diagram gives the biorhythm variations for the 2014 World Championship in Germany when the physical biorhythm was high enough – that is indicative of good working capacity and fitness. The Intellectual biorhythm was on the fall although still high enough; and the emotional biorhythm was on the rise albeit still in the lowest point. And the lower diagram gives the biorhythm variations for the 2017 World Championship in South Korea. The physical biorhythm was on the fall, and no wonder the athlete was sick at that time; the intellectual biorhythm was on the fall close to the zero point; and the emotional biorhythm was also low although on the rise.

Given on Figure 2 are the biorhythm variations in the Russian Championships. We highlighted 2012 as the startup year, 2015 when the athlete made progress and 2017 as the peak time in the three-year cycle. The top two diagrams show the physical biorhythms on the fall albeit high and moderate, respectively; whilst the emotional biorhythm was low and on the fall. And the lowest diagram – that refers to the top success period – shows the physical and intellectual biorhythms in the lowest points, whilst the emotional biorhythm was on

the peak. This was the reason for the athlete to succeed in the 2017 event despite the low physical biorhythm.

The success could be due to the good design and management of the training system, mental conditioning and sound competitive experience. It should be noted that this was the third year when the biorhythm reached the peaking values.

Conclusion. Competitive success may be interpreted as a specific product that includes a few constituents – with their interrelations still underexplored as yet. It may be beneficial to have integrated efforts in every relevant science to find the best ways for competitive successes. The study data and analyses provide only a first indication of the individual biorhythmic cycles being one of the factors need to be taken into consideration by the training system designers, since these cycles correlate with the ups and downs, plateaus and peaks in the competitive performances – as demonstrated by our case study. The individual biorhythm cycles are strongly recommended being taken into account by the individual training systems.

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Classification of methods to make final effort in javelin throw

UDC 796.012

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Abstract

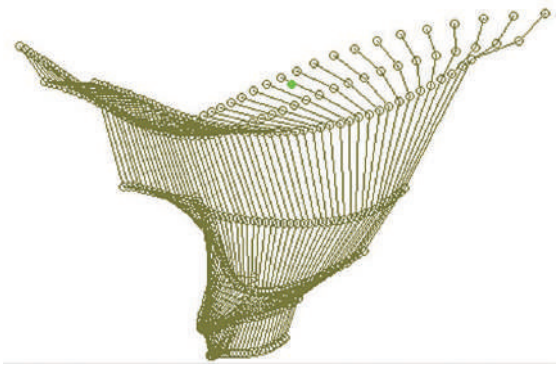
Objective of the present study was to identify kinematic characteristics of the technique of throwing auxiliary projectile.

Methods and structure of the study. We studied the kinematic characteristics of the auxiliary projectile throwing technique of the Honored Masters of Sport of Russia Dmitry Tarabin and Maria Abakumova using the 3-dimensional optical motion capture software system. The study was performed at the Ergonomic Biomechanics Study Laboratory of Adyghe State University.

Results of the study and conclusions. The study revealed the kinematic sequence of actions for building angular speed in the kinematic chain of the locomotor system of athletes. We identified the phase structure of the final effort and the sequence of actions for angular speed building. The data obtained made it possible to differentiate between the two final effort techniques: throwing on a take-off and throwing with a run-up. Throwing on a take-off is based on the unsupported actions of the thrower, while throwing with a run-up is based on the supported actions of the thrower. In addition, it was found that throwing on a take-off requires from the athlete to primarily develop his coordination mechanisms of control of the angular speed in the kinematic chain of the locomotor system, while throwing on a run-up requires organizing a pedagogical action aimed to promote the development of the strength display mechanisms.

Keywords: *javelin throwing technique.*

Background. The javelin throwing technique is based on the spatial and temporal structure of linear and angular movement sequences exercised by the kinematic chains of the locomotor system of athletes, which ensures high speed of the projectile at the instant of release. The athlete gains speed and gradually reaches the maximum to perform the springing strides. The transference of speed to the javelin is carried out during the final effort. The high release speed transferred to the projectile through the wrist is generated in the links of the kinematic chain of the athlete's locomotor system and, to a great extent, determines the result achieved [1, 2, 4]. However, modern literature does not have any information describing the process management mechanism, which ensures that the speed capacities of the links in the kinematic chain are added up to achieve a systemic effect - the maximum projectile release speed. In particular, the dominant links in the kinematic chain and the spatial and temporal structure of the angular speed building process in the kinematic chains of the locomotor system, the basic and specific features of the technique, the rhythmic structure of the activity of the links in the kinematic chain and latent errors remain unstudied. The above positions can be determined through a systemic analysis of the kinematic sequence of actions for angular speed building during the final effort. The realization of this task becomes possible due to the use of a 3-dimensional optical motion capture software system. The systematization of the data obtained will help determine the directions of the methodical support of the training process of javelin throwers of different skill levels.



Kinematogram of final effort in auxiliary projectile throw

Objective of the present study was to identify kinematic characteristics of the technique of throwing auxiliary projectile.

Methods and structure of the study. The kinematic characteristics of the auxiliary projectile throwing technique of the Honored Masters of Sport of Russia Dmitry Tarabin and Maria Abakumova were studied using the 3-dimensional optical motion capture software system [3]. The study was performed at the Ergonomic Biomechanics Study Laboratory of Adyghe State University.

Results and discussion. The study of the angular movement speed in the kinematic chains of the locomotor system during the auxiliary projectile throw enables to divide the test execution technique into four phases: the unsupported phase, the amortization phase, the phase of taking up the final position, and the final effort phase. Each phase includes the sequence of actions for angular speed building typical for each type of throw. Thus, in the unsupported action phase, D. Tarabin was found to have a simultaneous hip flexion at the rate of 414 degrees/ sec, knee extension at the rate of 364 degrees/ sec, and ankle flexion at the rate of 561 degrees/ sec (see the table). The maximum angular speeds were recorded at the end of the unsupported actions.

M. Abakumova was found to have another unsupported action pattern: a simultaneous hip flexion at the rate of 134 degrees/ sec, knee flexion at the rate of 240 degrees/ sec, and ankle flexion at the rate of 654 degrees/ sec. The main difference in the unsupported actions of the throwers was that at the moment of placing the right foot on the support, M. Abakumova bended her leg in the knee, and D. Tarabin – straightened it.

After touching the support with the right foot, both athletes moved to the amortization phase, where the direction of the angular movements, which had been established in the unsupported phase, was preserved while the movement speed decreased. D. Tarabin continued simultaneously bending his right leg in the hip, straightening his knee and bending his ankle. The amortization phase lasted 0.05 sec only. He interacted with the support with the forefoot. By the end of the amortization phase, the angular movement speed de-

Maximum angular speeds in joints in auxiliary projectile throw (HMS of Russia D. Tarabin and M. Abakumova)

Final effort phases	D. Tarabin				M. Abakumova			
	Joints	Angular movement direction	Angular speed, degrees/ sec	Time, sec	Joints	Angular movement direction	Angular speed, degrees/ sec	Time, sec
Unsupported phase *(from the moment of coming out of the cross-step till the moment of landing on the support)*	Hip joint	Flexion	414	0	Hip joint	Flexion	134	0
	Knee joint	Extension	364	0	Knee joint	Flexion	240	0
	Ankle joint	Flexion	561	0	Ankle joint	Flexion	654	0
Amortization phase *(from the moment of placing the right foot on the support till the moment of extending the ankle joint)*	Hip joint	Flexion	366	0.05	Hip joint	Flexion	95	0.39
	Knee joint	Extension	269	0.05	Knee joint	Flexion	173	0.39
	Ankle joint	Flexion	502	0.05	Ankle joint	Flexion	39	0.39
Phase of taking up the final position *(from the moment of touching the support with the right foot till the moment of placing the left foot on the support)*	Ankle joint	Extension	368	0.24	Ankle joint	Extension	362	0.54
	Knee joint	Extension	140	0.32	Knee joint	Extension	96	0.63
	Hip joint	Flexion	136	0.32	Hip joint	Flexion	41	0.53
Final effort phase *(from the moment of placing the left foot on the support till the moment of the projectile release)*	Hip joint	Extension	136	0.33	Hip joint	Extension	64	0.73
	Shoulder joint	Extension	251	0.36	Shoulder joint	Extension	150	0.86
	Elbow joint	Extension	345	0.51	Elbow joint	Extension	182	0.93
	Wrist joint	Extension	------	------	Wrist joint	Extension	-----	------

creased: in the hip joint - from 414 to 366 degrees/ sec, in the knee joint - from 364 to 269 degrees/ sec, and in the ankle joint - from 551 to 502 degrees/ sec. The amortization phase was completed at the moment of transition from the ankle flexion to the ankle extension.

The amortization phase was different for M. Abakumova. After touching the support, she continued simultaneously bending her right leg in the ankle, knee, and hip. The amortization phase lasted 0.39 sec. She interacted with the support with the whole foot. The angular movement speed in the amortization phase decreased: in the hip joint - from 134 to 95 degrees/ sec, in the knee joint - from 240 to 173 degrees/ sec, and in the ankle joint - from 654 to 39 degrees/ sec. The amortization phase was completed at the moment of transition from the ankle flexion to the ankle extension.

In the phase of taking up the final position, the athletes' actions were predominantly identical, and the angular speed building was realized by gradually achieving the maximum speed of extension in the ankle and knee joints. The dominant link in the kinematic chain of the locomotor system was the ankle joint, where the highest extension speed was built (see the table). The differences in the throwers' actions could be seen in the phase duration when throwing with a run-up - 0.24 sec (M. Abakumova) and on a take-off - 0.315 sec (D. Tarabin). The longer duration of this phase enables to longer maintain the high speed of flexion in the hip joint and that of extension in the knee and ankle joints, which creates greater flexibility in the kinematic chain and allows making the final effort using its inertia. The final effort phase was realized by the gradual achievement of the maximum speed of extension in the hip, shoulder, elbow, and wrist joints. The sequence of actions for building maximum angular speeds was similar for both athletes. At the same time, the phase duration varied. It was 0.4 sec for M. Abakumova and 0.18 sec for D. Tarabin. D. Tarabin spent half as much time on the final effort, which was due to the higher angular movement speed.

Conclusions. The study of the spatial and temporal structure of angular speed building in the kinematic chains of the locomotor system, detected in the Honored Masters of Sport D. Tarabin and M. Abakumova, makes it possible to differentiate between the two final effort techniques: throwing on a take-off and throwing with a run-up. Throwing on a take-off is based on the unsupported actions performed by the thrower after coming out of the cross-step. Building the high speed of extension in the right knee joint upon placing the right foot on the support enables to swiftly start a repulsion by continuing the knee extension initiated in the unsupported action phase. In addition, the high speed of flexion in the ankle joint allows taking up an advantageous position for performing a powerful reverse movement after placing the foot on the support. In this case, it is only the forefoot that interacts with the support.

The combination of the above actions makes it possible to perform the last step by making a take-off. This technique was throwing on a take-off. Its advantage is the possibility to use more of the inertia of the run-up and minimize the speed losses during the transition from the cross-step to the springing stride. The main technical complexity of such a throwing technique is the need to accurately reproduce the rhythmic structure of the movements under conditions of high speed, i.e., to "play in time". In this regard, athletes using such a throwing technique may encounter problems associated with action stability. Besides, the process of training of athletes using this throwing technique is more likely to require continuous development of the javelin throwing technique. The visual indicator for determining this throwing technique is that the support is touched with the right forefoot when the last step is taken to make the final effort.

Throwing with a run-up is based on the supported actions of the throwers. The passive actions of the thrower in the unsupported position make it possible to reduce the movement speed, which, in turn, reduces the potential for a run-up, though creates conditions for increasing the accuracy of subsequent actions. The longer duration of the amortization phase by bending the support leg in the hip, knee, and ankle joints enables to create the most advantageous angular positions for the realization of the speed-strength potential of the athlete, while the static interaction with the support with the whole foot through a run-up - to use the reaction force. This technique was called throwing with a run-up. Its advantage is the possibility to unleash the speed-strength potential of the athlete. However, the speed potential of the run-up is to be sacrificed here. The visual indicator for determining this throwing technique is that the support is touched with the whole right foot when the last step is taken to make the final effort.

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Equestrian sport excellence stage: technical dressage in hurdle race

UDC УДК 798.22

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Abstract

Objective of the study was to offer and test benefits of a new technical dressage model for horse hurdling applicable in the sport excellence period.

Methods and structure of the study. The new technical dressage model testing experiment was run in September through May 2019 at Jockey Sports Club in Tomsk city. We sampled the 16-18 year old hurdlers (n=24) from the sport excellence groups and split them up into Experimental and Reference Groups (EG, RG) of 12 people each. The group technical fitness progresses were tested by the standard pre- and post-experimental tests.

The EG training system was complemented by the new technical dressage model to improve the hurdlers' technical fitness. Every 90-minute training session included a 30-40-minute special show jumping dressage to improve the rider's contact (tactile sensations) with the horse, posture and riding skills. The EG made a special emphasis, in addition to the couple hurdle racing skills excellence trainings, on technicalities of every dressage element including: the horse's relaxation, emphasis on the reins, balance, impulse and straight set. A special attention in the trainings was given to the horse's anxiety mitigation by an easy riding style to ensure due relaxation of the animal and maintain it for the whole training session.

Results and conclusions. The new technical dressage model for horse hurdlers in the sport excellence period was tested beneficial as verified by the EG versus RG progress in most of the core technical fitness elements critical for competitive progress in modern equestrian sport.

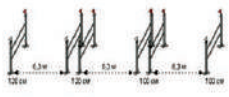
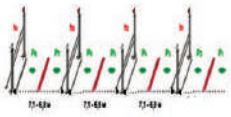
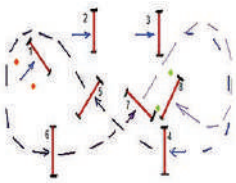
Keywords: *equestrian sport, dressage, hurdle race training tools, small circle tests, training system, technical fitness, sport excellence stage.*

Background. Modern equestrian sport is rather specific in the sense that the sport discipline uses trained animals in competitions, with the technical excellence and artistry of both the rider and horse being equally critical for a competitive success. The competitiveness in modern equestrian sport have been fast growing for the last decades (as is the case for many other sports disciplines), with the experienced athletes gradually giving way to the young newcomers [5]. One of the core reasons for the competitive regresses is the failures in the technical fitness building domain in the sports excellence period [4], and this is the reason why the equestrian sport research and coaching communities give a special priority to the technical progress methods (training system) and tools in the dressage systems for success on the sports arenas.

Objective of the study was to offer and test benefits of a new technical dressage model for horse hurdling applicable in the sport excellence period.

Methods and structure of the study. The new technical dressage model testing experiment was run in September through May 2019 at Jockey Sports Club in Tomsk city. We sampled the 16-18 year old hurdlers (n=24) from the sport excellence groups and split them up into Experimental and Reference

Table 1. *Special dressage tools used by the EG with a hurdling scheme*

Hurdles and movement scheme	Description and hurdling techniques	Positions of hurdles
Hurdles system	Two-three-plus hurdles standing 7-12m apart, with the hurdles system passed by two-plus jumps	
Ivories	15-20cm high bars with end crosses to train walk, trot and canter. Numbers of ivories are increased in proportion to the horse strides	
Cavalletti route with vault and figure of eight	Route is the distance the rider should cover taking the hurdles in the numbered sequence. The Cavalletti route is used to excel the jumping techniques, posture and riding skills	

Groups (EG, RG) of 12 people each. The group technical fitness progresses were tested by the standard pre- and post-experimental tests.

Results and discussion. The EG training system was complemented by the new technical dressage model to improve the hurdlers' technical fitness [2]. Every 90-minute training session included a 30-40-minute special show jumping dressage to improve the rider's contact (tactile sensations) with the horse, posture and riding skills: see Table 1.

Trainings 'on ivories' were designed to excel the rider's posture and muscular sensations in contact with the horse when hurdling. Twice a week the EG was trained on the hurdles system to excel the jumping techniques [3]. The hurdles system included high and wide hurdles to excel both the long and high jumping skills. The hurdle-to-hurdle distances were measured from the landing side of the prior hurdle to the take-off side of the next hurdle [5]: see the hurdles scheme in Table. 1.

The EG made a special emphasis, in addition to the couple hurdle racing skills excellence trainings, on technicalities of every dressage element including: the horse's relaxation, emphasis on the reins, balance, impulse and straight set [1]. Relaxation was trained at the beginning of every workout by special practices – light trot, canter-to-trot and vice versa runs etc.

A special attention in the trainings was given to the horse's anxiety mitigation by an easy riding style to ensure due relaxation of the animal and maintain it for the whole training session. With the growing relaxation, the rider's leg pushing force was harmonized with calmly restraining hands to develop the correct technical skill known as "rest on the rein". The couple performance harmony was secured by a special focus on the medium positioning of the horse's neck and sub-hanging/vertical relaxed position of the head. When practicing the horse's direct "stance", a special attention was given to the rider's tactile sensations (contact) and gentle freedom of the horse's movement control actions.

Table 2. *Pre- versus post-experimental technical fitness test data of the sample, points*

Technical skills	Pre-experimental		Post-experimental	
	RG $\overline{X} \pm \sigma$	EG $\overline{X} \pm \sigma$	RG $\overline{X} \pm \sigma$	EG $\overline{X} \pm \sigma$
Trot accept move	6,83±0,24	6,80±0,37	6,40±0,24	7,00±0,32*
Shoulder-in accept move	6,20±0,37	6,40±0,50	6,20±0,24	6,80±0,20
Aerial leg switchover move	6,68±0,00	6,60±0,24	6,20±0,20	7,40±0,24*
Canter accept move	6,20±0,31	6,19±0,37	5,40±0,24	6,40±0,24*
Half-pirouette on stride	6,60±0,24	6,70±0,24	5,60±0,24	6,80±0,20*

* $p<0.05$ *for the intergroup difference*

Analysis of the pre- versus post-experimental test rates of the EG and RG (Table 2) found meaningful ($p < 0.05$) intergroup differences in the trot accept, aerial leg switchover and canter accept moves and half- pirouette on stride; and meaningless intergroup difference in the shoulder-in accept move – that may be interpreted as indicative of the new technical dressage model being beneficial for hurdlers' training systems.

Conclusion. The new technical dressage model for horse hurdlers in the sport excellence period was tested beneficial as verified by the EG versus RG progress in most of the core technical fitness elements critical for competitive progress in modern equestrian sport.

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Elite athletes turned coaches: functionality, adaptability and stress tolerance study

UDC 796.01:612

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Abstract

Objective of the study was to rate and analyze the post-retirement functionality, adaptability and stress tolerance of elite athletes turned coaches.

Methods and structure of the study. We sampled for the study elite athletes turned coaches for Experimental Group (EG, n=30) and mid-class coaches for Reference Group (RG, n=30). We used the Karpman version of the cycle ergometer PWC170 (Physical Working Capacity) test with analyses of the physical working capacity versus power range with the heart rate maintained at 170 beats per min.

The adaptive capabilities of the nervous and cardiovascular systems were assessed based on the values of the mode amplitude (AMo) and index of tension of the heart rate on the scale of A.G. Bayevsky. The efficiency of adaptation, as well as several psychological characteristics of the participants of the experiment, indicating the levels of anxiety, fatigue, stress tolerance, were determined using the standard methods: Luscher test, Kettell questionnaire, Ehlers questionnaire.

Results of the study and conclusions. The elite athletes turned coaches were tested with fairly good health standards and functional and social adaptabilities to the new lifestyles and careers in the post-retirement periods; albeit some mental controls and physiology tests were indicative of their relatively lower stress tolerance as verified by the somewhat higher (although insignificantly different) anxiety and emotional stress test rates versus the RG.

Keywords: *functionality, adaptability, fatigue, stress tolerance, physical working capacity, anxiety, emotional stress, mode amplitude, stress index (SI)*

Background. Functional regresses in any aspect are known to trigger physical and mental performance inefficiencies since motor skills and mental controls largely depend on the functional aspects in any service field, including modern elite sports [6]. Elite athletes upon retirement from sports with radical changes in the lifestyles and careers are known to go through difficult adaptation period, with success of the transition largely determined by the individual mental controls, functionality and physical health on the whole. Of special research interest in the post-retirement period are the social and functional adaptability issues of the former elite athletes [1].

Objective of the study was to rate and analyze the post-retirement functionality, adaptability and stress tolerance of elite athletes turned coaches.

Methods and structure of the study. We sampled for the study elite athletes turned coaches for Experimental Group (EG, n=30) and mid-class coaches for Reference Group (RG, n=30). We used the Karpman version of the cycle ergometer PWC170 (Physical Working Capacity) test with analyses of the physical working capacity versus power range with the heart rate maintained at 170 beats per min [3].

Results and discussion. Physical working capacity rates yielded by the Kapman version of PWC170 test were interpreted as indicative of the cardio-respiratory

system functionality with the individual weight-class differences balanced by the specific physical working capacity to body mass ratios. Note that the untrained healthy males are normally tested with physical working capacity varying around 14.4 kgm/ min/ kg.

The nervous and cardiovascular system adaptability was rated by the mode amplitude and heart rate stress index on the A.G. Bayevsky scale with its good, low, poor and failed adaptation classes. The age-specific EG versus RG adaptation test rates were classified versus the cardiointervalography benchmarks on the A.G. Bayevsky scale [2]. The EG physical working capacity was tested at 15.4±1.4 kgm/ min/ kg i.e. slightly higher than the 14.4 kgm/ min/ kg benchmark for untrained individuals, albeit this and the intergroup (EG vs. RG) difference was found insignificant. Note that the EG vs. RG adaptation test rates were benchmarked versus the 26-40 year-old group standards: see Table 1.

Table 1. *Healthy 26-40 year old male adaptation classes on the A.G. Bayevsky scale*

Adaptation class	Mode amplitude (M±m)	Stress index (M±m)
Good	47 ± 3	112 ± 22
Low	47 ± 4	123 ± 23
Poor	46 ± 3	156 ± 24
Failed	–	–

The pre-workday mode amplitude in the EG was tested good, whilst the stress index was slightly under the good standard (108.1±12.9 versus 112±22); versus the RG test rates that were good on both scales. The post-workday mode amplitude and stress index rates were found good and low in the RG and EG, respectively: see Table 2.

Furthermore, the pre- and post-workday group fatigue was tested by the proofreading, tapping and simple visual motor response tests [5]. The group adaptability rates and some mental controls were tested by the anxiety, fatigue and stress tolerance tests from the Luscher Color test, Cattell 16 Personality Factor test and Ehlers Questionnaire Survey toolkits [4].

Cognitive/ thinking performance regresses due to overstresses of any etiology may be fairly well tested by the standard proofreading test. The test found insignificant intergroup differences in the error rates and test times and no excessive fatigue in the group pre- versus post-workday tests. The only significant difference was found in the RG pre- versus post-workday proofreading test rates: see Table 3.

Service motivations in two aspects were tested and classified as poor (1-10 points), low (11-16 points), good (17-20 points) and excellent (21-32 points). Mental control and personality factors were rated by the Luscher Color Test and Cattell Test and classified as poor (1-3 points), low (4 points), moderate (5-6 points), good (7 points) and high (8-10 points). Thus

Table 2. *Group pre- versus post-workday adaptation test rates*

Groups	Mode amplitude (M±m)		Stress index (M±m)	
	Pre-workday		Post-workday	
EG	43,5 ± 11,5	108,1 ± 12,9	48,0 ± 6,7	126,6 ± 22,1
RG	32,8 ± 10,4	85,9 ± 21,5	46,6 ± 10,8	108,4 ± 23,2

Table 3. *Fatigue rating proofreading test rates, M±m*

Group	Error rate, count		Test time, min	
	Pre-workday	Post-workday	Pre-workday	Post-workday
EG	9,9±1,9	10,7 ± 1,7	6,7±1,2	8,3 ± 1,1
RG	4,9±1,5	9,8 ± 1,7*	5,7 ±1,1	7,1 ± 1,3
	Tapping test, frequency		*Simple visual motor response test, ms*	
EG	5,4 ± 1,8	3,9 ± 1,1	250,2 ± 26,2	335,6 ± 44,4
RG	5,0 ± 1,3	4,0 ± 0,9	292,3 ± 37,8	298,5 ± 27,5

*Note: *statistically significant: p<0.05*

Table 4. *Group mental control and physical working capacity test rates, STEN scores, M±m*

Groups	Luscher Color Test			Cattell 16 Personality Factor test		
	Physical working capacity	Anxiety	Aggression	Emotional stress	Self control	Stress
EG	7,1 ± 1,6	7,2 ± 1,2	5,5 ± 1,5	4,5 ± 2,0	5,7 ± 1,9	7,1 ± 1,3
RG	5,8 ± 1,5	3,8 ± 1,9	4,5 ± 1,6	5,0 ± 1,1	4,7 ± 1,5	5,5 ± 1,4

the age-specific Luscher Color Test of the EG and RG found insignificant intergroup differences on the anxiety level and aggression scales (with the EG being in the higher range) and some physical working capacity growth: see Table 4.

The Ehlers Questionnaire Survey tested the EG with the higher (albeit significantly different) success motivations versus the failure avoidance motivations: see Table 5. Note that the intergroup differences on both motivation scales were insignificant as well.

Table 5. *Group motivations rated by the Ehlers Questionnaire Survey,* M±m

Group	Success motivations	Failure avoidance motivations
EG	15,8 ± 3,0	17,4 ± 4,2
RG	13,0 ± 3,1	11,6 ± 3,0

Conclusion. The elite athletes turned coaches were tested with fairly good health standards and functional and social adaptabilities to the new lifestyles and careers in the post-retirement periods; albeit some mental controls and physiology tests were indicative of their relatively lower stress tolerance as verified by the somewhat higher (although insignificantly different) anxiety and emotional stress test rates versus the RG.

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Physical fitness and skills specific goalball techniques: timing and quantifying analysis

UDC 796.034

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Abstract

Objective of the study was to classify the goalball motor skills by the key types and movement algorithms.

Methods and structure of the study. We sampled for the study the 17-38 years old Goalball players (n=41) of both sexes and different skill levels. The research method was geared to rate the key competitive performance elements using the relevant quantitative and timing criteria, on a skill-level-specific basis. Based on these data, we further classified the key motor skill in the ball control context. Having identified and classified the motor skill, we counted them in the competitive performance sequences to find the motor skill time viewed as the key success criterion. The ball control/ handling skills were classified into the ball controls, passes and shots.

We analyzed the match videos to catch the motor skill starting and finishing points and, knowing the video shooting frequency, compute the motor skill time. The competitive performance analyses were made to rate every individual player's competitive performance and goalball team competitive performance in every match on the whole.

Conclusion. The study data and analyses made it possible to classify the goalball motor skills in the temporal and quantitative terms depending on the teams' skill levels. The study data and findings are recommended being taken into account by the motor skill training and test system designers and coaches for the special skills-specific technical and tactical fitness rating and perfection purposes, and for the motor skill biomechanics research in the modern goalball sport.

Keywords: *technical and tactical training, Paralympic sports, movement biomechanics, motor skills, competitive performance.*

Background. Modern Paralympic sports communities report a growing need for a sound theoretical and practical research provisions, with a special demand for the basic technical and tactical training provisions for the popular Paralympic team sports. A special priority is given to the movement biomechanics research to perfect every motor skill in the adaptive team sports. These efforts are expected to secure new quality for our theoretical and practical understanding of the individual motor skill formation logics and help form a foundation for the technical and tactical progress in every adaptive sport [5].

Goalball is a Paralympic team sport discipline for blind and visually impaired athletes, with the competitive progresses, wins and losses governed by basically the same competitive standards and rules as any other goal-scoring sport [6], with the goalball techniques naturally and traditionally classified into the defenses and attacks. The defenses are further classified into stands, blocks, belays, rebounds, footwork and penalty taking; and the attacks classified into shots on goal, passes, ball control, feints, footwork/ positioning and penalty shots [3].

Objective of the study was to classify the goalball motor skills by the key types and movement algorithms.

Methods and structure of the study. We sampled for the study the 17-38 years old Goalball play-

ers (n=41) of both sexes and different skill levels. The research method was geared to rate the key competitive performance elements using the relevant quantitative and timing criteria, on a skill-level-specific basis. Based on these data, we further classified the key motor skill in the ball control context. Having identified and classified the motor skill, we counted them in the competitive performance sequences to find the motor skill time viewed as the key success criterion [1]. The ball control/ handling skills were classified [4] into the ball controls, passes and shots.

We analyzed the match videos to catch the motor skill starting and finishing points and, knowing the video shooting frequency, compute the motor skill time. The competitive performance analyses were made to rate every individual player's competitive performance and goalball team competitive performance in every match on the whole. We sampled for the competitive performance analyses 6 formal top-ranking Federal Goalball events (finals and championships) and 12 teams (6 men's and 6 women's ones) with the following skill levels: (1) beginner teams with little if any competitive experiences; (2) mid-level teams with good practical competitive experiences; and (3) professional teams ranked with the top-three competitors.

Results and discussion. Subject to our analysis in the 2018 Russian Goalball Championship matches were 994 motor skill of the beginner-level teams (Table 1). We found the ball controls and shooting times virtually the same in the beginner men's and women's teams; with the ball controls estimated at 50% of the total motor skill per match and shots making up 47% and 43.9% of the totals in the women's and men's teams, respectively. It should be noted that the beginner men's teams made twice more passes than the women's. It terms of the total time demand, shots were prevailing in the motor skill toolkit. Thus the ball control times were 44.5% and 36.7% shorter than the shooting times in the women's and men's teams, respectively. On the whole, the shooting time was on average triple as long as the ball control and pass time.

Given in Table 2 hereunder is the analysis of the mid-level teams' motor skill (n=1032) in the 2018 Russian Goalball Championship. Note that the ball control statistics remained close to the above for the beginner teams. The ball shooting motor skill to the total motor skill ratio was also fairly close to the beginner one. The men's teams, however, were found to make 3 times more passes than the women's, with the ball control times of both found longer than in the beginner teams. The growth of the ball control time to the total match time ratio may be explained by the higher skill level and experience of the players who prudently take their time to analyze the situation and get fit for the shot.

Given in Table 3 hereunder is the analysis of the top-level teams' motor skill (n=990) in the 2018 Russian Goalball Championship. It shows further growth of the ball control times when the players get fit for decisive actions, and faster shots versus the beginner and mid-level team statistics.

The motor skill quantifying analysis found the top players shooting on goal less often and making more passes, particularly in the women's teams. The average and relative shooting times further fall, whilst the relative ball control times grow both in the men's and women's teams. The top-level junior men's teams made particularly high progress in the average ball control time than the lower-level peers.

Table 1. *Beginner teams' motor skill statistics in the 2018 Russian Goalball Championship*

Motor skill	Per match		% in total motor skill		Average time, s		% in total	
	Women	Men	Women	Men	Women	Men	Women	Men
Ball control	235	262	50	50	1,419	1,353	27	29,8
Passes	14	32	3	6,1	1,415	1,385	1,5	3,7
Shots	221	230	47	43,9	3,987	3,361	71,5	66,5

Table 2. *Mid-level teams' motor skill statistics in the 2018 Russian Goalball Championship*

Motor skill	Per match		% in total motor skill		Average time, s		% in total	
	Women	Men	Women	Men	Women	Men	Women	Men
Ball control	234	282	50	50	2,158	1,771	37,9	35,6
Passes	17	53	3,6	9,4	1,323	1,065	1,9	4
Shots	217	229	46,4	40,6	3,734	3,670	60,2	60,4

Table 3. *Top-level teams' motor skill statistics in the 2018 Russian Goalball Championship*

Motor skill	Per match		% in total motor skill		Average time, s		% in total	
	Women	Men	Women	Men	Women	Men	Women	Men
Ball control	266	229	50	50	1,840	2,401	38,9	42,3
Passes	56	20	10,5	4,4	0,905	1,178	4,1	1,7
Shots	210	209	39,5	45,6	3,375	3,206	57	56

Comparative analyses of the motor skills versus the skill levels found that the higher is the skill level, the higher are the numbers of passes and the lower are the shooting attempts; whilst the ball control times tend to grow with the mastery, as underlined by the shorter decision-making and shooting times. This progress is obviously attributable to the excellent technical and tactical training of the top-professional teams.

Conclusion. The study data and analyses made it possible to classify the goalball motor skills in the temporal and quantitative terms depending on the teams' skill levels. The study data and findings are recommended being taken into account by the motor skill training and test system designers and coaches for the special skills-specific technical and tactical fitness rating and perfection purposes, and for the motor skill biomechanics research in the modern goalball sport.

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Physical fitness test data for national population in context of GTO complex tests

UDC 796.034.2

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Abstract

Objective of the study was to analyze physical qualities / physical fitness test data reported by the popular GTO Complex test system on the age- and gender-specific basis.

Methods and structure of the study. We used for the study the physical qualities / physical fitness (speed, endurance, strength and flexibility) test data of the national 6-plus year old population (n= 2,050,019) reported by the GTO Complex test system.

Speed was rated by the 3x10m/ 30m/ 60m/ 100m sprint tests. Endurance was rated by the 1000m/ 1500m/ 2000m/ 3000m race tests and 1000m/ 2000m combined (walking + running) tests, plus the 3000m Nordic walking test. Strength was rated by the pull-ups on a high/ low bar, prone push-ups and 16kg kettlebell snatch (males) tests.

The flexibility rates in the boys (young males) and girls (young females) were determined between 6 and 24 years of age.

Results and conclusions. The test data and analyses give grounds to conclude that the physical qualities / physical fitness test rates in the age and gender groups are rather uneven, with the share of those who failed the GTO Complex tests estimated at 47.5% in 2018 – that means that half of the people tested were found unfit.

The GTO Complex test data and analysis showed the physical trainings and tests being of growing interest for different population groups committed for habitual physical education and sport service and progress tests. The physical education and sport service research and training communities are recommended giving more priority to new training models and tools to encourage physical progress of adults and improvements of the physical education and sport service curricula at every level of the national educational system.

Keywords: *physical qualities, physical fitness, GTO Complex tests, physical education and sports, healthy lifestyle, physical activity.*

Background. Traditional popular physical education and sports and health-prioritizing physical education and sport services are increasingly versatile nowadays in their forms and methods and include multiple physical education and sports events; demo/ motivational/ healthy lifestyle promotion and physical activation initiatives/ actions; group/ individual/ club physical education and sports training and self-reliant physical education and sports activity facilitation services [4]. It should be mentioned that the individual preferences in the physical education and sport service sector are characteristic of the personality physical education and sports / heath agendas. Main personality physical education and sports agendas and physical activity test rates and analyses generally characterize the healthy needs for movement and ways to satisfy them [5]. The individual physical education and sport activity forms, intensities, timeframes and regularities – are indicative of the group satisfaction with the specific physical activity forms [3].

The actual range of accessible physical education and sports / health-improvement service forms and methods and the group/ individual commitments for the services may be indicative of the physical education and sport service system efficiency [2]. As things now stand, it is the GTO Complex system that provides

the most accessible and broad-based popular physical education and sport service system with the age-specific physical progress test standards and mechanisms [6]. It may be beneficial to analyze the public demand for specific physical exercises in the GTO Complex test system and the group-specific physical qualities / physical fitness test rates.

Objective of the study was to analyze physical qualities / physical fitness test data reported by the popular GTO Complex test system on the age- and gender-specific basis.

Methods and structure of the study. We used for the study the physical qualities / physical fitness (speed, endurance, strength and flexibility) test data of the national 6-plus year old population (n= 2,050,019) reported by the GTO Complex test system [7].

Results and discussion. Speed was rated by the 3x10m/ 30m/ 60m/ 100m sprint tests, with the highest speeds demonstrated by the 25-49 year old males and females ((72.6% and 60.4%, respectively); whilst in the 6-24 year old groups, 49.2% and 50.9% of males and females were tested excellent and 50.8% and 49.1 moderate and low on the speed rating scale, respectively: see Tables 1 and 2.

Table 1. *Speed test rates of the male age groups*

GTO test ranks	6-24 year olds (n=462 937)	25-49 year olds (n=62 930)	50-plus year olds (n=16 209)
Gold badge, %	49,2	72,6	-
Silver badge, %	35,6	14,9	-
Bronze badge, %	15,2	12,5	-

Table 2. *Speed test rates of the female age groups*

GTO test ranks	6-24 year olds (n=335 079)	25-49 year olds (n=73 911)	50-plus year olds (n=22 735)
Gold badge, %	50,9	60,4	-
Silver badge, %	32,8	23,9	-
Bronze badge, %	16,3	15,7	-

Generally speed was tested high in the adult groups and moderate in the 6-24 year old groups. The test data showed the adult groups being more skilled in sprint and motivated for the tests, whilst the young groups, including students were tested less skilled in the sprint techniques – that means that the school/ university physical education and sports curricula need to be updated to make a special emphasis on the running techniques and run speed training tools. The least popular of the three speed rating sprint tests was the 100m (chosen by 12% of the sample); followed by 60m (39.3%) and 3x10m and 30m (48.7%) sprints.

Endurance was rated by the 1000m/ 1500m/ 2000m/ 3000m race tests and 1000m/ 2000m combined (walking + running) tests, plus the 3000m Nordic walking test. Generally the adult groups were tested fairly high on this test scale, while the 6-24 year-olds were tested relatively low: see Tables 3 and 4.

Table 3. *Overall endurance test rates of the male age groups*

GTO test ranks	6-24 year olds (n=462 937)	25-49 year olds (n=62 930)	50-plus year olds (n=16 209)
Gold badge, %	36,0	61,3	66,1
Silver badge, %	37,7	15,8	6,0
Bronze badge, %	26,3	22,9	27,9

Table 4. *Overall endurance test rates of the female age groups*

GTO test ranks	6-24 year olds (n=335 079)	25-49 year olds (n=73 911)	50-plus year olds (n=22 735)
Gold badge, %	45,7	56,9	60,6
Silver badge, %	26,2	20,0	31,3
Bronze badge, %	28,1	23,1	8,1

Analysis of the above data shows the relatively low endurance rates in the 6-24 year old males and females (36% and 45.7%, respectively); whilst the 50+ year old seniors, despite the natural physiological regresses, were tested fairly high on this scale (66.1% and 60.6%, respectively). On the whole, the endurance tests demonstrated the need for the physical education curricula in the national educational system to be updated correspondingly.

Strength was rated by the pull-ups on a high/ low bar, prone push-ups and 16kg kettlebell snatch (males) tests. The tests ranked the 25-49 year old groups the highest on the strength scale: see Tables 5 and 6.

The strength tests ranked the 6-24 year old females relatively low (46%) in the sample, and this finding should be taken into account by the full-time and advanced physical education service systems. One of two 50-plus year old females was successful in winning a gold badge in the tests. The 6-24 and 25-49 year old males were tested fairly high and close on the strength scale (53.5% and 54.8%, respectively), that is natural for the human ontogenesis – i.e. the

strength progress in juniors and regress in adults. It may also be pertinent to mention that strength is tested by three and two tests in the male and female groups, respectively, and it may be beneficial to make these GTO tests gender-unspecific for equality in this domain.

Table 5. *Strength test rates of the male age groups*

GTO test ranks	6-24 year olds (n=462 937)	25-49 year olds (n=62 930)	50-plus year olds (n=16 209)
Gold badge, %	53,5	79,1	54,8
Silver badge, %	28,0	12,9	26,4
Bronze badge, %	18,5	8,0	18,8

Table 6. *Strength test rates of the female age groups*

GTO test ranks	6-24 year olds (n=335 079)	25-49 year olds (n=73 911)	50-plus year olds (n=22 735)
Gold badge, %	46,0	59,7	51,6
Silver badge, %	26,5	23,3	17,8
Bronze badge, %	27,5	17,0	30,6

Flexibility was expectedly tested highest in the 6-24 year old males and females: see Tables 7 and 8.

Table 7. *Flexibility test rates of the male age groups*

GTO test ranks	6-24 year olds (n=462 937)	25-49 year olds (n=62 930)	50-plus year olds (n=16 209)
Gold badge, %	75,4	46,4	19,8
Silver badge, %	14,7	33,6	52,3
Bronze badge, %	9,9	20,0	27,9

Table 8. *Flexibility test rates of the female age groups*

GTO test ranks	6-24 year olds (n=335 079)	25-49 year olds (n=73 911)	50-plus year olds (n=22 735)
Gold badge, %	85,9	68,0	22,4
Silver badge, %	9,5	21,2	43,9
Bronze badge, %	4,6	10,8	33,7

Of special interest in the above data are the low flexibility test rates in the 25-49 year old males and 50+ year old females – that may be due to the natural anatomical and physiological regress with age in the joint motility and muscle/ tendons elasticity on the other hand, and the too challenging flexibility test standards on the other hand. It may be reasonable to have the GTO Class VIII test standards for these age groups revised; and pay more attention to the flexibility training service for the 35-plus year old population in view of the fact that flexibility is directly correlated with movement speed, coordination and strength abilities.

The test data and analyses give grounds to conclude that the physical qualities / physical fitness test rates in the age and gender groups are rather uneven, with the share of those who failed the GTO Complex tests estimated at 47.5% in 2018 – that means that half of the people tested were found unfit [1].

Conclusion. The GTO Complex test data and analysis showed the physical trainings and tests being of growing interest for different population groups committed for habitual physical education and sport service and progress tests. The physical education and sport service research and training communities are recommended giving more priority to new training models and tools to encourage physical progress of adults and improvements of the physical education and sport service curricula at every level of the national educational system.

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Physical education and sports components of educational programs in children and youth tourism sector

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Abstract

Objective of the study was to analyze the supplementary education programs in the field of children's and youth tourism and highlight the specifics of physical education and sports components in their realization.

Methods and structure of the study. At the first stage of the study, we conducted quantitative and content analyses of the supplementary education programs for children and youth in a given region (Tomsk region) implemented within the state personal finance system in the 2019/2020 academic year. The total number of the analyzed tourism-related educational programs amounted to 295. At the second stage, we carried out the content analysis of the selected components of educational programs for individual age groups of students.

Results and conclusions. The results obtained indicate that the physical education and sports components are leading in all tourism-oriented supplementary programs for children and youth. In terms of physical education and sports programs, the predominance of these components over others is characteristic of all age groups. Programs concerned with tourism, local history, natural science, and social pedagogy give priority to the components of the corresponding specialization, however, at the initial stages (9-11 years and 12-13 years), their health and fitness component remains at the forefront until students have completed their training in tourism techniques and technologies.

Keywords: *sports tourism, children and youth tourism, supplementary education, tourism with local history studies, physical education and recreation, physical education and sports, healthy lifestyle.*

Background. For the last decade, the relevant Russian governmental agencies have given a special priority to modern education technologies and concepts to improve the educational service standards for the young population groups [1, 2]. Of special interest in this context is the range of modern children and youth tourism services with their patriotic education basics, natural environment awareness and practical physical education and recreation elements [3, 4]. special tourism with local history study programs well-designed and enthusiastically implemented by the sector professionals could be of special benefits for these initiatives.

Objective of the study was to analyze the existing children and youth tourism services in the supplementary education system with a special priority to their sporting, physical education and recreation elements.

Methods and structure of the study. The first stage of the study was designed to analyze the contents and ranges of the tourism-prioritizing supplementary education programs in the Tomsk Oblast supported by the state personified funding system in the 2019-20 academic year. Subject to analysis were 295 supplementary education programs including 24 for the children and youth population with special health needs; with 238 programs reported to prioritize the physical education and recreation service; 17 natural scientific studies; and 8 social studies, with every program reporting different priority physical education and recreation and sporting components. And

32 special purely physical education and sports programs offer trainings in sports tourism techniques and technologies, refereeing service basics and sports excellence trainings with expected sports qualifications. The second stage of the study was designed to comprehensively analyze contents of the training programs on an age-specific basis.

Results and discussion. We analyzed the tourism-prioritizing supplementary education programs to prioritize their cultural, educational, and developmental aspects for the children and youth tourism service: see Figure 1 hereunder. Most of the regional programs were found to prioritize hiking with local history studies, and only a few – cycling tourism services.

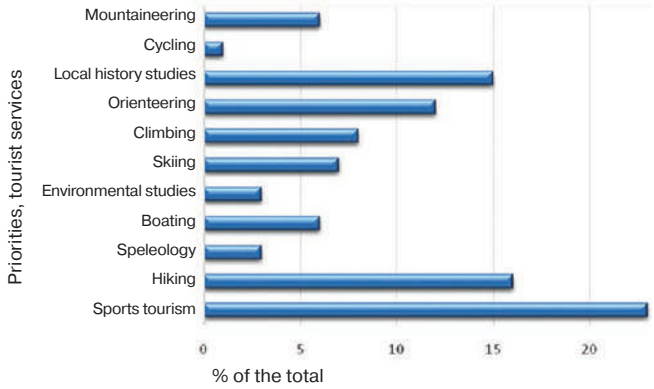

Figure 1. *Priorities of the children and youth tourism supplementary education programs with the tourism with local history elements*

Every program includes 1 to 8 modules for the 5-18 year-olds, with the preschool programs (for 5-7 year-olds) found to make up only 6% of the total – that means that this service sector is still heavily underdeveloped. Most of the programs offer staged trainings for the 10-16 year-olds, plus many of them include advanced training modules for the 16-18 year-olds inclusive. Age classes in the children and youth tourism programs are rather important for their design and priorities, since the children and adolescents have special needs for cognitive and active elements, whilst more adult population tends to prioritize the emotional and practical ('consumer') elements of the services [2]. Based on the content analysis of the supplementary education programs, we categorized their services as follows on an age-specific basis.

Physical education and health service geared to form the children and youth health agendas and motivations, i.e. health-sensitive attitudes to own body with needs for habitual physical education, healthy lifestyles, good personal hygienic habits etc. This children and youth tourism service component is also intended to secure progress in general physical fitness and every physical quality (movement coordination, dexterity, endurance, strength etc.), with a conscious recreational activity.

Sporting service to form the sports tourism knowledgebase with tourist training basics; primary knowledge of modern tourist technologies and tactics; natural obstacles crossing and survival skills; with a special priority to the physical training elements; trainings for sports qualifications in tourism, other relevant sports and coaching service; plus competitive experience accumulation, sportsmanship and discipline building elements.

Psychological and communicative progress service element makes an emphasis on the individual communicative skills and core mental qualities including the leadership/ managerial ones – for successful socialization of the children and youth trainees; to make them fit for good teamwork and cooperation under pressure, on a tolerant, friendly and constructive basis.

Research element is intended to encourage the research and project skills building, natural studies, progress planning and forecasting capacities – to help students learn how to mine data, find key facts, analyze, systematize and present the collected materials.

Life safety service element is geared to develop survival skills in natural environments in the hiking and competitive events and expeditions based on the sound life safety knowledge and practical experience. The trainees are expected to develop the extreme/ unexpected situation analyzing/ coping/ response skills based on a perfect knowledge of the individual/ team safety standards and requirements.

Creative element encourages self-assertion of the children and youth trainees in the creative, intellectual and practical thinking and design domains, with a special emphasis on the creative gifts and skills development aspects – including the tourist equipment design, operation and maintenance skills.

Local history and environmental study element familiarizes the CT trainees with the local natural, cultural and historical heritage and attractions for the local, federal and international tourism, with a special emphasis on the patriotic education and environmental sensitivity components.

Professional identification element facilitates basic vocational awareness and training in the tourist and recreational service domains.

Based on the content analysis, we prioritized the above children and youth tourism training service elements on an age-specific basis and rated them on an 8-point scale: see Table 1 hereunder.

Conclusion. The study data and analyses found the physical education and recreation and sporting elements being dominant in every children and youth tourism program. The sporting physical education

Table 1. *Supplementary education program elements and priorities for the age groups*

Age	Supplementary education program elements								Priorities
9-11	4	3	7	5	6	8	2	1	Cognitive, practical
12-13	4	2	8	5	3	7	6	1	Practical, cognitive
14-15	1	6	2	7	4	8	5	3	Emotional, practical
16-18	3	8	2	6	1	5	4	7	Emotional, cognitive
	Studies	Sports	Physical education	Communication	Healthy lifestyle	Tourism with local history, environment	Creativity	Professional identification	

and recreation programs for the children and youth population give a special priority to the above service aspects irrespective of the age groups. The tourism with local history, natural science and social studies prioritizing children and youth tourism programs for beginners (9-11 and 12-13 years-olds) still rank the physical education and health element on top of the list of priorities till the basics of the relevant tourist techniques and technologies are fully mastered by the trainees.

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35-48 year-old skyrunners' functionality tests in mid-altitude trainings

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Abstract

Objective of the study was to run the 35-48 year-old sport veterans' health/ functionality tests in the middle-altitude trainings.

Methods and structure of the study. We sampled for the gender-equal Experimental Group the 35-48 year-old (40 years old on average) amateur Class III skyrunners of about the same physical and competitive fitness having no health limitations for trainings and competitions. The group heart rates and peripheral oxygen (SpO2) levels in blood were tested by Choicemmed MD300C318 portable pulse oximeters; and the lactic acid/ lactate levels were tested by AccutrendPlus portable biochemistry analyzers, with the tests run every morning on an empty stomach in a quiescent state for 13 days of the training period.

Results and conclusions. It is shown that the oxygen saturation rate monitoring being more informative than the heart rate tests only for the acclimatization process tests and self-controls – due to the heart rate in trained samples normally staying within a healthy range and being sensitive at the same time to many factors. The study data and analyses showed the middle-altitude adaptation going in a phased manner, with some functionality falls in week 1 (blood oxygen drops, heart rate growths and lactate growths) and crisis occurring on day 5, with the health situation coming back to normality and stability on week 2 and thereafter. Therefore, the 35-48 year-old skyrunners are recommended scheduling at least a week for adaptation and acclimatization period, with the low-intensity trainings reasonably controlled and limited by a safe heart rate range.

Keywords: *skyrunning, adaptation, heart rate monitoring, pulse oximetry, lactate tests, middle-altitude training, training system.*

Background. Modern mountaineering sports, tourism and trekking tours are increasingly popular in every population group, particularly in the urban communities [8], with the range of mountain sports and physical activities growing with time [8, 11]. A special progress and popularity the world over and in Russia has recently been won by skyrunning, a 2000m-plus mountain running discipline that emerged in 2012 [6]. Modern skyrunning events may be described as the high-altitude races including Vertical Kilometer, SkyRace and SkyMarathon. It should be mentioned that the amateur sports community grows and includes more and more mature people with time [9]. Sport veterans are known to appreciate the active leisure time options, peer communication and teamwork opportunities of the new sport discipline, whilst the purely competitive aspects are ranked second on their list of priorities. Since the veteran sports are known to be highly sensitive to many negative age-specific factors [1], and this holds particularly true for the amateur sports and self-reliant uncontrolled trainings often run with violations for the key training system safety standards [4, 10], a special priority shall be given to the 35+ year-olds health/ functionality tests and analyses – particularly in the high-difficulty situations and challenging environments including the middle- and high-altitude trainings and competitions.

Objective of the study was to run the 35-48 year-old sport veterans' health/ functionality tests in the middle-altitude trainings.

Methods and structure of the study. We sampled for the gender-equal Experimental Group the 35-48 year-old (40 years old on average) amateur Class III skyrunners of about the same physical and competitive fitness having no health limitations for trainings and competitions. The group heart rates and peripheral oxygen (SpO2) levels in blood were tested by Choicemmed MD300C318 portable pulse oximeters; and the lactic acid/ lactate levels were tested by AccutrendPlus portable biochemistry analyzers, with the tests run every morning on an empty stomach in a quiescent state for 13 days of the training period. The test data were processed by the standard statistical data processing Statistica 8.0 software toolkit and followed by descriptive, comparative and correlation analyzes. Differences of the data arrays were rated significant at $p \leq 0.05$. It should be emphasized that the test data were found gender-unspecific ($p > 0.05$) and, hence, there was no need for gender grouping of the sample.

Results and discussion. The *middle-altitude group training course* was run in May 28 through June 9, 2019 in the Altai Republic at Altai-Aktru Highland Center in a trough valley of the Aktru River – downhill from the Severo-Chuisky ridge glacier 2150 m above the sea level [3]. The training cycle was designed to acclimatize the group for the Vertical Kilometer race at the Tomsk Region Skyrunning Championship on June 12, 2019. The 3000m race was run on the Teacher Hill starting from 1000 m altitude. The precompetitive trainings were dominated by active moderate-intensity runs (3 hours at most) every morning on 1000-3000m high tracks, with the heart rate kept at most 70% of the maximum; plus outdoor team sports in the afternoon including volleyball, futsal, badminton, etc.

Middle-altitude training course overview: it was run in the 1400 m to 2500 m altitudes with a relatively lower atmospheric pressure, air temperature and humidity levels and higher radiation (light, ultraviolet, etc.). Most influential of these factors is the atmospheric pressure under 596 mm Hg since it is known to force the partial oxygen pressure (pO2) drop by 23% to 115 mm Hg (from 149 mm Hg on the sea level) [2]. Such pO2 drops are associated with adaptive physiological changes that are normally moderate and transient in healthy individuals [5] although the 35-plus year-olds may face some altitude-specific hypoxic issues.

Given on Figure 1 are the *SpO_2 test data*. As provided in the 2009 WHO guidelines on pulse oximetry, the SpO_2 levels of 95%-minus are indicative of hypoxia, while the 90%-minus level are critical and emergency medical care is needed [7]. As demonstrated by Figure 1, hypoxia was diagnosed in every trainee, with one 48 years-old woman even tested with SpO_2 of only 91%. A correlation analysis found a strong inverse age-to-SpO_2 correlation on day 1(-0.85 points), with further SpO_2 fall by day 5 to 93.2±1.7% on average. On the whole, the sample was tested with a wide SpO2 variation in the first week – mostly in the hypoxic zone. Later on the test rate was found to grow and normalize at 98-99%.

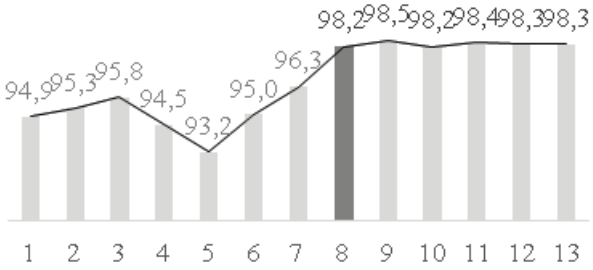

Figure 1. *Peripheral blood oxygen: variation for the training period, %*

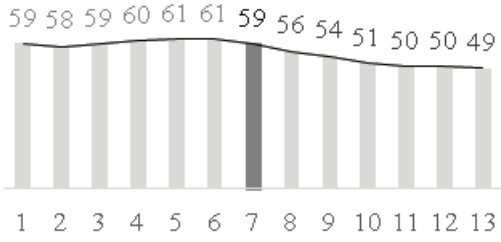

Figure 2. *Heart rate variation for the training period, bpm*

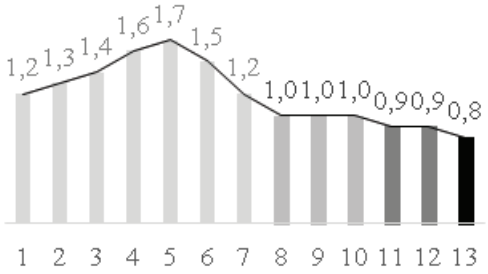

Figure 3. *Capillary blood lactate: variation for the training period, mmol/l*

Given on Figure 2 is the *heart rate monitoring* data. Random pre-training heart rate were found to vary at 49 ± 2 beats/ min on average, grow by 10-plus beats in week 1 of the middle-altitude trainings still staying within the normal range of 60-90 beats/ min, with maximums reached on days 5-6 to come back to norm on week 2 and later on.

Given on Figure 3 is the *lactate monitoring data*. Note that even in the moderate-intensity trainings with the heart rate kept under 70% of the maximum, lactate was tested to grow at first above 1 mmol/l (due to the natural fall of the tissue oxygenation in mid-altitude conditions) and fall down on week 2 to normalize thereafter at 0.8-0.9 mmol/l, with one individual tested with lactate of 0.8±0.1 mmol/l on day 13.

Conclusion. Middle-altitude trainings were tested to change the 35-48 year-olds functionality and trigger adaptation processes in response to a relative drop in pO2, with every individual tested with age-specific hypoxic responses on day 1. The study found the oxygen saturation rate monitoring being more informative than the heart rate tests only for the acclimatization process tests and self-controls – due to the heart rate in trained samples normally staying within a healthy range and being sensitive at the same time to many factors. The study data and analyses showed the middle-altitude adaptation going in a phased manner, with some functionality falls in week 1 (blood oxygen drops, heart rate growths and lactate growths) and crisis occurring on day 5, with the health situation coming back to normality and stability on week 2 and thereafter. Therefore, the 35-48 year-old skyrunners are recommended scheduling at least a week for adaptation and acclimatization period, with the low-intensity trainings reasonably controlled and limited by a safe heart rate range.

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Physical education in context of current problems in higher education

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Abstract

Objective of the study was to analyze the current physical education service situation in the context of the modern educational paradigm with the higher education system reforms and new higher education system standards.

Methods and structure of the study. During the study, we applied a battery of theoretical methods including analysis, synthesis, comparison, and generalization of paradigmatic approaches in higher education, as well as traditional and alternative educational concepts of physical education.

Results and conclusions. We identified the orientation of the scientific paradigms in education; made a theoretical generalization of the accumulated knowledge and experience in the field of physical education from the perspective of the paradigmatic approach; showed the role and place of physical education in the structure of the state higher education standards; disclosed the structural and content base of the thematic sections of the sample physical education program.

Based on the results of the theoretical analysis, the authors conclude that the current reality of higher education implies the implementation of alternative concepts of educational activity into the long-standing traditional teaching practice. The contradiction between the objective requirements of the society for the level of development of physical education competences and the prevalence of a practical-oriented approach to the formation of educational functions necessitates the development of a theoretical-methodological grounds for educational technologies from a paradigmatic perspective. In terms of actualization of the Federal State Education Standard, the higher education standard ensures that mandatory requirements are met when future specialists develop competences to support an adequate physical fitness level to provide for full-fledged social and professional activities.

Keywords: *physical education, education paradigm, higher education system, sample curriculum, Federal State Higher Education Standards.*

Background. One of the key priorities of the national higher education system is the students' health protection and improvement programs with their social, medical, academic progress test and mental health securing aspects in the context of the national health and education paradigms [5, 8]. Missions and objectives of the academic physical education service with its theoretical and practical aspects are consistent with the national education paradigm, concepts and models. The physical education service progress strategies are persistently updated as required by the new knowledge and experience in the education service fields, with a special priority to the new theoretical and practical service models, tools and methods [4].

Objective of the study was to analyze the current physical education service situation in the context of the modern educational paradigm with the higher education system reforms and new higher education system standards.

Results and discussion. The national higher education system in its every element and level has

long been governed by the traditional paradigms, with the higher education system goal limited by the academic knowledgebase and practical skill set building mission [1]. The recent revision of the traditional paradigms has prioritized a learning individual as the key cultural phenomenon and educational process subject. The shift towards humanistic / humanitarian/ phenomenological paradigms has changed the cultural content of the higher education service to establish proactive cultural standards and norms in the educational system in advance of the present social reality [11]. In this context, the traditional and humanistic education paradigms need to be harmonized in every aspect [7]. It should also be mentioned that, despite the versatility of the new education paradigm, it still favors at this juncture the competency-prioritizing model [2, 3, 10] geared to develop the standard key competences as required by the state standards for the relevant professional, social, economic, informational and other service missions [12].

As things now stand, the academic physical education service is designed as required by the Federal State Higher Educational Standards (FSHES) that set forth requirements to the physical education curricula. Analysis of the educational system design and content for the last two decades shows that they have been transformed in the approaches to the educational service and professional requirements to graduates – to make a transition from the traditional paradigm to the competency-centered one [8]. The first- and second-generation FSHES mandated the educational paradigm transition towards the humanistic education model. In practical terms, it has given more freedom to universities in their educational curricula design and management aspects. However, the traditional approaches to the academic disciplines, design and content without the still substandard academic progress test system have made the results short of expectations.

Drawbacks of the second-generation FSHES were addressed by Federal Law of December 29, 2012 No. 273-FZ "On Education in the Russian Federation" that provided for transition to the third-generation FSHES with the new higher education system objectives and graduates' education quality assurance requirements including the key general cultural and professional competences. Further amendments to the FSHES-3 once again affected the physical education service standards. The physical education discipline was eventually listed beyond the humanitarian, social and economic disciplines to stand alone as a separate mandatory course. The conceptual uncertainty and inconsistencies in the requirements to the graduates' education levels resulted in the standard competences and the relevant notions and interpretations in the education curricula being contradictory in many aspects.

Further updates to the FSHES-3 to produce FSHES-3+ and FSHES-3++ included revisions both to the list of competences and even the titles and contents of the curricula. Thus the general cultural competences gave way to the so called universal competences (UC) classified into categories/ groups. The academic physical education service is required to form UC-7 including the graduate's competence in "due physical fitness maintenance for the fully-fledged social and professional service (self-control, self-development and health safety category)".

The sample physical education curricula are developed in compliance with the valid FSHES and fundamental legal and regulatory provisions that spell out the core priorities, scopes and contents of the education service harmonized with the local socio-cultural and climatic contexts and professional specialist training traditions [4]. Cognitive goals of the modern academic education service are secured by the theoretical educational materials; although it should be mentioned that the theoretical part of the physical education service (critical for the students' health agendas, healthy lifestyle and even world outlooks) virtually never exceeds 10% of the total labor intensity of the discipline.

Despite the few updates of the FSHES for the last decade with changes to the lists of competences and design and content of the curricula, the sample physical education curriculum effective since 2011 remains the only regulatory document for the academic physical education service priorities, goals, scopes and contents. At this juncture, the decision-makers pay much attention to new revisions of the education service concepts to allow a broader use of distance education service models to fully enjoy benefits of the modern IT and communication tools with interactive student-teacher and student-student communication, data flows and teamwork. These revisions are considered beneficial, resourceful and highly promising for the national education system [9].

Conclusions. The current reality of higher education implies the implementation of alternative concepts of educational activity into the long-standing traditional teaching practice. The contradiction between the objective requirements of the society for the level of development of physical education competences and the prevalence of a practical-oriented approach to the formation of educational functions necessitates the development of a theoretical-methodological grounds for educational technologies from a paradigmatic perspective. In terms of actualization of the Federal State Education Standard, the higher education standard ensures that mandatory

requirements are met when future specialists develop competences to support an adequate physical fitness level to provide for full-fledged social and professional activities.

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Comparative analysis of state anxiety and morbidity rate in female students engaged in classical and slide aerobics

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Abstract

Objective of the study was to rate and analyze benefits of the slide and classical aerobics training models for the mental and physical health standards of the first-year female students.

Methods and structure of the study. We sampled for the slide aerobics model testing experiment the 17-19 years old first-year female students (n=54) from 9 National Research Tomsk State University departments and institutes qualified with the main and preparatory health groups; and split up the sample into Experimental and Reference Groups (EG, RG) of 27 people each. The RG was formed of the classical aerobics trainees, and EG was trained as required by the new slide aerobics model of our own design, with both groups trained twice a week for 1.5 hours for the period of October 2017 through May 2018.

Mental health was tested by the Spielberger-Khanin State-Trait Anxiety Inventory (STAI) tests; and the emotional health was tested by synchronous stress tolerance tests that rate the stress tolerance by varied intensity and time stresses.

Results and conclusions. The study found a close correlation between the stress tolerance and morbidity rate of the first-year female students, regardless of their physical activity. The classical and slide aerobics trainings were found to equally facilitate the students' adaptation to the academic living and learning environments, with the stress tolerance and morbidity rate falling down to the minimal values by completion of the first academic year – versus their unsporting peers whose adaptation processes were tested to take up to two years. The study data and analyses proved high benefits of the slide aerobics training service that may be ranked among the key adaptability factors for its accelerating effects on the bodily adaptive responses to academic stressors the students are always exposed to in the first academic year.

Keywords: *state anxiety, classical aerobics, slide aerobics, morbidity rate, adaptation.*

Background. The national research community gives a growing priority to the studies meant to improve the students' mental and physical health standards and academic living and learning environments by special physical practices, with the highest attention to the university entrants [4]. The academic physical education and sport service offers a wide range of the physical activation and health improvement models, with modern aerobics systems (dominated by the classical and slide aerobics) being among the most popular and demanded by the female students [2]. Thus National Research Tomsk State University has offered the classical aerobics service for the last few decades in the academic physical education and sport curricula and accumulated a vast experience – that proves benefits of the courses for the physical education and sport service mission; albeit the slide aerobics course is relatively new for the academic physical education and sport service; and its benefits, as we believe, still need to be comprehensively tested and analyzed [3].

Objective of the study was to rate and analyze benefits of the slide and classical aerobics training models for the mental and physical health standards of the first-year female students.

Methods and structure of the study. We sampled for the slide aerobics model testing experiment the 17-19 years old first-year female students (n=54) from 9 National Research Tomsk State University departments and institutes qualified with the main and preparatory health groups; and split up the sample into Experimental and Reference Groups (EG, RG) of 27 people each. The RG was formed of the classical aerobics trainees, and EG was trained as required by the new slide aerobics model of our own design, with both groups trained twice a week for 1.5 hours for the period of October 2017 through May 2018.

Mental health was tested by the Spielberger-Khanin State-Trait Anxiety Inventory (STAI) tests; and the emotional health was tested by synchronous stress tolerance tests that rate the stress tolerance by varied intensity and time stresses [1]. The group progresses were tested by the pre-, mid- and post-experimental tests (in October 2017, late November 2017 and May 2018, respectively). The pre-experimental tests found the intergroup differences in the stress tolerance and morbidity rates (reported by the university health clinic) insignificant ($p>0.05$).

Results and discussion. Presently National Research Tomsk State University runs comprehensive studies with analyses of the classical aerobics benefits for the physical development, physical fitness and stress tolerance of the beginner students [3], with a special interest to the stress tolerance and mental adaptability in the first two academic semesters including the physical and mental health benefits of the classical and slide aerobics classes. We also ranked for the study purposes the academic stressors the first-year female students are inevitably exposed to.

We run a questionnaire survey and found most of the sample reporting high emotional discomforts due to the drastic changes in the lifestyles and learning environments. Thus the sample (n=47) was dominated by resettled people, with 43 living in hostels; 4 in rented apartments and only 7 locals. Most reported shortages in the rehab sleep time (averaging 6 hours only) and too long academic learning time, with the majority (38 people) reporting 10+ hours claimed by the class and off-class studies: see Figure 1 hereunder.

Figure 1. *Questionnaire survey data (n=47)*

Accommodation	Sleep time	Academic workload
Family	8-10 hours	6-7 hours
Rented space	6-8 hours	8-9 hours
Hostel	6-minus hours	10-plus hours

We tested the state anxiety in RG and EG versus the benchmarks (Table 2) to find the group test data being still within the moderate zone albeit close to the upper limit: see Table. 1. Despite this, the pre-experimental stress tolerance rates were insignificantly ($p\leq0.05$) above the threshold values: see Table. 2.

Table 1. *Spielberger-Khanin STAI tests: pre-, mid- and post-experimental state anxiety test data, points*

Groups	Pre-experimental	Mid-experimental	Post-experimental
EG	36,9±4,5	47,7±10,4*	40,3±10,4*
RG	37,4±3,0	48,6±10,3*	40,0±11,4*

Table 2. *Spielberger-Khanin STAI test: anxiety benchmarks, points*

Very low	Low	Moderate	Very high
<12	12-30	31-45	> 46

Table 3. *Morbidity rates of the sample, people*

Groups	Pre-experimental	Mid-experimental	Post-experimental
EG	1	16*	7*
RG	1	13*	8*
* $p\leq0.05$			

Stressors in this period are associated with the drastic difference of the academic lifestyles and learning processes from the school ones, with the relevant living and financial challenges, congested living environments, unhealthy daily regimen, etc. Thus the mid-experimental tests found significant anxiety growth in EG and RG (47.7±10.4 and 48.6±10.3 points, respectively): see Table 1. The test data showed the examinations-related stressors being dominant among the academic stressors.

Having analyzed the stress tolerance test data variations for the experimental academic year, we found a insignificant fall ($p\leq0.05$) in the mid-experimental versus pre-experimental test rates (see Table 1), with the fall being attributable to the natural adaptations – facilitated, among other things, by the classical and slide aerobics trainings. It should be noted, however, that the mid- and post-experimental test rates were still insignificantly above the benchmarks (Table 2).

The group morbidity rate variation analysis showed the morbidity rates for the study period being directly correlated with the stress tolerance test rates. Thus the pre-experimental morbidity rates were minimal with the intergroup difference statistically insignificant (Table 3); but the mid-experimental morbidity rates grew many times due to the heavy mental stressors. And, despite the post-experimental morbidity rates

were found to fall significantly (more than twice in the EG) versus the mid-experimental ones, they were still far above the pre-experimental background values (see Table. 3).

It should be noted that the post-experimental stress tolerance and morbidity rate data of both groups were within the lower range of the moderate zone (Table 2); and both of the data arrays were insignificantly different in the 3rd and 4th academic semesters – that may be interpreted as indicative of the high benefits of the classical and slide aerobics classes that facilitated the students' adaptation to the academic living and learning environments.

Conclusion. The study found a close correlation between the stress tolerance and morbidity rate of the first-year female students, regardless of their physical activity. The classical and slide aerobics trainings were found to equally facilitate the students' adaptation to the academic living and learning environments, with the stress tolerance and morbidity rate falling down to the minimal values by completion of the first academic year – versus their unsporting peers whose adaptation processes were tested to take up to two years. The study data and analyses proved high benefits of the slide aerobics training service that may be ranked among the key adaptability factors for its accelerating effects on the bodily adaptive responses to academic stressors the students are always exposed to in the first academic year.

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University students' physical fitness and health standards variation tests and analysis

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Abstract

Objective of the study was to find the factors of hampering effect on the university students' motivations for habitual physical education and sports practices.

Methods and structure of the study. We tested and analyzed variations of the physical fitness and health standard in the 1-3-year National Research Tomsk State University (NRTSU) students (n=6000) sampled at 20 NRTSU institutes and departments, with their progress tests and medical examinations run for 10 years (2009-2019). The physical fitness and health standards test and analytical data were verified by annual questionnaire surveys of the students that yielded subjective physical fitness and health self-rates.

Results and conclusions. It is shown that, despite the positive changes in the socio-economic situation of the country and the significant improvement in the basic development indicators of the physical culture and sports sector, which are reflected in the report on the success of implementation of the Russian Federation State Program "Development of physical culture and sports sector" over the past 10 years (2009-2019). There were no qualitative changes in the students' state of health and physical fitness. The authors believe that the pace of development of the physical culture and sports sector in the Russian Federation still lags behind the real possibilities of the majority of Russia's population in satisfying their physical education and sports interests and needs, since the improvement of the standard of living of the population indirectly implies the severization of requirements for the creation of a comfortable environment for physical education and sports activities. In order to meet the challenges facing the physical culture and sports sector, it is necessary to speed up the process of establishing a modern physical culture and sports infrastructure, equipping it with modern sports equipment, developing and introducing modern pedagogical technologies, etc.

Keywords: *physical fitness, health standards, physical education and sports infrastructure, physical health, physical activity.*

Background. The national physical education and sport sector made progress for the last decade as mentioned in the physical education and sports Progress Report of the Russian Federation for 2019 [2], with special advances in the following domains: sports facilities accessibility rate reported to grow up to 55.7%; habitually sporting 3-79 years old population reported to grow to 42.3%; 78 new mass sports facilities and 33 football fields with artificial surface were commissioned; 112 Children and Youth Olympic Reserve Sport Schools (CYORSS) were modernized and re-equipped, etc.

However, the planned progress has not been made in a few other domains. On the whole, the national physical education and sports progress and mass physical education and sport service supply still lags behind the demand of different population groups. It should be mentioned that the demand for physical education and sport services tend to grow with the improving living standards. As provided by T.S. Susikova and N.R. Arbuzin, the physical education and sport service infrastructure in the Russian Federation is still less developed than reported by most of the leading sporting nations. For example,

Table 1. *Health test data of the sample of 2009 and 2019*

Health group	2009		2019	
	n	%	n	%
Exempted from physical education classes	357	5,9%	397	6%
Therapeutic physical education group	666	11,1%	616	9,3%
Special health group	912	13,7%	912	13,7%
Preparatory and main health groups	4141	68,6%	5052	71,0%
Total	6033		6647	

the national supply of the outdoor sports facilities is still 2.7 and 6.8 times lower than in Japan and Italy, respectively; and supply of swimming pools is 30 and 7.7 times lower than in both countries, etc. [3].

Objective of the study was to find the factors of hampering effect on the university students' motivations for habitual physical education and sports practices.

Methods and structure of the study. We tested and analyzed variations of the physical fitness and health standard in the 1-3-year National Research Tomsk State University (NRTSU) students (n=6000) sampled at 20 NRTSU institutes and departments, with their progress tests and medical examinations run for 10 years (2009-2019). The physical fitness and health standards test and analytical data were verified by annual questionnaire surveys of the students that yielded subjective physical fitness and health self-rates.

Results and discussion. The questionnaire survey found the students still ranking the poor physical fitness and health standards on top of their problems, as was the case in previous years. This was the finding of a ten-year (2009-2019) physical fitness and health standards survey of 6000 NRTSU students, and we have sound reasons to assume that the situation is much the same for many other universities of the Russian Federation, since the students has come to NRTSU from 23 Russia's constituents. The survey found 15%, 30%, 45% and 10% of respondents self-ranking their physical health standards as high, good, moderate and low, respectively. Real health situation, however, was found different from the self-rates – as verified by the annual medical examinations that rated 5%, 20%, 35% and 40% of the sample high, good, moderate and low on the physical health standards scale, respectively.

The situation was largely the same for the physical fitness tests and self-rates. The survey found 5%, 20%, 45% and 30% of the sample self-rating the physical fitness as high, good, moderate and low; whilst the actual physical fitness tests ranked the sample only 2%, 10%, 38% and 50% high, good, moderate and low on the physical fitness scale, respectively. It should be noted that most (65%) of the NRTSU sample self-rated their physical fitness and physical health standards insufficient, whilst the rest (35%) were quite happy with them. Furthermore, the annual medical examinations of the 1-3-year student population classified by the academic health groups showed no changes in the health situation for the last 10 years (2009-2019): see Table 1 hereunder.

On the whole, the physical health standards of the students made insignificant ($p < 0.05$) progress for the 10 years [1]. The study also found that the obligatory physical education and sport service of 4 hours per week fails to facilitate physical progress as verified by the poor physical fitness test data and secure the physiological minimum of physical activity of 6-8 hours a week to keep up the key mental and physical health standards. Thus only 57% of the 2019 sample was successful in the standard physical fitness tests. We also found drops for the last few years (to 3-4%) in the numbers of university entrants having sports qualifications. Note that this figure includes most (up to 80%) the Physical Education Department entrants having sports qualifications.

The still substandard physical fitness is confirmed by the regular GTO Complex tests that have been run by the NRTSU's GTO Complex Training and Test Center for the last four years since it was established. The Center reports 1715 qualifiers for the tests for the period, with only 24, 18 and 94 successful in tests for gold, silver and bronze badges, respectively (n=136 in total that makes about 8% of the tested population).

The annual questionnaire surveys found that the key reason for the students being still low motivated for the standard academic physical education and sport service is the short supply of modern sports facilities, equipment and accessories. Thus about 80% of the sample mentioned the substandard sports infrastructure as the core reason for their reluctance to train – as most of their sports and physical activity needs and interests are rather specific. These needs should be met by modern gyms, stadiums, outdoor sports arenas, swimming pools, etc. Note that NRTSU presently holds only one sports building commis-

sioned in 1969 and never rehabilitated since then for 50 years.

The situation is largely the same for the sporting student population. Most of the qualified academic athletes have to excel in their sports beyond the NRTSU and face multiple problems, from the time-taking daily trips to costly (and not always affordable) commercial physical education and sport services. This is the reason why most of the qualified athletes have to retire from sports after they enter NRTSU. Presently the students competing in the university teams account for less than 5.8% of the total NRTSU population.

In addition to the obligatory standard physical education classes, NRTSU hosts many off-class physical education and sports events on holidays and weekends; although these events expected to encourage the students' physical activity fail to offer solutions for multiple problems faced by the academic physical education and sport service at present for the above mentioned reasons.

Conclusion. The study data and analyses showed that the university still fails to successfully solve many problems faced by the physical education and sport service as it badly needs a modern service infrastructure with the cutting-edge physical education and sports technologies, and with due contributions from the modern physical education and sports theory and practice, sports training systems, sports psychology, biomechanics, pharmacology, medicine, nanotechnology, etc.

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Experimental simulation of cyclic training loads

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Abstract

Objective of the study was to develop and test benefits of a cyclic physical training model on laboratory mice.

Methods and structure of the study. We sampled for the new cyclic physical training model testing experiment the 12 weeks-old male mice of C57BL/6 line (n = 60 procured from the Institute of Pharmacology's Siberian Affiliate) split up into Experimental and Reference Groups (EG, RG) of 30 mice each). The RG was untrained, and the EG training was designed under the new model.

Results and conclusions. All mice performed the physical loads successfully. After the first insight into the test procedure, the animals completely familiarized themselves with the task, and on the second day performed the loads in full. There was no abnormal reaction in their behavior and functional state. No reduction of food or water intake was detected. No fatalities were reported during or after the tests either.

The new cyclic physical training model was tested beneficial for small laboratory animals and may be recommended for a wide range of preclinical and other experimental studies in sports physiology.

Keywords: *cyclic physical training model, treadmill, small laboratory animals.*

Background. Lately in sports physiology a growing priority has been given to experimental research [5, 8, 9] of physical training process that is known to trigger molecular changes in muscles and stimulate endocrine function [6, 7]. It has become traditional to use laboratory mice in the experiments to clarify the physical training process [2, 3], since mice have many advantages to other small laboratory animals – e.g. in homology of the human and murine genes that is very close in many aspects. The mice-using experiments may model quite a few physiological and pathological changes in the human body that are well traceable due to the short reproductive cycles [4]. Physical training experiments may use a wide range of physical loads including wheel running, swimming, hanging, weight trainings etc. Of special interest for such experiments are the treadmill trainings [4].

Objective of the study was to develop and test benefits of a cyclic physical training model on laboratory mice.

Methods and structure of the study. We sampled for the new cyclic physical training model testing experiment the 12 weeks-old male mice of C57BL/6 line (n = 60 procured from the Institute of Pharmacology's Siberian Affiliate) split up into Experimental and Reference Groups (EG, RG) of 30 mice each). The RG was untrained, and the EG training was designed under the new model. The mice were kept in an isolated ventilated vivarium at 24±1.0°C, air humidity of 60%, and day/night regime of 12+12. Every mouse was marked and kept in quarantine for 7 days, 6 mice per cage, with free access to water and standard food "Prokorm" (made by ZAO "Biopro", Novosibirsk).

We used a treadmill for small laboratory animals made on a special contract for the cyclic physical

trainings. The treadmill includes the following elements: (1) Rough-surface varied-incline rubber run belt of 60 cm^2; (2) Casing to divide the run surface into 10 isolated tracks; (3) Electrical stimulation module with the contact copper plates behind the run spots to force the mice run; and (4) Control unit (see Figure 1).

Body mass of the animals was tested on a permanent basis by DL-WP laboratory balance (A&DI, Japan) and processed by STATISTICA10.0 software toolkit, with the group differences rated by the non-parametric Mann-Whitney test, and with the differences deemed statistically significant at $p<0.05$; and the data presented in Xav ± SE format. The experiment was approved by the local Ethics Committee of the Biological Institute of National Research Tomsk State University (Protocol No. 32 dated December 2, 2019).

Results and discussion. The cyclic physical training model was tested for 4 weeks, with every weekly microcycle including 6 run days and 1 rest day: see the cyclic physical training model design in Table 1 hereunder. The mice run on the treadmill at varied speeds, with the runs alternated with passive rest breaks to simulate as close as possible the natural lifestyles of the animals (as reported by etiology of rodents, their natural lifestyle is dominated by short dashes with passive rest breaks, with the top speeds relatively seldom [1].

The 4-week cyclic physical training model testing experiment resulted in the EG body mass reduction versus the RG due to the high-intensity aerobic practices – as verified by the pre- versus post-experimental weights averaging 28.67±0.6g and 27.98±1.12g, respectively, ($p<0.05$), versus the RG body mass growth up to 31.02±1.3g ($p<0.05$): Figure 2.

It should be noted that every animal stood the experiment well. Actually it took only one day for the mice to get used to the cyclic physical training and run effectively, with no abnormal behavioral and functional reactions fixed; no reductions in the water/food demands; and not one lethal case in the experiment.

Conclusion. The new cyclic physical training model was tested beneficial for small laboratory animals and may be recommended for a wide range of preclinical and other experimental studies in sports physiology.

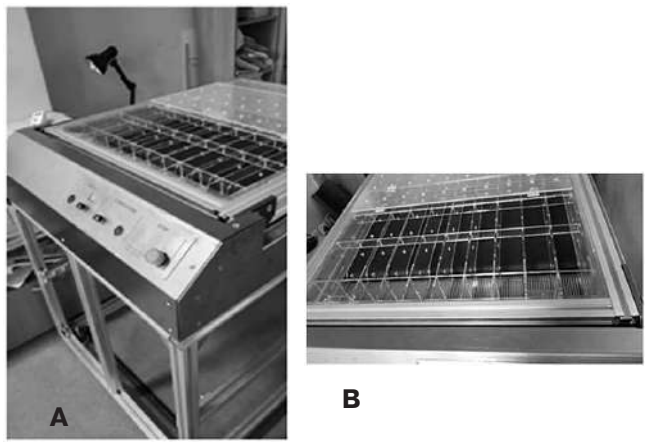

Figure 1. *Treadmill for small laboratory animals: A general view; B run belt and electric stimulators*

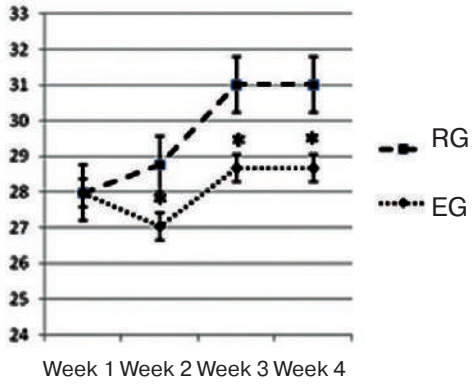

Figure 2. *Body mass variation for the test period; *p<0.05 for intergroup difference*

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Table 1. *Cyclic physical training model design*

Speed, m/ min	Week 1 14	Week 2 15	Week 3 16	Week 4 18
Time, min	10-60*	60	60	60
Incline, degrees	0	5	10	10

*Note: *Run time was stepped by 10min every day in Week 1 to reach 60min thereafter*

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Endotoxin aggression in athletes: etiological factor analysis

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Abstract

Objective of the study was to analyze the etiological factors of influence on a sport-specific endotoxin aggression.

Methods and structure of the study. We tested endotoxin of gram-negative intestinal bacteria in the blood plasma, plus antibacterial humoral immunity in the 18-20 year-old athletes (n=79) versus the Reference Group of virtually healthy 20-40 year-olds (RG, n=30). We used the systemic endotoxinemia and antiendotoxin immunity test method developed by the Institute of General and Clinical Pathology (RF Patents No. 2011993, 2088936, 2093825); and rated the antibacterial humoral immunity by an enzyme immunoassay to find contents of the antibacterial antibodies to the following antigens of opportunistic bacteria: Pseudomonas aeruginosa, Escherichia coli, Proteus, bacteroids, Klebsiella, bifidumbacteria and Candida antigens. The test data were processed by the MS Excel 5.0 statistical toolkit, with the data array differences rated significant at $p<0.05$.

Results and conclusions. The study found a direct correlation between the blood plasma endotoxin and antibodies to bifidobacteria indicative of a high permeability of the intestinal barrier. The group with high antibodies to bifidobacteria was diagnosed with endotoxin aggression of different sport-specific etiologies that exposes the group to a high risk of an adaptation failure (de-adaptation).

Keywords: *endotoxin, endotoxin aggression, etiological factors.*

Background. Endotoxin is known to activate the hemostatic system [2, 3] in certain physiological conditions due to its Hageman factor activation capacity, and interact with receptors of granulocytes and platelets [4]. One of the endotoxinemia rating methods in case of a gram-negative sepsis is based on endotoxin rating in the blood circulation system with antibacterial immunity tests in athletic trainings that provide the means to rate the training system efficiency and detect latent diseases in need of special diagnostics and pathogenetic therapy.

Objective of the study was to analyze the etiological factors of influence on a sport-specific endotoxin aggression.

Methods and structure of the study. We tested endotoxin of gram-negative intestinal bacteria in the blood plasma, plus antibacterial humoral immunity in the 18-20 year-old athletes (n=79) versus the Reference Group of virtually healthy 20-40 year-olds (RG, n=30). We used the systemic endotoxinemia and antiendotoxin immunity (AEI) test method developed by the Institute of General and Clinical Pathology (RF Patents No. 2011993, 2088936, 2093825); and rated the antibacterial humoral immunity by an enzyme immunoassay to find contents of the antibacterial antibodies to the following antigens of opportunistic bacteria: Pseudomonas aeruginosa, Escherichia coli, Proteus, bacteroids, Klebsiella, bifidumbacteria and Candida antigens. The test data were processed by the MS Excel 5.0 statistical toolkit, with the data array differences rated significant at $p<0.05$.

Results and discussion. The relevant reference literature reports correlations of endotoxinemia with thrombocytopenia [1, 4]; and we matched in this

Table 1. *Peripheral blood platelets versus endotoxin in athletic EG-1 and EG-2*

Endotoxin in plasma, EU/ ml	Average endotoxin in plasma, EU/ml	Test group	Blood platelets per 1 mcl	Standard blood platelets per 1 mcl
EG-1: 0,3-1,25	0,96 ± 0,11	37 (46,8%)	264085±10603	243382±9800
EG-2: 1,5-5,0	2,53 ± 0,13	42 (53,2%)	187303±11713*	

Note: *p≤0.05

context the peripheral blood platelets in EG-1 individuals tested with blood plasma endotoxin of 0.3-1.25 EU/ ml (close to the physiological norm of 0-1.0 EU/ ml) versus that in EG-2 tested with blood plasma endotoxin of 1.5-5.0 EU/ ml: see Table 1 hereunder. Note that EG-1 was tested with increased platelets indicative of "irritation" i.e. endotoxin stimulation of the myelocytic bone marrow lineage [1].

EG-2 was tested with the platelet levels 25% and 30% lower than the standard and the EG-2 test rates, respectively, close to the bottom of the standard range which has been established by the decades-long clinical tests of virtually healthy samples. The clinical data shows that when endotoxin averages 2.53±0.13 EU/ ml, it may be indicative of the myelocytic bone marrow lineage reserves being close to depletion. Such imbalance may result in an adaptation failure (de-adaptation) under pressure, with the granulocyte link response being almost the same as response from platelets.

It should be noted that 42 athletes (53.2% of the EG) were tested with endotoxin aggression without expressed clinical manifestations, since none in the EG was tested with body temperature above 36.7^{0}C. This may mean that the subjects may be diagnosed with a chronic endotoxin aggression in the "endotoxin tolerance" stage. Presently "endotoxin tolerance" may be defined as the purely experimental notion for the situations when no temperature growth is found in response to endotoxin in the blood.

Of special interest for us in the above context was an attempt to find which of the gram-negative intestinal bacteria contribute to the endotoxin aggression progress in the group. We used for this purpose an indirect serological test to rate antibodies to microbial sources of endotoxin aggression - most probable in our opinion. In addition, we rated antibodies to Candida and bifidobacteria, to detect secondary immunodeficiency (in the first case) and potential damage to the intestinal barrier permeability (second case), since bifidobacteria are known to be highly adhesive to the epithelium of the colon mucosa and compete there with gram-negative bacteria.

Based on the above test data, we classified the EG into EG-1a and EG-2b with the normal and high antibodies to bifidobacteria in the blood plasma. Thus EG-1a was tested with 3.6 to 4.6 μg/ ml (4.10 ± 0.50 on average); and EG-2 with 6.1 to 18.2 μg/ ml (8.90 ± 0.70 on average) of antibodies to bifidobacteria. Of special interest is the fact that EG-1a and EG-2a differed also in the blood plasma endotoxin, titers of antiendotoxin antibodies and antibacterial antibodies.

Every group with normal antibodies to bifidobacteria rates was tested with increased blood plasma endotoxin and low titers of antiendotoxin antibodies. These groups were also tested with significant growth of antibodies to Candida antigens (save for the weightlifting group) – that may be indicative of candidal dysbiosis as a marker of secondary immunodeficiency. Subjects with the high antibodies to bifidobacteria were tested with significantly ($p < 0.05$) high blood plasma endotoxin and high titers of antibodies to E. coli 014; plus significantly ($p < 0.05$) lower titers of antibodies to Re-glycolipid.

The above changes are assumedly typical for increased translocation of bacteria and/ or endotoxin from the intestine into the bloodstream due to intestinal dysbiosis associated with a deficiency of bifidobacteria. Individuals with high antibodies to bifidobacteria were tested with significant changes in antibodies to antigens of gram-negative bacteria: Pseudomonas aeruginosa (triathletes and basketball players), Proteus (basketball players), bacteroids (weightlifters and basketball players), Klebsiella (weightlifters, triathletes, track and field athletes and basketball players), and Candida (weightlifters, triathletes and basketball players) – versus those tested with normal antibodies to bifidobacteria. The detected variations in the antibacterial antibodies may be due to dysbiosis triggered by sport-specific stressors and contributing to the endotoxin aggression progress.

Conclusion. The study found a direct correlation between the blood plasma endotoxin and antibodies to bifidobacteria indicative of a high permeability of the intestinal barrier. The group with high antibodies to bifidobacteria was diagnosed with endotoxin aggression of different sport-specific etiologies that exposes the group to a high risk of an adaptation failure (de-adaptation).

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Hormonal status monitoring in qualified judokas during trainings

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Abstract

Objective of the study was to rate and analyze adaptation of judo elite of the Republic of Adygea to training system based on the serum hormone tests.

Methods and structure of the study. We sampled for Experimental Group (EG) the local 18-21 year-old Masters of Sports in judo (n=12), many-times champions and runner-ups of the Russian Cups, CIS Championships, European Cups, European Judo Championships, trained at Adyghe State University (Maikop) in elite judo groups. The sample is coached by B.A. Nepso, follower of Yakub K. Koblev, Honored Trainer of the USSR, in traditions of the local Olympic Reserve School.

The hormone tests were made using IFA System (made by "Vector-Best", Russia) at the Immunogenetic Laboratory of the ASU (Research Institute of Complex Problems), with triple tests to average the test data, provided the variation range falls within 10%. The hormone test data correlations were rated by the Pearson parametric correlation analysis using SPSS Statistics 17.0 software toolkit.

Results and conclusions. The original hormonal profiles of the donors and judokas did not differ statistically significantly and did not exceed the standard values. After intensive trainings, the concentrations of stress hormone cortisol ($p \leq 0.05$) and testosterone ($p \leq 0.05$) increased, while those of luteinizing hormones, follicle-stimulating hormones, and prolactin decreased. Changes in the hormonal profile of the qualified judokas within the physiological values indicated a high degree of adaptation of their body to physical loads during training activities.

Keywords: *judo elite, hormonal tests, testosterone, cortisol, prolactin, follicle-stimulating hormone, luteinizing hormones, physical training, training system, training cycle, technical and tactical training.*

Background. Modern theoretically grounded elite training systems are generally designed to secure competitive progress – that need to be supported by due test systems including the hormonal system adaptability tests otherwise the top-intensity workloads close to absolute physiological maximums may result in failures of adaptation mechanisms. Balances of serum hormones yielded by the tests and analyses make it possible to analyze the training systems efficiency and make timely adjustments to the physical training intensity when necessary [4, 8].

Functionality and adaptation to physical training is controlled by multiple hormones dominated by steroid hormones (testosterone), glucocorticoids (cortisol), follicle-stimulating hormone, prolactin and luteinizing hormones; with the hormonal responses known to be dependent on the physical training intensity and duration, practical adaptability to specific practices and homeostasis [1-3].

Objective of the study was to rate and analyze adaptation of judo elite of the Republic of Adygea to training system based on the serum hormone tests.

Methods and structure of the study. We sampled for Experimental Group (EG) the local 18-21 year-old Masters of Sports in judo (n=12), many-times champions and runner-ups of the Russian Cups, CIS Championships, European Cups, European Judo Championships, trained at Adyghe State University (Maikop) in elite judo groups. The sample is coached by B.A. Nepso, follower of Yakub K. Koblev, Honored Trainer of the USSR, in traditions of the local Olympic Reserve School.

The traditional training process may be classified into training cycle with the physical training peaks in the pre-competitive and competitive periods. Every micro- or weekly training cycle includes a daily (morning, with exclusion of Sundays) 1.5-hour technical and tactical training plus 2.5-hour evening high-intensity training on Mondays and Thursdays. Competitive sparring sessions are run on Tuesdays and Fridays with the top-intensity workloads including 10 four-minute bouts with 4-minute rest breaks. On Wednesdays the groups run morning technical and tactical training followed by evening sauna or pool swimming plus walking, massaging and other rehabilitation services. On Saturdays the groups play volleyball, basketball, football, run cross-country races etc. Every training cycle is followed by a 72-hour recovery period.

We tested the training cycle stage-specific serum hormone (testosterone, cortisol, follicle-stimulating hormone, luteinizing hormones and prolactin) variations in blood samples as follows. Point 1: basal post-recovery level; and Point 2: post-training level upon a 2-day high-intensity combined physical training, with blood sampled in the middle of a training microcycle. Reference Group (RG, n=12) was composed of unsporting 18-21 (20.2±1.32) year-olds.

The hormone tests were made using IFA System (made by "Vector-Best", Russia) at the Immunogenetic Laboratory of the ASU (Research Institute of Complex Problems), with triple tests to average the test data, provided the variation range falls within 10%. The hormone test data correlations were rated by the Pearson parametric correlation analysis using SPSS Statistics 17.0 software toolkit.

Results and discussion. Given in Table 1 hereunder are the RG vs. EG basal hormone tests made upon the 72-hour recovery period.

We found insignificant intergroup differences in 4 of 5 analyzed hormones tested within the physiological norms. The EG was tested with the highest deviation from the norm (4.5-35.4 nmol/ l) in the testosterone tests – that may be due to the shortage of rehab period or some stress: see Table 1).

Table 1. *Basal serum hormone test data of the EG and RG, (M±m)*

Group	Luteinizing hormones, ME/ml	Follicle-stimulating hormone, ME/ml	Testosterone, ng/ ml	Cortisol, ng/ ml	Prolactin, ng/ ml
EG	2,65±0,76	4,39±0,62	0,38±0,03	23,68±3,12	10,21±1,02
RG	3,1±0,4	3,7±1,2	0,45±0,05	17,95±3,58	15,75±2,74
t	-1,135	0,468	-1,17	1,52	-1,79
p	0,289	0,649	0,26	0,15	0,10

Note: t – Student criterion; p – significance of difference rate, M±m – average

Table 2. *Correlations of the hormone test rates in the RG*

Hormone		Cortisol	Testosterone	Follicle-stimulating hormone	Luteinizing hormones	Prolactin
Cortisol	Pearson correlation	1	0,587*	-0,453	-0,244	-0,057
	r, bipolar		0,045	0,139	0,445	0,861
Testosterone	Pearson correlation	0,587*	1	-0,596*	-0,438	0,524
	r, bipolar	0,045		0,041	0,154	0,080
Follicle-stimulating hormone	Pearson correlation	-0,453	-0,596*	1	0,651*	-0,008
	r, bipolar	0,139	0,041		0,022	0,981
Luteinizing hormones	Pearson correlation	-0,244	-0,438	0,651*	1	-0,086
	r, bipolar	0,445	0,154	0,022		0,790
Prolactin	Pearson correlation	-0,057	0,524	-0,008	-0,086	1
	r, bipolar	0,861	0,080	0,981	0,790	

**significant at p=0.05*

Despite the fact that habitual judo trainings are known to increase the basal blood testosterone and cortisol levels, the EG was tested with some testosterone falls and cortisol growths, with the testosterone to cortisol ratio applied to rate the individual adaptation to training systems [7]. The testosterone drop and cortisol growth may be indicative of an overtraining and fatigue. Therefore, a serum cortisol growth should be interpreted by the coaches as a negative indication of the athlete's functionality sagging in the training process. Balance of hormones is generally determined by the competition of glucocorticoids for specific cellular receptors, with the cortisol activity dependent on the share of receptors captured by testosterone [5]. We analyzed the EG and RG for correlations of the hormone test rates: see Tables 2 and 3.

We found moderate correlations (2 positive and 1 negative) between testosterone vs. cortisol (r = + 0.587; p = 0.045), testosterone vs. follicle-stimulating hormone (r = -0.596; p = 0.041) and luteinizing hormones vs. follicle-stimulating hormone (r = + 0.651; p = 0.02) in the RG: see Table 2.

The EG was tested different from the RG (see Table 3) in the resting basal cortisol vs. follicle-stimulating hormone correlation ratios (r = -0.728; p = 0.007).

As demonstrated by Table 4, the EG was tested with significantly higher levels of stress hormone cortisol after high-intensity precompetitive trainings, versus insignificant testosterone growth and drops in luteinizing hormones, follicle-stimulating hormone and prolactin levels.

The Point 1 (pre-exercise) and Point 2 (post-exercise) tests found growth in 4 of 5 analyzed hormones. Note that the post-exercise cortisol test rates were found to moderately grow – that is indicative of the adequate adaptive responses to physical training. The 44% post-exercise testosterone growth is due to not only hemoconcentration but also to the exercise intensity (see Table 5) that stimulates synthesis of the hormone in the anterior pituitary gland, an anabolic regulator of prolactin [5]. A moderate post-exercise prolactin growth ($p < 0.05$) was found to facilitate the testosterone production (see Table 5).

Furthermore, the significant post-exercise drop in follicle-stimulating hormone test rates may be due to the high-intensity physical training with increased production of ACTH, glucocorticoids and opioid peptides of inhibitory effect on its synthesis [5]. The minor pre- versus post-exercise luteinizing hormones variations may be interpreted as indicative of the good adapta-

Table 3. *Correlations of the hormone test rates in the EG*

Hormone		Cortisol	Testosterone	Follicle-stimulating hormone	Luteinizing hormones	Prolactin
Cortisol	Pearson correlation	1	0,215	-0,728**	-0,234	-0,272
	r, bipolar		0,502	0,007	0,464	0,392
Testosterone	Pearson correlation	0,215	1	-0,193	-0,505	-0,155
	r, bipolar	0,502		0,547	0,094	0,630
Follicle-stimulating hormone	Pearson correlation	-0,728**	-0,193	1	-0,117	0,174
	r, bipolar	0,007	0,547		,0717	0,589
Luteinizing hormones	Pearson correlation	-0,234	-0,505	-0,117	1	-0,007
	r, bipolar	0,464	0,094	0,717		0,984
Prolactin	Pearson correlation	-0,272	-0,155	0,174	-0,007	1
	r, bipolar	0,392	0,630	0,589	0,984	

*** significant at p=0.01; * significant at p=0.05*

Table 4. *Point 2 hormone test data of the EG (post-2-day training cycle), M±m*

Group	Luteinizing hormones, ME/ml	Follicle-stimulating hormone, ME/ml	Testosterone, ng/ ml	Cortisol, ng/ ml	Prolactin, ng/ ml
EG	2,70±0,40	2,68±0,37	0,57±0,07	39,05±6,77	12,84±1,30
RG	3,1±0,4	3,7±1,2	0,45±0,05	17,95±3,58	15,75±2,74
t	-0,784	-0,675	1,60	3,66	-0,78
p	0,450	0,513	0,13	0,004	0,45

Note: t – Student criterion; p – significant of differences rate, M±m – average

Table 5. *Point 1 and Point 2 hormone test data of the EG, M±m*

Tests	Luteinizing hormones, ME/ml	Follicle-stimulating hormone, ME/ml	Testosterone, ng/ ml	Cortisol, ng/ ml	Prolactin, ng/ ml
Point 1: pre-exercise	2,65±0,76	4,39±0,62	0,38±0,03	23,68±3,12	10,21±1,02
Point 2: post-exercise	2,70±0,40	2,68±0,37	0,57±0,07	39,05±6,77	12,84±1,30
t	-0,057	2,89	-2,403	-2,429	-2,446
p	0,956	0,015*	0,035*	0,033*	0,034*

Note: t – Student criterion; p – significance of difference rate, M±m – average

tion of the neuroendocrine system to the long-acting stressors [6].

Conclusion. The study found the hormone levels profiling tests and analyses being beneficial for the adaptation process control in judo elite trainings to keep the training system intensity within the physiological standards.

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Development of adaptive physical education and sports in belgorod region

UDC 796.011.3

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Abstract

Objective of the study was to analyze progress of the adaptive physical education and sports sector in the Belgorod Oblast for 2017-19.

Methods and structure of the study. We made, for the purposes of the study, analyses of the relevant theoretical and practical research materials, legal and regulatory frameworks and statistical reports including the available online databases on the subject.

Results and conclusions. The habitually sporting and physically trained disabled Belgorod Oblast population for the last three years was reported to grow from 13.2% to 16.9% and 19.7% in 2017, 2018 and 2019, respectively. A special contribution to the adaptive physical education and sports service was made by the state Belgorod Oblast Adaptive Physical Education and Sports Center which mission is to lure the disabled people to the adaptive physical education and sport system and facilitate progress of the Paralympic, Deaf Olympic and Special Olympic sports in the region and Russia on the whole.

The Federation manages four sports disciplines in the Belgorod Oblast as stated by its Charter, and presently its membership is reported at 435 people. The priority policies of the Federation are to lure the disabled people in habitual physical education and sports trainings and advance the local elite adaptive sports including Paralympic, Deaflympic and Special Olympic sports disciplines. The local Adaptive Physical Education and Sports Center serves both children and adults with hearing, visional and musculoskeletal disorders and mental retardations. The Adaptive Physical Education and Sports Center employs certified coaches including the Belgorod State National Research University graduates with Adaptive Physical Education and Sports and Physical Rehabilitation degrees

Keywords: *adaptive physical education and sports, rehabilitation, disabled people, disadvantaged health groups.*

Background. Presently the Belgorod Oblast authorities take special efforts to develop the local adaptive physical education and sports pursuant to the federal government policies that give a high priority to adaptive physical education and sports services for people with physical or mental health disorders and disabilities.

Objective of the study was to analyze progress of the adaptive physical education and sports sector in the Belgorod Oblast for 2017-19.

Methods and structure of the study. We made, for the purposes of the study, analyses of the relevant theoretical and practical research materials, legal and regulatory frameworks and statistical reports including the available online databases on the subject.

Results and discussion. In our analyses of the progress made by the Belgorod Oblast adaptive physical education and sports developmental policies (as provided by the Belgorod Oblast Adaptive Physical Education and Sports Development Program) and practices, we gave a special attention to a few progress factors of the Program including growth of the 6-18 years old disabled local population com-

mitted for habitual physical education and sports to 69.5% of the total Belgorod Oblast population by 2025 (as of December 31, 2019 this ratio was reported at 54.9%). The coverage of the disabled population by the adaptive physical education and sports service, as reported by formal Report Form 3-AFK, has been clearly on the rise: see Figure 1 hereunder.

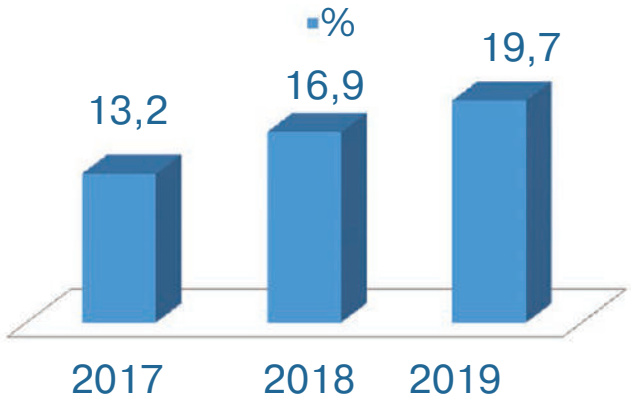

Figure 1. *Reported growth of the habitually sporting and trained disabled Belgorod Oblast population for the last three years*

The habitually sporting and physically trained disabled Belgorod Oblast population for the last three years was reported to grow from 13.2% to 16.9% and 19.7% in 2017, 2018 and 2019, respectively. A special contribution to the adaptive physical education and sports service was made by the state Belgorod Oblast Adaptive Physical Education and Sports Center which mission is to lure the disabled people to the adaptive physical education and sport system and facilitate progress of the Paralympic, Deaf Olympic and Special Olympic sports in the region and Russia on the whole.

As things now stand, the Belgorod Oblast government reports 6,215 sports facilities operating in the Belgorod Oblast (as per Report Form of 1-FC 2019). Pursuant to the Belgorod Oblast Government Decree dated September 21, 2015 No. 346-pp "On approving the roadmap to step up accessibility of the adaptive physical education and sports facilities and social protection, labor, employment, health, cultural, transportation, trade, housing and communal services for disabled people and the relevant urban planning policies", the Belgorod Oblast agencies adapted, as of the early 2020, 35 sports facilities in 17 municipalities for adaptive physical education and sports service; with 5 more facilities slated for adaptation in 2020. Furthermore, 9 Belgorod Oblast municipalities have launched special physical education and sport services for disabled people at 29 adapted training bases for disadvantaged health groups.

A non-governmental Deaf, Blind, Physically Impaired and Mentally Retarded Sports Federation was established in the Belgorod Oblast in 2017. The Federation manages four sports disciplines in the Belgorod Oblast as stated by its Charter, and presently its membership is reported at 435 people. The priority policies of the Federation are to lure the disabled people in habitual physical education and sports trainings and advance the local elite adaptive sports including Paralympic, Deaflympic and Special Olympic sports disciplines. The local Adaptive Physical Education and Sports Center serves both children and adults with hearing, visional and musculoskeletal disorders and mental retardations. The Adaptive Physical Education and Sports Center employs certified coaches including the Belgorod State National Research University graduates with Adaptive Physical Education and Sports and Physical Rehabilitation degrees: see Table 1 hereunder.

Conclusion. The local disabled and disadvantaged health groups engaged in habitual adaptive physical education and sport services were reported to grow by 6.5% (to 19.7%) for the last three years, with the key contribution to the progress made by the state Belgorod Oblast Adaptive Physical Education and Sports Center and non-governmental Deaf, Blind, Physically Impaired and Mentally Retarded Sports Federation.

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Table 1. *Flow of certified coaching staff reported by the Belgorod Oblast Adaptive Physical Education and Sports Center for 2017-2019*

2017 n=46		2018 n=53		2019 n=50	
Top grade	17	Top grade	18	Top grade	17
Grade I	7	Grade I	6	Grade I	3

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Benefits of chinese qigong gymnastics for physical fitness and mental health of special health group students

UDC 796.011.3

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Abstract

Objective of the study was to rate and analyze benefits of a Chinese Qigong gymnastics model for special health group to complement the adaptive academic physical education and sport service.

Methods and structure of the study. The new Qigong gymnastics model testing experiment was run at the National Research Tomsk State University's Physical Education and Sport Department, with 76 female students sampled for the study. The sample was split up into Experimental and Reference Groups (EG, RG) of 38 people each, with the RG trained under the standard physical education and sport curriculum, whilst the EG trainings were dominated by the special-health-group-adapted Chinese Qigong gymnastics model. Both groups were trained twice a week for 1.5 hours for one semester.

Results and conclusions. After the educational experiment, we found a statistically significant improvement of the coordination skills, flexibility, and leg strength in the Experimental Group as opposed to the Control Group. The female students practicing the Chinese Qigong gymnastics demonstrated a significant improvement in their psychological and emotional state. For example, somatization, obsessive-compulsive, depression, anxiety, and phobic anxiety decreased in the Experimental Group females as compared to the Control Group ones ($p<0.05$). It should be noted that interpersonal sensitivity, hostility, paranoid thinking, and psychoticism decreased in the Experimental Group, too ($p>0.05$).

The new Chinese Qigong gymnastics model for special health group students was tested beneficial as verified by the EG versus RG progress in the physical health rating monopodalic eyes-closed balance, standing bents and squats tests and mental health and emotionality rating somatization, obsessive-compulsive, depression, anxiety and phobic anxiety tests.

Keywords: *Qigong gymnastics, female students, physical fitness, mental health and emotionality, physical health, special health group, physical education and sports.*

Background. For the last few decades, the Russian health system has been reporting deterioration of the university students' health standards, since most of the Russian students are prone to unhealthy lifestyles and bad habits associated with physical inactivity. The numbers of university entrants qualified with the special health group are also on the rise [5]. The physical inactivity and different chronic diseases are inevitably associated with emotional stressors which further undermine the working capacity and intellectual functionality of the students. These are the reasons why the physical health and mental health improvement initiatives are in a growing priority in the adaptive health research community [4].

Furthermore, it is widely acknowledged that the academic physical education service for special health group needs to be improved by a variety of models including, as demonstrated by a few studies [1, 6], adapted versions of Chinese Qigong gymnastics that have proved beneficial for physical health and mental health standards of special health group

Table 1. *Pre- versus post-experimental physical fitness test rates of the sample*

Tests	Pre-experimental		Post-experimental	
	RG (n=38)	EG(n=38)	RG (n=38)	EG(n=38)
Monopodalic eyes-closed balance, s	15,32±10,52	17,51±8,73	18,68±8,75	28,31±7,32*
Standing bends, cm	5,49±1,21	4,11±0,78	7,17±0,58	11,67±1,13*
Squats, reps	18,44±1,25	18,87±2,43	18,25±1,78	24,37±1,56*
Sit-ups, reps	29,49±3,70	28,92±4,23	31,34±1,53	32,57±2,43

*Note: * statistically significant intergroup difference,* p<0.05

students. Thus the Qigong gymnastics Ba Duan Jin practices designed to relax body and calm down mind (with the trainee focusing his/ her thoughts on own self associating with flowing water or flying clouds) have been successfully applied to improve physical health / mental health standards by many universities in China [2, 3].

Objective of the study was to rate and analyze benefits of a Chinese Qigong gymnastics model for special health group to complement the adaptive academic physical education and sport service.

Methods and structure of the study. The new Qigong gymnastics model testing experiment was run at the National Research Tomsk State University's Physical Education and Sport Department, with 76 female students sampled for the study. The sample was split up into Experimental and Reference Groups (EG, RG) of 38 people each, with the RG trained under the standard physical education and sport curriculum, whilst the EG trainings were dominated by the special-health-group-adapted Chinese Qigong gymnastics model. Both groups were trained twice a week for 1.5 hours for one semester. The physical fitness, mental health and emotionality of the sample were tested by SCL-90 questionnaire survey to rate 90 symptoms on the following 9 test scales:

1. Somatization meaning mostly local bodily discomforts with the symptoms including headache, muscle pain etc;
2. Obsessive-compulsive issues with proneness to obsessive meaningless thought(s) or useless behavior;
3. Interpersonal sensitivity that means communicational issues with feels of awkwardness, shyness, inferiority etc;
4. Depression with the relevant depressive sentiments and fears;
5. Anxiety that means the personality anxiety with active frustration avoidance behavior;
6. Hostility in three aspects: thoughts, feelings and behavior, including attacks on material objects, arguments and tantrums;
7. Phobic anxiety including fairs of empty spaces with the relevant physical symptoms;
8. Paranoid thinking with excessive sensitivity to disappointment, doubt, resentment, constant discontent with others; and
9. Psychoticism that mostly refers to a few specific behavior and health disorders including auditory hallucinations.

Table 2. *Pre- versus post-experimental mental health test rates of the sample*

Tests	Pre-experimental		Post-experimental	
	RG (n=38)	EG(n=38)	RG (n=38)	EG (n=38)
Somatization	0,77±0,64	0,76±0,52	0,75±0,56	0,55±0,42*
Obsessive-compulsive	1,10±0,56	1,09±0,46	1,05±0,57	0,78±0,33*
Interpersonal sensitivity	1,08±0,54	1,11±0,45	1,03±0,60	0,95±0,53
Depression	0,87±0,51	0,86±0,48	0,85±0,38	0,52±0,32*
Anxiety	0,76±0,49	0,74±0,58	0,73±0,38	0,58±0,45*
Hostility	0,53±0,35	0,52±0,32	0,52±0,22	0,51±0,31
Phobic anxiety	0,55±0,26	0,55±0,34	0,51±0,30	0,32±0,24*
Paranoid thinking	0,67±0,37	0,66±0,42	0,63±0,42	0,64±0,27
Psychoticism	0,44±0,25	0,44±0,33	0,45±0,33	0,43±0,41

*Note: * statistically significant intergroup difference, p<0.05*

Physical fitness of the sample was rated by standard movement coordination (monopodalic eyes-closed balance), flexibility (standing bents), legs strength (squats), and abs strength (recumbent to sit) tests.

Results and discussion. Qigong Ba Duan Jin is one of the most popular versions of the Chinese Qigong gymnastics believed to be at least 2500 years old. Unlike the traditional practices (weightlifting, muscle endurance and strength trainings) focused on body only, the Qigong gymnastics Ba Duan Jin practices are designed to integrate mind and body for harmonized physical and mental progress [3]. The pre-experimental tests of both groups found no significant intergroup differences; whilst the post-experimental tests showed a statistically significant progress of the EG versus RG in the movement coordination, flexibility and leg strength test rates: see Table 1.

Given in Table 2 hereunder are the pre- versus post-experimental mental health and emotionality test rates of the sample – that show significant progress of the EG versus RG in the somatization, obsessive-compulsive, depression, anxiety and phobic anxiety test rates ($p < 0.05$). Of special interest was the significant falls in the interpersonal sensitivity, hostility, paranoid thinking and psychoticism test rates in the EG versus RG ($p > 0.05$).

Conclusion. The new Chinese Qigong gymnastics model for special health group students was tested beneficial as verified by the EG versus RG progress in the physical health rating monopodalic eyes-closed balance, standing bents and squats tests and mental health and emotionality rating somatization, obsessive-compulsive, depression, anxiety and phobic anxiety tests.

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Fitness of secondary schoolchildren with intellectual disabilities for gto tests

UDC 796.011.3

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Abstract

Objective of the study was to test fitness of the mentally retarded 11-12 year old boys for the mental-health- and age-specific GTO Complex tests.

Methods and structure of the study. We analyzed, for the purposes of the study, medical records of the 11-12 year old male sample (n=40 including 20 11-year olds and 20 12-year-olds); and rated their physical development harmony (using centile tables) and physical progress by 3 standard and 3 optional tests from the relevant GTO Complex test set; with the test data processed by the standard mathematical statistics toolkit. The experiment with the pre- and post-experimental tests took one academic year and was run at the municipal state Comprehensive School No. 30 in Belgorod.

Research results and conclusions. The study data and analyses demonstrated drawbacks in the national physical education and sport service for the mentally retarded 11-12-year-old boys, in agreement with the other relevant study reports, and underlined the need for special multisided physical education and sport service system for the age group with traditional and extracurricular models. Such models are recommended giving a special priority to the speed and speed-strength training tools and elements with new methods and technologies customizable to the mental and physical health standards and diagnoses of the mentally retarded children. The physical fitness tests and analysis of the age group in transition from the primary to secondary school showed the children being largely unfit for the age-specific GTO Class III tests for mentally retarded groups; and this is the reason why the GTO Complex system should give a special attention to the principle of continuity in its practical applications.

Keywords: *physical fitness, physical development, GTO Complex tests, mental retardations, physical education and sports.*

Background. Physical education and sports services for physically and mentally handicapped and otherwise disadvantaged population are given a high priority by the national physical education and sports community [2, 3]. The GTO Complex test system has been expanded to include every disability and functionality class for the last few years. We believe that the GTO Complex test system shall offer tests for the mentally retarded children to facilitate the relevant physical education and sport service with a special emphasis on the group social adaptation and the focused health service to correct their hypo-/ hyperactivity, volitional control disorders, indifference, susceptibility to fatigue etc. The relevant modern national and foreign studies give special attention to the mentally retarded children's mental and physical health regresses and their correlations – that need to be reversed and corrected by special physical education and sport service models and tools [1, 4, 5]. A special emphasis in the adaptive, compensatory, rehabilitation and motivation domains of the GTO Complex test system for mentally retarded children shall be made on their physical fitness progress tests in trainings for the GTO tests.

Objective of the study was to test fitness of the mentally retarded 11-12 year old boys for the mental-health- and age-specific GTO Complex tests.

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Results and discussion. The medical records analysis assisted by a certified school health specialist found every individual in the sample diagnosed with Mild Mental Retardation and/or Minimal Cerebral Dysfunction complicated, in some cases, by concomitant pathologies of some body systems. The physical development harmony tests rated 40% of the sample with moderate harmony category and 60% with physical development disharmonies due to the excessive body weights and retarded growth rates. 25% (10 of 40) and 75% (30 of 40) of the sample were qualified with the main and preparatory health groups, respectively. Not a single individual in the sample had medical contraindications for physical trainings.

Given on Figure 1 are the pre- versus post-experimental (September 2018 vs. May 2019) physical fitness test rates of the sample indicative of the physical progress for the school year, with the physical fitness test data benchmarked versus the GTO Bronze Badge test standards.

The pre-experimental tests of the 11-year-old subsample found their physical fitness lower than the GTO Bronze Badge test standards in the endurance, strength and speed-strength tests (see Fig. 1); whilst the post-experimental tests showed significant progress in the flexibility, movement coordination and endurance tests ($p<0.05$).

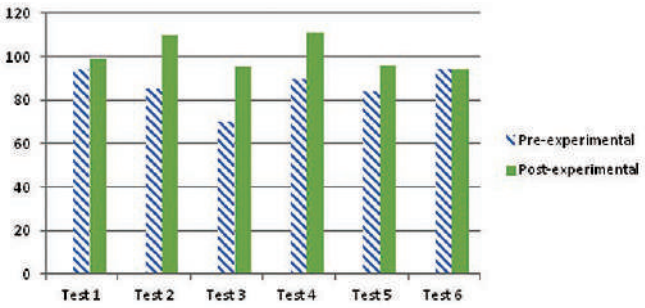

Figure 1. *11-year-olds pre- versus post-experimental physical fitness test data*

Note: 100% is the GTO Bronze Badge test standards

Standard tests: Test 1: 60m sprint (s); Test 2: 1500m race (s); Test 3: pull-ups on a horizontal bar (count); and optional tests: Test 4: floor sitting front lean (cm); Test 5: standing long jump (cm); and Test 6: tennis ball throws on 6m-far target (10 attempts).

The pre-experimental tests of the 12-year-old subsample found their physical fitness close to the GTO Bronze Badge test standards (see Fig. 2); whilst the post-experimental tests showed the statistically significant and highest progress in the flexibility (16% growth), endurance and ball throw tests (8%), i.e. the same physical fitness qualities as for the 11-year-old subsample.

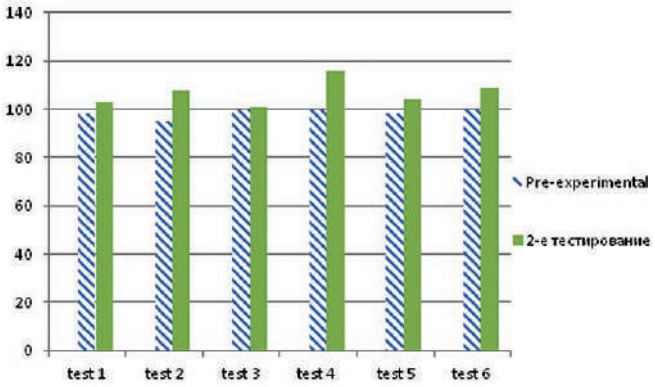

Figure 2. *12-year-olds pre- versus post-experimental physical fitness test data*

Note: 100% is the GTO Bronze Badge test standards

The pre- versus post-experimental physical fitness test data of the sample rated versus the GTO Class III tests for mentally retarded 11-12 year-olds showed neither of the individuals being fit for the GTO Gold and Silver Badges; and nobody could pass all the GTO Bronze Badge test – only a few of them: see Table 1 hereunder. The sample made the lowest progress in the speed rating 60m sprint and speed-strength rating standing long jump tests; and the highest progresses in the flexibility and coordination tests.

Table 1. *Successes in the GTO Bronze Badge tests: post-experimental tests*

Age	Test 1	Test 2	Test3	Test 4	Test 5	Test 6	Total
11	0	2	1	3	0	2	8
12	1	5	1	10	2	6	25

Note that the 11-years-old subsample succeeded in only 8 GTO Bronze Badge tests, whilst the 12-year-old subsample was more than 3 times more successful – that may be explained by the natural age-specific physical progress close to the upper limit of the GTO Class III tests for mentally retarded 11-12 year-olds.

Conclusion. The study data and analyses demonstrated drawbacks in the national physical education and sport service for the mentally retarded 11-12-year-old boys, in agreement with the other relevant study reports, and underlined the need for special multisided physical education and sport service system for the age group with traditional and extracurricular models. Such models are recommended giving a special priority to the speed and speed-strength training tools and elements with new methods and technologies customizable to the mental and physical health standards and diagnoses of the mentally retarded children. The physical fitness tests and analysis of the age group in transition from the primary to secondary school showed the children being largely unfit for the age-specific GTO Class III tests for mentally retarded groups; and this is the reason why the GTO Complex system should give a special attention to the principle of continuity in its practical applications.

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Lower limb kinesio taping for blood circulation control in powerlifting and track and field sports

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Abstract

Objective of the study was to test and analyze kinesio taping effects on the lower limb blood flows in powerlifting and track and field sports.

Methods and structure of the study. We sampled for the study the 17-28 year old athletes (n=12) including powerlifters (n=5) and sprinters and middle-distance track runners (n=7) qualified Class II to Masters of Sports, with all the sample reporting the lead right leg. Upper and lower thirds of the shins and ankles of both legs were tested by means of rheovasography using Valenta 1.4 software. Kinesio taping was used in the microcirculatory/ lymphatic correction (the so called Tunneling) version with application of the fan-shaped BBTape so that the tension-free anchor was fixed on the lymph nodes and the tape tension was ranged from 0 to 20%. The tapes were fixed on proximal to distal muscles, with the tension-free tails, and with prior activation of the adhesive layer.

Results and conclusions. The kinesio taping was tested of special influence on the venous outflow in the lead right leg i.e. on this hemodynamics component of the venous system, plus on the left leg vessels elasticity and vascular tone. The powerlifting group was tested with virtually no changes in the left leg blood circulation with taping, whilst the right leg blood circulation was found to change only in few test rates. The study data and analyses give reasons to conclude that the kinesio taping is of little if any benefits for the powerlifting sport – in contrast to the track and field sports where it may be beneficial for the lower limb blood flow control purposes.

Keywords: *kinesio taping, blood circulation control, rheovasography, powerlifting, track and field.*

Background. Kinesio taping is ranked among the most popular and promising new physiotherapeutic tools for sports. Its developers claim that the tape optimizes lymph/ blood circulation, facilitates lymphatic drainage in the dermis and hypodermis and improves the permeability of skin lymphatic vessels with the surface lymph flows effectively improved by the pressure gradients [1, 6]. In view of the cardiovascular system adaptability important for progress in sports [2, 4, 5] many people in the sports communities do believe that the modern kinesio taping may be highly beneficial for the blood circulation control in many aspects.

Objective of the study was to test and analyze kinesio taping effects on the lower limb blood flows in powerlifting and track and field sports.

Methods and structure of the study. We sampled for the study the 17-28 year old athletes (n=12) including powerlifters (n=5) and sprinters and middle-distance track runners (n=7) qualified Class II to Masters of Sports, with all the sample reporting the lead right leg. The tests were run in a pre-season every day at 9 a.m. to 3 p.m. a day before training. Every subject gave a pre-experimental written informed consent for the study and information about athletic experience, training system, health, etc. People with the recent injuries, poor health, taking medicines and reporting bad habits (mostly smoking) were screened out of the sample.

Upper and lower thirds of the shins and ankles of both legs were tested by means of rheovasography using Valenta 1.4 software. Kinesio taping was used

in the microcirculatory/ lymphatic correction (the so called Tunneling) version with application of the fan-shaped BBTape [3] so that the tension-free anchor was fixed on the lymph nodes and the tape tension was ranged from 0 to 20%. The tapes were fixed on proximal to distal muscles, with the tension-free tails, and with prior activation of the adhesive layer.

The sample was tested by the standard PWC_{170} tests including two 5min stepped-intensity tests with a 3min rest break; with the heart rate tested on a post-training basis. On the whole the tests were designed as follows: (1) Informed consent, personal data collection, 5min rest break, and a resting heart rate test; (2) resting rheovasographic test, PWC test, post-test rheovasography; and (3) kinesio taping, resting rheovasography, PWC test, and a post-test rheovasography. The test data were statistically processed using the standard STATISTICA 10.0 software toolkit. Related and unrelated data arrays were matched using the Wilcoxon test and Mann-Whitney test, respectively.

Results and discussion. Statistically significant differences were found in only a few rheovasography rates. The powerlifting group tests found the following specific variations with taping: *Upper right shin* was tested with the post-training growth of the elasticity modulus (16.8 ± 3.49 to 21.8 ± 4.65%, p <0.05) and diastolic index (0.45 ± 0.09 to 0.9 ± 0.2 points, p <0.05) – apparently due to the post-training adaptive pressure and tone growth in the vessels. The kinesio taping was found to level down the changes – probably due to the tape increasing the outside pressure on the vessels and changing their elasticity rates. *Lower right shin* was tested, upon kinesio taping, with growth of Alpha index (0.14 ± 0.02 to 0.17 ± 0.00 s, p <0.05) and elastic modulus (16.20 ± 2.16 to 24.80 ± 13.82%, p <0.05). This means that the kinesio taping changes the vessels elasticity rate in the lower shin. The post-training diastolic index was tested to fall (0.85 ± 0.29 to 0.50 ± 0.18 points, p <0.05). No kinesio-taping-related changes were tested in the other body segments.

The track and field group tests found the following specific variations with taping. *Upper right shin* was tested with the pre-training growth of the resting venous outflow rate (22.00 ± 2.70 to 50.28 ± 24.07%, p <0.05) plus its post-training growth (25 ± 12.6% without tape and 47.42 ± 16.50% with tape, p <0.05). *Lower right shin* was tested with a fall of the resting venous outflow rate (25.00 ± 9.30 to 14.29 ± 5.12%, p <0.05) and post-training growth (22.00 ± 6.30 to 12.85 ± 3.89%, p <0.05). *Right ankle* was tested with a fall of the resting venous outflow rate (24.43 ± 6.05 to 14.43 ± 2.63%, p <0.05). *Upper left shin was* tested with a post-training growth of the Alpha index – indicative of the time of maximum systolic vascular filling correlated with the tone and elasticity of small vessels (arterioles) and middle arteries – (0.12 ± 0.01s without tape to 0.14 ± 0.02 s with tape, p <0.05); and growth with taping of a resting Alpha 1 index (time of rapid filling indicative of the tone and elasticity of large vessels) from 0.03 ± 0.001s to 0.06 ± 0.01s, p <0.05. *Lower left shin was* tested with a significant growth with taping of the elastic modulus (13.57 ± 1.98 to 19.14 ± 1.95%, p <0.05) and significant fall of the resting venous outflow (33.00 ± 13.00% without tape to 17.57 ± 5.59% with tape, p <0.05), and post-training venous outflow (24.00 ± 9.80% without tape to 14.28 ± 5.08% with tape, p <0.05). *Left ankle* was tested with a post-training growth of the Alpha index (0.03±0.001s without tape to 0.05±0.01s with tape, p<0.05).

Therefore, the track and field group was tested with the kinesio-taping-related changes in the blood flow indices in every tested bodily segment. Since the lead leg was right for the whole sample, the kinesio taping was of special effect on the venous outflow in the right shin; whilst the left shin taping was found to change the vessels tone and elasticity.

Conclusion. The kinesio taping was tested of special influence on the venous outflow in the lead right leg i.e. on this hemodynamics component of the venous system, plus on the left leg vessels elasticity and vascular tone. The powerlifting group was tested with virtually no changes in the left leg blood circulation with taping, whilst the right leg blood circulation was found to change only in few test rates. The study data and analyses give reasons to conclude that the kinesio taping is of little if any benefits for the powerlifting sport – in contrast to the track and field sports where it may be beneficial for the lower limb blood flow control purposes.

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Team building and teamwork predictors for progress in beginner ice hockey

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Abstract

Objective of the study was to analyze the key socio-psychological and motivational predictors for the team building and teamwork in modern beginner ice hockey.

Methods and structure of the study. We formed for the purposes of the study, based on a practical coaching experience, the following two hockey teams: high-performance Group 1 (n= 24) and mid-performance Group 2 (n=23). Both of the groups competed in the 2016-17/ 2017-18 Ice Hockey Federation Open Children's Cup in St. Petersburg for the players born in 2008. Statistical significance of the intergroup test data differences were rated by the Mann-Whitney U-test. As demonstrated by Table 1, the coach rated Group 1 competitive performance much higher than that of Group 2 based on the following considerations: quality of passes, teamwork, repossessions, gate defenses and counterattacks in the final games of the season

For the team building purposes, the coach set the game roles/ links based on own professional experience and logics and practical analysis of every player's competitive performance plus the key personality traits assumed as critical for the game link/ role success including: game-control thinking; willpower; personality traits: determination, tactical skills/ execution, collectivism/ teamwork; individual technical skills; seasonal physical progress statistics; and seasonal progress goals attained versus the progress forecasts.

Results and conclusions. The findings indicated the possibility of determining the level of team cohesion and teamwork of young hockey players by considering their socio-psychological qualities and skills, influence of the motivational value of parental preferences, and efficient formation of game combinations.

Keywords: *game links/ roles, sports motivations, teamwork, team spirit, psychological qualities, ice hockey, sports motivations.*

Background. Competitive progress in the modern ice hockey sport has always been ranked among the top priorities by the professional athletic, coaching and sport psychology research communities, with the latter reporting a growing demand for the practical team building and psychological compatibility rating and analyzing tools for improvement of the teamwork on the whole and game links/ roles inside the team in particular [2, 5].

Objective of the study was to analyze the key socio-psychological and motivational predictors for the team building and teamwork in modern beginner ice hockey.

Methods and structure of the study. We formed for the purposes of the study, based on a practical coaching experience, the following two hockey teams: high-performance Group 1 (n= 24) and mid-performance Group 2 (n=23). Both of the groups competed in the 2016-17/ 2017-18 Ice Hockey Federation Open Children's Cup in St. Petersburg for the players born in 2008. Statistical significance of the intergroup test data differences were rated by the Mann- Whitney U-test. As demonstrated by Table 1, the coach rated Group 1 competitive performance much higher than that of Group 2 based on the following considerations: quality of passes, teamwork, repossessions, gate de-

Table 1. *Group performances rated by coach*

	Performance groups		Mann- Whitney U-test
	High-performance Group 1	Moderate-performance Group 2	
Sample	**n = 24**	**n = 23**	
Expert scores on a 10-point scale	6,3	3,5	60,5***

****highly significant difference, p≤0.01*

fenses and counterattacks in the final games of the season [3].

For the team building purposes, the coach set the game roles/ links based on own professional experience and logics and practical analysis of every player's competitive performance plus the key personality traits assumed as critical for the game link/ role success including: (1) game-control thinking (23.6%); (2) willpower (18.7%); (3) personality traits: determination, tactical skills/ execution, collectivism/ teamwork (16.4%); (4) individual technical skills (14.3%); (5) seasonal physical progress statistics (14.0%); and (6) seasonal progress goals attained versus the progress forecasts (13%).

We rated the game control thinking; volitional qualities; personality traits; individual technical skills; sports performance (rated by the coach); and used the E.E. Khvatskaya Questionnaire Survey method (developed at the Puni Psychology Department of the Lesgaft National State University in St. Petersburg) to rate seven sports motivations; and individual perfectionism [1, 4, 6] tested by the question "Why do you play or want play ice hockey?".

Results and discussion. One of the key athletic performance drivers are the sports motivations ratable by the relevant survey tools: in this case E.E. Khvatskaya Questionnaire Survey method.

The group sports motivation profiles given in Table 2 are different in virtually every key motivation, with the only exception for the family encouragement sports motivation; and it should be noted that those who are motivated mostly by their families demonstrate relatively lower determination and competitive progresses. Note that the intergroup difference is at the statistical trend level (1.9 versus 3.2 points). We should also emphasize that the teamwork motivations are much higher in the high-performance Group 1 (31.7 points versus 27.4 points) although the differences are insignificat (p> 0.01).

Of special interest is the fact that the health motivations are lower in the high-performance Group 1 – that may mean that the leading athletes come to the sport for self-assertion/ success related goals rather than for a healthy lifestyle. In other words, some athletes make a fast transition from the initial illusive goals to competitive achievements related ones and are prepared to sacrifice health in the top-intensity trainings and competitions for success.

Having analyzed the group ambitions, we naturally rated 25% of Group 1 high on this scale (including 8.3% and 16.7% of unrealistically and realistically high ones, respectively) – versus only 13.1% in Group 2. This means that Group 1 is highly determined in the sports careers albeit 8.3% of the group are unrealistic

Table 2. *Group sports motivations*

Motivations rated by the E.E. Khvatskaya Questionnaire Survey method	Performance groups		Mann- Whitney U-test
	High-performance Group 1	Moderate-performance Group 3	
Health sports motivation	23,6	27,9	184*
Cognitive sports motivation	24,5	27,9	238*
Communication sports motivation	11,4	11,3	266
Self-assertion/ success sports motivation	43,9	42,9	255,5*
Teamwork sports motivation	31,7	27,4	206,5*
Progress sports motivation	22,4	25,5	202*
Family encouragement sports motivation	1,9	3,2	111,5**

***p≤0.05; *p≤0.1*

in their ambitions and, hence, may be prone to inadequate/ unpermitted game actions.

Furthermore, the relatively low family encouragement sports motivation was found in most of the high-performance Group 1 (87.5%) – that is indicative of the personal sports motivation being dominant. Group 2 was found somewhat more dependent on the family support (69.3%) although 70% of the group was still tested with good sport progress/ success motivations and determination in ice hockey. The family encouragement sports motivation was tested on average higher in Group 2 versus Group 1 (17.4% versus 12.5%, respectively).

Conclusion. The high-performance and ambitious Group 1 was tested with the high sport-specific personality traits including benevolence, good communication skills, attentiveness, compassion, responsibility, team spirit and conflict tolerance. The group, however, is still partially prone to non-acknowledgment of own errors, emotionally vulnerable to losses, disrespectful to other opinions (unauthorized) i.e. tend to act in their own ways – that is (1) natural for this age group, and (2) natural for the ambitious, emotional and gifted players focused on dominance, success and progress in every domain.

The high-performance Group 1 was also tested higher than Group 2 on the determination, competitive spirit, energy and self-confidence rating scales, with the key role played by the teamwork and self-assertion motivations deemed beneficial for the team building for joint competitive progress – as verified by the actual success records.

Ambitions in the moderate-performance Group 2 are significantly correlated with the self-assertion motivations – that in practical terms are associated with potential performance volatility and unpredictability. It is important that more than one third of the group is tested with psychological discomforts and dissatisfactions with the circumstances and experiences – that may be due to their high dependence on the family motivations imposed on them by the adult family leaders. Such athletes are often tested with high suggestibility, trustfulness, high need for communication, compassion and recognition associated with curiosity. Of special interest is that 13.3% of the group was tested with the high dependence on family support and dissatisfactions with some psychologically undesirable aspects (more than 30%) – that means that the group is low motivated for the team building and teamwork, as verified by the still low actual competitive progress rates.

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Questionnaire survey to rank priorities of supplementary vocational curricula to meet professional coaching standard

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Abstract

Objective of the study was to offer practical grounds for the Professional-Coaching-Standard-compliant supplementary vocational curricula customizable to the individual needs of coaches.

Methods and structure of the study. We analyzed, for the purposes of the study, the relevant legal and regulatory framework and run a questionnaire survey of the beginner group coaches (n=128) sampled from a few sports schools in St. Petersburg. The questionnaire survey form generally addressed the following two key Professional Coaching Standard services: (1) Beginner technical training service (Code B, qualification class 5); and (2) Special (specialization stage) athletic technical training and competitive progress management service (Code C, qualification class 5). A special attention was given to a few coach's service competences including Service Responsibilities, Necessary Skills and Necessary Knowledge.

The sample was questioned to rank, on a 3-point scale, the service responsibilities, knowledge and skills that need to be covered, in their opinion, by the new supplementary vocational curricula for the refresher courses as follows: 0 was the minimal rate – i.e. no need for the issue being covered by supplementary vocational curricula; and 3 is the maximal rate that means the issue is highly relevant for the coaching service.

A socio-demographic analysis of the sample showed about half having higher physical education and sport certificates; and every fifth having a secondary vocational education certificate; with the practical coaching experiences of 57.8% of the sample reported under 5 years.

Results and conclusions. The new supplementary vocational curricula development efforts need to be governed by the valid legal and regulatory framework that provides guiding design and content for the service. The new supplementary vocational curricula for the coach refresher courses are recommended to address the key coaching services, necessary knowledge and skills in compliance with the valid Professional Coaching Standard, with special detailed emphases when necessary. The supplementary vocational curricula developers are recommended to respect the individual needs of the coaches for the necessary knowledge and skills by making the supplementary vocational curricula reasonably customizable in the service ranges and priorities.

Keywords: *supplementary vocational curricula, legal and regulatory framework, Professional Coaching Standard, questionnaire survey, individual needs, technical training, physical education and sport.*

Background. Presently the national education system gives a special priority to supplementary curricula designed to meet the Professional Standards for different services being implemented in the country. The legal and regulatory framework for the Professional Standards-compliant supplementary vocational curricula development efforts has been set by the following provisions: Labor Code of the Russian Federation [1]; Federal Law "On Education in the Russian Federation" [2]; Ministry of Labor Order "On approving the qualification classes for the professional standards development projects' [3]; and the Ministry of Education and Science Order "On approving the supplementary curricula design and management procedure" [4]. Further specifications to the Education Law in application to the sup-

plementary vocational curricula were provided by the 'Procedure for the supplementary vocational curricula design and management service' that spells out the sample supplementary vocational curricula contents and frames [4]. The supplementary vocational curricula are generally designed using a wide variety of modern methodological approaches traditional for the educational service research, including the competency-building, personality-sensitive, modular and other approaches.

Objective of the study was to offer practical grounds for the Professional-Coaching-Standard-compliant supplementary vocational curricula customizable to the individual needs of coaches.

Methods and structure of the study. We analyzed, for the purposes of the study, the relevant

Table 1. *Ranked needs for the new services, skills and knowledge elements expected from supplementary vocational curricula*

Services	Rank, points			
	0	1	2	3
1. Sports training service planning with calendars and topics to attain the short-, mid- and long-term physical education and sport service goals and missions	9,4 4-5	35,2 2	25,8 7	29,6 5
2. Consulting service for the underage trainees, their families and legal trustees on the beginner qualifications for the groups and technical training service	17,9 1	30,5 4	20,3 8	31,3 4
3. Technical training service design and management at every sports progress stage	7,8 6	21,8 6-7	35,2 3	35,2 2
4. Age-specific mental and physical health and physical fitness standards for sports group qualifications by progress stages and sports disciplines	2,3 8	31,3 3	38,3 2	28,1 6
5. Practical help and consulting service to families and legal trustees of the underage trainees	13,3 2	43,0 1	29,6 6	14,1 8
6. Training service individualization and special management when necessary	9,4 4-5	29,6 5	40,7 1	20,3 7
7. Modern preparatory/ progress training methods and their progress-stage-specific applications	3.9 7	12,5 8	30,5 5	53,1 1
8. Selecting the most promising trainees for special excellence training service	10.9 3	21,9 6-7	32,8 4	34,4 3
Necessary skills				
1. Entrants' interviewing skills to rate their motivations, mindsets and mental fitness for the preparatory/ progress training groups	10,2 3	22,7 4	37,5 3-4	29,6 2
2. Modern IT/ communication technologies usage skills	12,5 1-2	27,4 2	35,9 5	24,2 3-4
3. Efficient differentiated education and competency-building technical training design and management skills	6,3 4-5	20,3 5	37,5 3-4	35,9 1
4. Conflict situation analyzing, prevention and management skills	6,3 4-5	29,6 1	40,7 1	23,4 5
5. Special advanced training service management skills when necessary	12,5 1-2	24,2 3	39,1 2	24,2 3-4
Necessary knowledge				
1. Federal Sports Training Standards for vocational sports disciplines	10,9 2-3	30,5 2	25,0 9	33,6 4-5
2. Valid federal and international anti-doping codes for the physical education and sport service sector	10,2 4	31,2 1	31,2 4-5	27,4 9
3. Training service control standards	13,3 1	21,1 6-7	32,8 3	32,8 6
4. Extreme training workloads	10,9 2-3	18,8 8-9	31,2 4-5	39,1 2
5. Scopes of individual sports training service	9,4 5	21,1 6-7	38,2 1	31,3 7-8
6. Age and mentality specific training service with elements of age-specific pedagogy	7,8 6-7	25,8 5	30,5 6	35,9 5
7. Physical fitness tests and analyses	7,8 6-7	29,7 5	28,9 6	33,6 5
8. Technical training service planning methods	3,9 8	28,9 4	35,9 2	31,3 7-8
9. Modern training service methods	3,1 9	18,8 8-9	26,6 8	51,5 1

Note: sample shares and ranks are given in numerator and denominator, respectively

legal and regulatory framework and run a questionnaire survey of the beginner group coaches (n=128) sampled from a few sports schools in St. Petersburg. The questionnaire survey form generally addressed the following two key Professional Coaching Standard services: (1) Beginner technical training service (Code B, qualification class 5); and (2) Special (specialization stage) athletic technical training and competitive progress management service (Code C, qualification class 5). A special attention was given to a few coach's service competences including Service Responsibilities, Necessary Skills and Necessary Knowledge.

The sample was questioned to rank, on a 3-point scale, the service responsibilities, knowledge and skills that need to be covered, in their opinion, by the new supplementary vocational curricula for the refresher courses as follows: 0 was the minimal rate – i.e. no need for the issue being covered by supplementary vocational curricula; and 3 is the maximal rate that means the issue is highly relevant for the coaching service.

A socio-demographic analysis of the sample showed about half having higher physical education and sport certificates; and every fifth having a secondary vocational education certificate; with the practical coaching experiences of 57.8% of the sample reported under 5 years.

Results and discussion. The questionnaire survey showed the following. Most of the sample (53.1%) ranked highest (3 points) the need for new knowledge and skills for the Service Responsibility of 'Modern preparatory/ progress training methods and their progress-stage-specific applications'. Ranked second was the 'Sport progress stage specific technical training service design and contents': see Table 1 hereunder. As for the Professional-Coaching-Standard-specific Necessary Skills section, 35.9% of the sample ranked highest (by 3 points) the 'Efficient differentiated education and competency-building technical training design and management skills'.

The respondents were found to believe that modern information is particularly needed for the 'Modern training service methods' (51.5% of the sample) and 'Extreme training workloads' (39.1%). The questionnaire survey data analysis also showed that the Services, Necessary Skills and Necessary Knowledge elements were ranked by the sample with respect to their practical coaching needs – that should be responded by the new supplementary vocational curricula. Note that every respondent reported the individual needs for the knowledge and skills covered by the valid Professional Coaching Standard. We believe in this context that the new supplementary vocational curricula will be made widely customizable – for the timely response to every need for professional skills and knowledge on a personality-sensitive basis.

As demonstrated above, the new supplementary vocational curricula shall offer a wide range of practical tools to attain the education service goals. Our questionnaire survey tested, among other things, the coaches' needs for practical trainings, and we found 62.5% of the sample supporting this idea.

Conclusion. The new supplementary vocational curricula development efforts need to be governed by the valid legal and regulatory framework that provides guiding design and content for the service. The new supplementary vocational curricula for the coach refresher courses are recommended to address the key coaching services, necessary knowledge and skills in compliance with the valid Professional Coaching Standard, with special detailed emphases when necessary. The supplementary vocational curricula developers are recommended to respect the individual needs of the coaches for the necessary knowledge and skills by making the supplementary vocational curricula reasonably customizable in the service ranges and priorities.

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