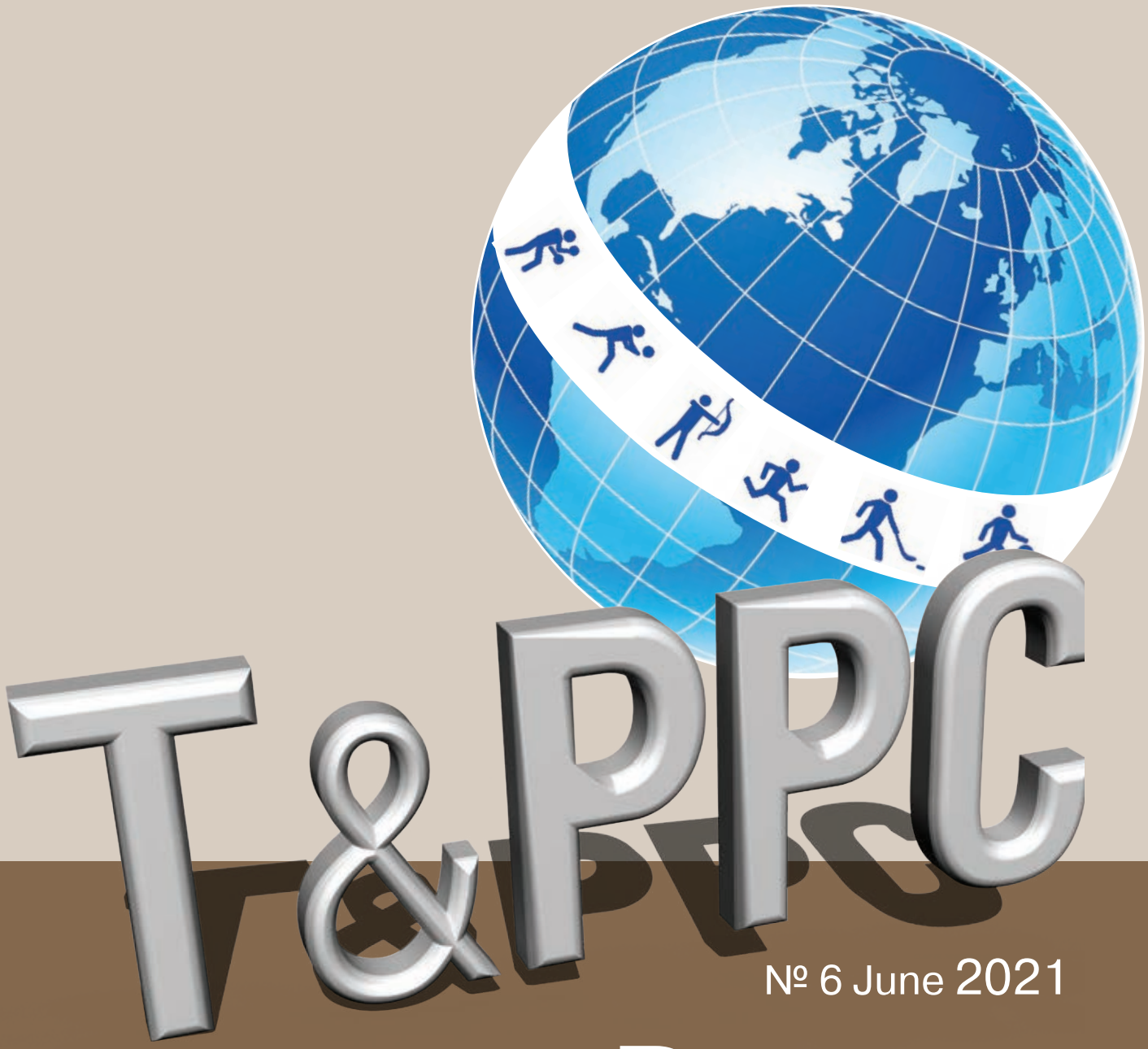

№ 6 June 2021

Theory & Practice of Physical Culture

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

Key issues of the modern sports science for discussion

Sports nutrition: from the request of practice to scientific and theoretical substantiation

Today, sports nutrition is one of the young and developing field of sports science. Sometimes ideas about the effective drug, biologically active supplement can radically change within one year. A classification of biologically active additives (BAS) according to the degree of effect achieved has already been created and generally accepted by specialists: certainly effective (class A), probably effective (class B), insufficiently studied additives (class C), certainly ineffective (class D).

This classification of supplements forces practitioners to use sports nutrition drugs with particular caution. However, it is probably also not worth completely refusing to use them, since extreme loads, especially in the sport of higher achievements, require the athlete to quickly restore performance. Although everyone knows that sports nutrition is not a drug, it allows you to restore the balance of trace elements, saturate the body with the necessary number of calories spent during the most difficult training and competitive loads.

Trainers and athletes need to approach the choice of drugs from a clear representation of the goals that are set at one stage or another of the training process. At the same time, their quality and reputation should be carefully monitored.

During training and competitive activities, a wide range of sports food products is used: protein, gainer, complex amino acids, arginine, glutamine, creatine, testosterone boosters, vitamin-mineral complex, omega-3, pre-training complexes, fat igniters, joint and ligament preparations.

Sports nutrition belongs to the category of supplements and is an addition to the main diet, consisting of ordinary products. The commercial orientation of the distribution of dietary supplements requires scientists to develop new methods for assessing the quality of drugs, conducting studies that could confirm the effectiveness, feasibility and usefulness of sports nutrition as an alternative to the use of doping in order to increase the sports result.

Chief editor of TPPC,
Honored Worker of Physical Culture of the Russian Federation,
Doctor of Pedagogical Sciences, Professor L.I. Lubysheva

Theory and Practice of Physical Culture

6'2021

Monthly Scientific-theoretical Journal, founded in 2013

ISSN 2409-4234

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

www.teoriya.ru/en

Theory and Practice of Physical Culture

Contents

Respiratory practices prioritizing universal competitive fitness model for elite biathletes

UDC 796.92.093.642

Dr. Hab., Associate Professor **V.V. Farbey**[1]
Applicant **E.G. Zhevlakov**[1]
[1]Herzen State Pedagogical University of Russia, St. Petersburg

Corresponding author: farbeyv@mail.ru

Abstract
Objective of the study was to test benefits of a respiratory practices prioritizing universal competitive fitness model for elite biathletes.
Methods and structure of the study. We sampled for the new universal competitive fitness model testing experiment highly skilled biathletes (CMS, n=26) from the Herzen State Pedagogical University team, Winter Sports Excellence School, UOR 2 and the Children and Youth Olympic Reserve Sports School in Vyborg district, St. Petersburg. The sample was provisionally split up into the following three Experimental Groups (EG): Racers (n=9), Shooters (n=8) and Universal athletes (n=9). The groups were trained as required by the universal competitive fitness model with the following respiratory practices sets: respiratory practice 1 resting practices; respiratory practice 2 breath holding; respiratory practice 3 forced breathing; respiratory practice 4 with aiming; respiratory practice 5 with a movable rest; respiratory practice 6 mirror-assisted with the rifle; and respiratory practice 7 breath calming-down and relaxation physical exercises with standard breath-control practices traditional for biathlon prior to shooting. Each of the respiratory practices sets was applied in every Experimental Group. The respiratory practices were mastered in the preparatory period in 28 gym training sessions that totaled 51 hours, with pure respiratory practices in every session taking 30-40 minutes. This means that the respiratory practices took 15 hours on the whole i.e. 8% of the total training time for the experimental period.
Results and conclusion. Our analysis of the competitive performance test data showed benefits of the new respiratory practices prioritizing universal competitive fitness model for the elite biathletes as it helps them progress to the universal competitive fitness type – mostly by improvements in the individual deficient shooting elements with progress in the breath control and breath harmonization with the motor skills in the shooting range; and with special improvements in the shooting speed, rhythm and accuracy associated with functional improvements.

Keywords: *elite biathlete, respiratory practices, universal competitive fitness.*

Background. Competitive fitness in modern biathlon may be defined as composed of the top competitive performance in every sport element, with the total competitive result integrating the shooting success and distance running and, hence, requiring a special training system with interrelated training tools to be prudently managed. Generally, the biathlon elite demonstrates universal competitive fitness although the lower-level sports excellence training groups are still dominated by the so called racers. This disharmony should be countered by special trainings to develop universal competitive fitness with a special emphasis on shooting skills [1]. We assumed that customizable respiratory practices may be beneficial for the universal competitive fitness service to elite biathletes due to the individual functional resource being effectively mobilized with improvements in the competitive adaptability, par-

ticularly in the shooting domain, as a basis for success.

Objective of the study was to test benefits of a respiratory practices prioritizing universal competitive fitness model for elite biathletes.

Methods and structure of the study. We sampled for the new universal competitive fitness model testing experiment highly skilled biathletes (CMS, n=26) from the Herzen State Pedagogical University team, Winter Sports Excellence School, UOR 2 and the Children and Youth Olympic Reserve Sports School in Vyborg district, St. Petersburg. The sample was provisionally split up into the following three Experimental Groups (EG): Racers (n=9), Shooters (n=8) and Universal athletes (n=9). The groups were trained as required by the universal competitive fitness model with the following respiratory practices sets: respiratory practice 1 resting practices; respiratory practice 2 breath holding; respiratory practice 3 forced breathing; respiratory practice 4 with aiming; respiratory practice 5 with a movable rest; respiratory practice 6 mirror-assisted with the rifle; and respiratory practice 7 breath calming-down and relaxation physical exercises with standard breath-control practices traditional for biathlon prior to shooting [2]. Each of the respiratory practices sets was applied in every Experimental Group. The respiratory practices were mastered in the preparatory period in 28 gym training sessions that totaled 51 hours, with pure respiratory practices in every session taking 30-40 minutes. This means that the respiratory practices took 15 hours on the whole i.e. 8% of the total training time for the experimental period.

Results and discussion. The respiratory-practices-based universal competitive fitness model testing experiment found the following most effective respiratory practices for the groups: forced breathing with the rest respiratory practices for Shooters; respiratory practices with aiming for Racers; and the aiming and mirror-assisted respiratory practices with the rifle for Universals [2]. Based on the practical respiratory practices combining and testing experiences, the groups were trained outdoors and in gyms using the following respiratory practice sets:

1) Three resting slow inhales-exhales followed by four deep inhales with forced exhales, and then again resting respiratory practices;

2) Three forced inhales with slow exhales plus three resting respiratory practices cycles, then four slow deep inhales with loud forced exhales, then again resting respiratory practices;

3) Three deep slow inhales-exhales with three resting respiratory practices cycles followed by four slow deep inhales with forced exhales ended up by resting respiratory practices.

Having tested the respiratory practices sets on the outdoor shooting ranges and indoor training machines with biofeedback in prone and standing positions, we found the following most effective respiratory practices: respiratory practices-1 for the

Table 1. *Pre- versus post-experimental competitive performance test rates of Shooters (S), Racers (R) and Universals (U)*

Competitive performance tests	Group	Results			
		Pre-exp., M±m	Post-exp., M±m	p	t
Individual ski race time net of penalties, s	R	2920±53,1	2829±32,9	<0,05	2,20
Total shooting time, s	R	49,9±2,4	44,3±2,2	<0,05	2,38
Standing shooting time, s	S	42,2±1,8	36,2±1,9	<0,05	2,54
	U	43±1,9	39,1±1,8	<0,05	3,03
Prone shooting time, s	S	4,2±0,2	3,5±0,1	<0,05	2,33
	R	4,5±0,1	3,7±0,1	<0,05	3,02
	U	4,4±0,2	3,5±0,1	<0,05	3,02
Prone shooting shot-to-shot breath cycles	S	3,4±0,2	3,0±0,1	<0,05	2,66
	R	3,7±0,4	3,5±0,1	<0,05	2,29
	U	3,8±0,6	3,3±0,1	<0,05	2,35
Standing shooting rhythm, s	S	4,1±0,2	3,4±0,1	<0,05	2,88
	U	4,3±0,1	3,6±0,1	<0,05	2,73
Standing shooting shot-to-shot breath cycles	S	3,2±0,4	2,3±0,1	<0,05	2,88
	R	3,6±0,6	3,0±0,2	<0,05	2,39
	U	3,7±0,8	2,8±0,1	<0,05	2,76
Shooting accuracy, %	S	75,9 ±3,0	84,8±3,6	<0,05	2,70
	R	65,8 ±5,7	73,2±2,5	<0,05	2,38

Shooters; respiratory practices - 2 for the Universal athletes; and respiratory practices-3 for the Racers ($p<0.05$) [2]. In the experimental period we analyzed the group progresses in the competitive performance tests classified by the shooting and running elements in the precompetitive and competitive stages: see Table hereunder.

The new respiratory practices prioritizing universal competitive fitness model for elite biathletes was tested beneficial as verified by their progress of every EG by 33.5% due to the more time-efficient shooting styles and higher shooting accuracy. Thus, the Racers made the 15.5% and 12.5% progress in the prone shooting accuracy and total shooting time, respectively; due to improvements in the shooting rhythm and shot-to-shot breath control by 21.5% and 14%, respectively ($p < 0.05$). The Shooters were tested with 10% and 16.5% progress in the shooting accuracy and standing shooting time, respectively; due to improvements in the shooting rhythm and breath control 20.5% and 13%, respectively ($p <0.05$). And the Universal athletes made progress in the total shooting time by 14%, shooting rhythm by 19.5% and shot-to-shot breath control by 21% ($p <0.05$).

The pre- versus post-experimental competitive fitness test data analysis showed that the three groups made a significant progress in the shooting speed and accuracy; and the numbers of athletes upgraded to the universal competitive fitness type increased by 34.6% as a result of the experimental training. This finding may be interpreted as indicative of the practical benefits of the respiratory practices in elite biathlon as it helps train universally fit competitors, with progress made both in the shooting skills and, in case of racers, in the individual race times by 8% ($p <0.05$). The racing progress is due to the improved physical fitness with more stable and high results versus the shooters and universal athletes, particularly in the long- distance biathlon disciplines. As a result of the experimental training, the EG biathletes won 9 first, 6 second and 11 third places in competitions for the study period, with seven athletes upgraded to Masters for Sports.

Conclusion. Our analysis of the competitive performance test data showed benefits of the new respiratory practices prioritizing universal competitive fitness model for the elite biathletes as it helps them progress to the universal competitive fitness type – mostly by improvements in the individual deficient shooting elements with progress in the breath controls and breath harmonization with the motor skills in the shooting range; and with special improvements in the shooting speed, rhythm and accuracy associated with functional improvements.

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World long-distance running elite: ethnicity-specific run energy efficiency analysis

UDC 796.422.1

Dr.Hab. **V.D. Kryazhev**[1]
Dr. Hab., Professor **V.Y. Karpov**[2]
PhD, Professor **K.K. Skorosov**[3]
PhD, Associate Professor **V.I. Sharagin**[4]
[1]Federal Scientific Center for Physical Culture and Sports, Moscow
[2]Russian State Social University, Moscow
[3]Penza State University, Penza
[4]Moscow State University of Psychology and Education, Moscow

Corresponding author: kryzev@mail.ru

Abstract

Objective of the study was to analyze, on a mathematical and statistical basis, the African and European long-distance running elite energy efficiencies.

Methods and structure of the study. We collected for analysis the individual competitive performance data of the top-five European and top-five African runners from the 2019 top-100 list.

Sports results (LnT times) were converted into the mean distance speeds (V) and processed in Excel to produce V-LnT correlations. The critical running speed (Vcrit) was found based on the seventh-minute LnT (Ln 420 = 6.04) [7, 8]. Based on the critical running speed concept [1] and using the ΔMAP = Crtot · Vcrit, W ratio, we computed the aerobic capacity maximum (AM) above the quiescent level (ΔMAP) using equation VO2max = (ΔMAP + 1.2) · 2.87 ml/kg/min. Note that Crtot means the run energy cost net of the air resistance. Run energy efficiency (net energy cost Cr) was estimated at 3.76 J/kg/m for the Europeans and 3.30 J/kg/m for the Ethiopians [4, 5]. Note that the aerobic maximum AM, run energy cost and endurance ratio (E, rated by the regression curve tilt angle V - LnT [8] as provided by Péronnet-Thibault model [7]) may be used to compute the individual energy efficiencies.

Results and discussion. The high run energy efficiencies of the world leading Ethiopian and Kenyan middle- and long-distance runners may be due to the genetically predetermined lower limb metrics and habitual high-altitude living conditions that develop more energy efficient aerobic metabolism. The shorter shin circumference (minus 3 cm on average) secures more efficient mass-inertial performance of the distal leg segments and eases the mechanical work [6]; plus the lower shoulder of forces acting in the Achilles tendon contributes to the energy efficiency of the elastic elements in the musculoskeletal system.

Mathematical analysis of the competitive performance data and energy efficiency of elite long-distance runners demonstrated serious advantages of the East African runners over their European competitors secured by the lower metabolic demands on the distances and, hence, better energy efficiencies as a sound basis for their great competitive accomplishments despite the relatively lower aerobic maximums.

Keywords: *long-distance running, mathematical modeling, run energy cost, run energy efficiency.*

Background. Di Prampero (Italy) [4] and F. Peronne, G. Thibault (Canada) [7] have developed a middle-/ long-distance run energy cost rating method based on the aerobic/ anaerobic metabolism capacity and kinetics rating formulae, with the resulting values calculated with only 0.68% error. Their calculations of VO2max were only 2-3 mm/kg/min different from the published individual long-distance running elite test data. It is commonly assumed that the long-distance running elite energy cost varies at around 3.86 J/kg/m, and the maximal oxygen consumption at 80 ml/kg/min [7]. Later it was found, however, that the East African long-distance running elite (from Ethiopia, Kenya and other nations) runs in much more energy efficient manner that the Europeans [5, 6]. We believe that it may be pertinent in this context to have the com-

mon long-distance running energy efficiency analysis and findings revised.

Objective of the study was to analyze, on a mathematical and statistical basis, the African and European long-distance running elite energy efficiency.

Methods and structure of the study. We collected for analysis the individual competitive performance data of the top-five European and top-five African runners from the 2019 top-100 list: see Table 1.

Sports results (LnT times) were converted into mean distance speed (V) and processed in Excel to produce V-LnT correlations. The critical running speed (Vcrit) was found based on the seventh-minute LnT (Ln 420 = 6.04) [7, 8]. Based on the critical running speed concept [1] and using the ΔMAP = Crtot · Vcrit, W ratio, we computed the maximum aerobic power (MAP) above the quiescent level (ΔMAP) using the equation VO2max = (ΔMAP + 1.2) · 2.87 ml/kg/min. Note that Crtot means the run energy cost net of the air resistance. Run energy efficiency (net energy cost Cr) was estimated at 3.76 J/kg/m for the Europeans and 3.30 J/kg/m for the Ethiopians [4, 5]. Note that the aerobic maximum aerobic power, run energy cost and endurance ratio (E, rated by the regression curve tilt angle V – LnT [8] as provided by Péronnet-Thibault model [7]) may be used to compute the individual energy efficiency [2].

Results and discussion. Given on Figure hereunder are the regression equations for the African and European runners with virtually the same tilt angles indicative of the similar E ratios and endurance indices EI. The critical speeds generated by the regression equations show advantage of the African group. Thus the Ethiopian runners demonstrate higher energy efficiencies i.e. energy costs per meter net of the air resistance; and, hence, lower metabolic demand (MD) on the distances. It should be emphasized that the African runners are generally more successful than the Europeans in spite of the lower aerobic maximums. The mathematical models that we applied give fairly accurate energy efficiency rates based on the known energy costs [2, 7].

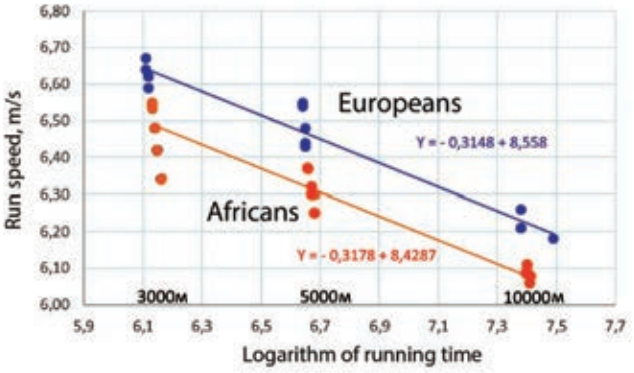

Figure 1. *Elite long-distance runners' distance speed variations on three distances*

Note that the mean values for the European/ African long-distance running elites vary within the range of around 7% [4, 6], although the intergroup energy efficiencies are quite significant.

Table 1. *Individual competitive performance data of the top-five European and top-five African competitors in 3000m, 5000m and 10000m*

№	Athlete	Nation	Rank	3000m	5000m	10000m
1	T. Bekele	ETH	1-5000	7:32.55	12:52.98	
2	S. Barega	ETH	1-5000	7:32.17	12:43.02	26:49.46
3	H. Gebhriwet	ETH	1-10000	7:30.36	12:45.82	26:48.95
4	A. Hadis	ETH	3-10000	7:39.10	12:56.27	26:56.46
5	J. Cheptegey	UGA	1-10000	7: 33.26	12:57.41	26:38.36
6	R. Ringer	GER	11-10000	7:53.81	13:23.04	28:44.17
7	J. Wanders	SWI	15-5000	7:43.62	13:13.84	27:17.29
8	S. McSweyn	AUS	7-10000	7:34.79	13:05.23	27:23.20
9	S.N. Moen	NOR	27-10000	7:52.55	13:20.16	27:24.78
10	P. Tiernan	AUS	12-5000	7:37.76	13:12.68	27:29.40

Table 2. *Calculated energy cost and performance test data of the European and African elite long-distance runners on 3000m distance*

Elite long-distance runners	V, m/s	Pv, W/kg	VO2max, ml/kg/m	Vcrit, m/s	Cr, J/kg/m
Africans	6,12 ± 0,01	26.76 ±0.03	76.2 ±0.11	6.65 ±0.011	3.80 ±0.006
Europeans	6,14 ± 0,013	28.62 ±0.06	82.4 ±0.17	6.51 ±0.014	4.21 ±0.009

Note: $p \leq 0.05$; *V – running speed; Pv – metabolic demand; VO2max – maximum oxygen consumption; Vcrit – critical running speed; Cr – energy cost per meter net of air resistance*

The high run energy efficiencies of the world leading Ethiopian and Kenyan middle- and long-distance runners may be due to the genetically predetermined lower limb metrics and habitual high-altitude living conditions [3] that develop more energy efficient aerobic metabolism. The shorter shin circumference (minus 3 cm on average) secures more efficient mass-inertial performance of the distal leg segments and eases the mechanical work [6]; plus the lower shoulder of forces acting in the Achilles tendon contributes to the energy efficiency of the elastic elements in the musculoskeletal system [3].

Conclusion. Mathematical analysis of the competitive performance data and energy efficiency of elite long-distance runners demonstrated serious advantages of the East African runners over their European competitors secured by the lower metabolic demands on the distances and, hence, better energy efficiencies as a sound basis for their great competitive accomplishments despite the relatively lower aerobic maximums.

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World skiathlon leaders' competitive performance analysis

UDC УДК796.012.37

PhD, Department Head **N.B. Novikova**[1]
Researcher **G.G. Zakharov**[1]
Researcher **I.G. Ivanova**[1]
PhD, Department Head **A.I. Golovachev**[2]
PhD, Department Head **A.V. Kubeev**[2]
[1]Saint-Petersburg scientific-research institute for physical culture, Saint-Petersburg
[2]Federal Science Center for Physical Culture and Sports, Moscow

Corresponding author: novik-nat@mail.ru

Abstract
Objective of the study was to analyze the competitive performance of the world skiathlon leaders in the 2021 World Ski Cup.
Methods and structure of the study. Subject to the study was the 30km skiathlon event of the World Nordic Ski Cup in Obersdorf (Germany) in January 2020. We shot the competitive performance videos on a 10° ascent in a key point of the eight loops by a video cam fixed on a tripod perpendicular to the track. The video captures were processed and analyzed using the DartfishPro 9 software toolkit to obtain the individual ascension speed, stride length, frequency and kick-off time for the 25 world strongest skiathletes. We also analyzed the individual time/ speed in every track section versus the terrain conditions, with the speed profiles verified by the formal competitive reports and analyses, including the detailed event statistics.
Results and conclusion. The middle-distance (2.3km) video captures yielded the ski stride macro-kinematics variation data including stride length, frequency and speed on ascend for each of the 25 competitors. The speed-ups in the final loops were associated with growth of the stride length plus insignificant growth of the movement frequency. The stride length was found correlated with the speed in agreement with the study data by St gg I.T., Pellegrini B. and Holmberg H.C. (2018) [7], although we would emphasize importance of the kick-off power growth in the final spurt. This aspect should be taken into consideration by the training systems designers since growth in the stride length is secured by the kick-off power that require high muscular endurance.
Of special interest was the macro-kinematics analysis of the race leaders versus outsiders.
The skiathlon leaders' racing tactics profiled by the macro-kinematics analysis provides an insight into the individual speed control patterns. We found the speed significantly falling on ascends in the skating-stride loops five and six and growing in the final loop. The race outsiders ranked 11-20th on the event scoreboard were tested with the lower speed variations, although their speed and stride length in loop six were tested higher than the leaders' ones. The ascension speed was tested to grow in both the leaders and outsiders groups. We found the individual speed and kick-off power acceleration resource mobilized in the final loops being critical for success in the race.
We recommend the study data and findings for application in the precompetitive training systems by the potential qualifiers for the 2021 World Ski Cup.

Keywords: *cross-country skiing, tactics, skiathlon, macro-kinematics, competitive performance, elite cross-country skiers.*

Background. Competitive success in the top-ranking cross-country skiing events is known to depend not only on the individual motor skills, gifts and experiences but also on the skiing tactics including own competitive resource management and opposition control tools and the technical performance scenarios customizable to the track/ weather conditions, terrains etc. [2, 3]. Analysis of the modern study reports on the subject demonstrate the growing role of the cross-country skiing tactics in elite competitions

due to the rapidly growing rivalry, new competitive formats, rules and challenges [4, 5, 6]. Modern long-distance cross-country skiing events with the hard terrains, widely varied weather and track conditions and multiple other factors of influence require highly efficient and versatile tactics for success [1].

Most of the researchers underline popularity of the positive resource management version that implies the athletes gradually decreasing the racing speed after the startup spurt [7]. In the mass competitions and pursuit races, the cross-country skiing tactics will always be customized to the terrains, track conditions, ski waxing specifics and, last but not least, the opponent tactics. Thus, the ski stride is ranked among the key success factors on ascends, whilst the stride frequency is deemed secondary by most of the cross-country skiing analysts. The distance speed analyses tend to prioritize the terrains, weather conditions and ski waxing specifics among the other important aspects [7].

Objective of the study was to analyze the competitive performance of the world skiathlon leaders in the 2021 World Ski Cup.

Methods and structure of the study. Subject to the study was the 30km skiathlon event of the World Nordic Ski Cup in Obersdorf (Germany) in January 2020. We shot the competitive performance videos on a 10° ascent in a key point of the eight loops by a video cam fixed on a tripod perpendicular to the track. The video captures were processed and analyzed using the DartfishPro 9 software toolkit to obtain the individual ascension speed, stride length, frequency and kick-off time for the 25 world strongest skiathletes. We also analyzed the individual time/ speed in every track section versus the terrain conditions, with the speed profiles verified by the formal competitive reports and analyses, including the detailed event statistics.

Results and discussion. To find and analyze the individual best skiing tactics on the distance, we made a statistical analysis of the individual average speeds in three track sections – basically flat (with minor irregularities), ascending and descending ones.

To find contributions of the sectional speeds into the competitive results, we input them as predictors in a linear regression equation to obtain the normalized linear regression rates: see Figure 1. As demonstrated by the Figure, the highest linear regression rates correlate with the final results – that means that the fastest sectional speeds heavily contributed to the competitive success. It should be emphasized that the descending speeds and ski replacement times had virtually no effect on the final individual ranks on the event scoreboard. We found the highest contribution to the final result of the first section speed (relatively flat terrain with a minor ascend), plus the steep ascend time in the final loop.

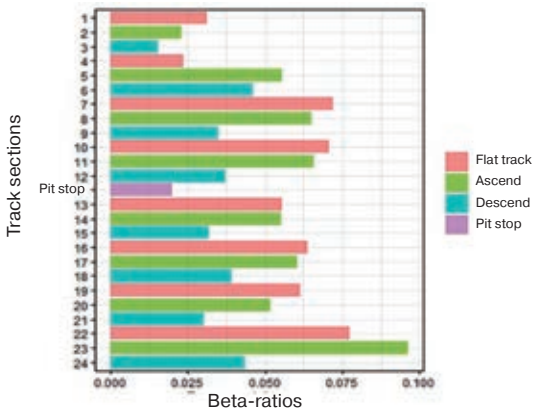

Figure 1. *Sectional speed contributions to the final result in the 30km skiathlon World Cup event in Obersdorf, n=30*

Given on Figure 2 are the individual sectional speed variations. The first-section speed (flat track with minor irregularities) was found to vary in a wavelike manner in the race, with some growth when the stride was changed and falls in the final loops. The speed variation range in this section (the gap between the fastest and slowest loop speeds) was estimated at 10.9%.

In the long ascending middle section of the track, the speed was increased in the second and fourth classic-stride loops – apparently due to the bonus points and tactical speed-ups. In the skating-stride skiathlon phase, the speed was growing with every loop to peak in the finishing span, with the speed increment in the final loop versus the prior one estimated at 9.9%. In the last loop sections (mostly on descends and final ascend) we tested significant speed sags in loops three and four – probably due to the lost ski slide in the classical style. In loop five the sectional speed was tested to grow due to the non-waxed skating stride advantage, with the speed increment in the skating phase (loops six through eight) estimated at 7.2% due to the final spurt on the last ascend and in the finishing span.

The middle-distance (2.3 km) video captures yielded the ski stride macro-kinematics variation data including stride length, frequency and speed on ascend for each of the 25 competitors. The speed-ups in the final loops were associated with growth of the stride length plus insignificant growth of the movement frequency. The stride length was found correlated with the speed in agreement with the study data by St gg I.T., Pellegrini

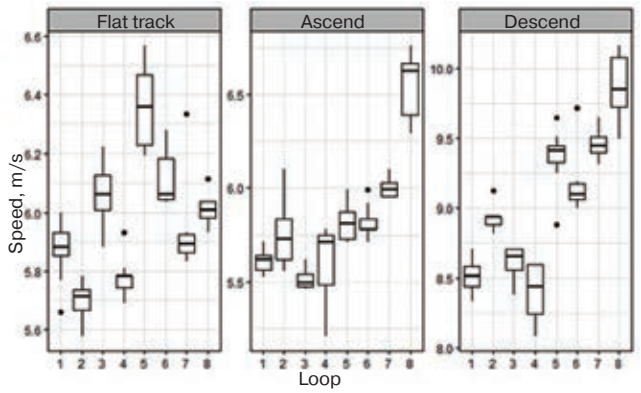

Figure 2. *Averaged sectional speeds of the leaders in the 30km skiathlon World Cup event in Oberstdorf, n=10*

B. and Holmberg H.C. (2018) [7], although we would emphasize importance of the kick-off power growth in the final spurt. This aspect should be taken into consideration by the training systems designers since growth in the stride length is secured by the kick-off power that require high muscular endurance.

Of special interest was the macro-kinematics analysis of the race leaders versus outsiders. We provisionally ranked with the leaders and outsiders the top-10 and the 11-20th competitors on the event scoreboard, respectively. Their individual speed and stride length profiles provide an insight into their competitive tactics with accelerations and slow-downs (see Figure 3).

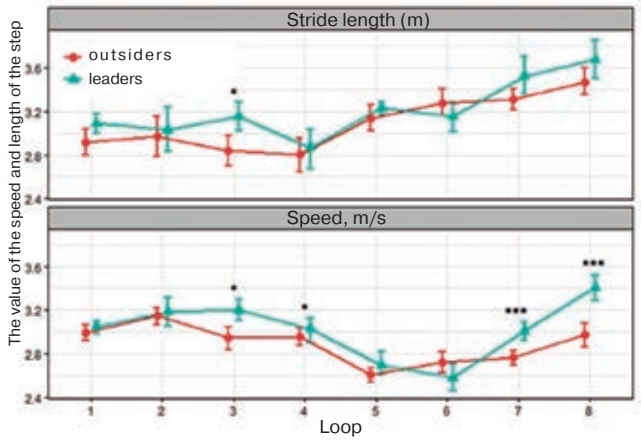

Figure 3. *Individual speed and stride length variation profiles for the race leaders (n=10) and outsiders (n=10), with differences ranked by the Kruskal-Wallis criterion (* p≤0,05, ** p≤0,01, *** p≤0,001)*

Conclusion. The skiathlon leaders' racing tactics profiled by the macro-kinematics analysis provides an insight into the individual speed control patterns. We found the speed significantly falling on ascends in the skating-stride loops five and six and growing in the final loop. The race outsiders ranked 11-20th on the event scoreboard were tested with the lower speed variations, although their speed and stride length in loop six were tested higher than the leaders' ones. The ascension speed was tested to grow in both the leaders and outsiders groups. We found the individual speed and kick-off power acceleration resource mobilized in the final loops being critical for success in the race. We recommend the study data and findings for application in the precompetitive training systems by the potential qualifiers for the 2021 World Ski Cup.

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Movement coordination skills training model for 11-13 year-old female handball players in advanced training stage

UDC 796.012

PhD **Fateh Zereg**[1]
Dr. Hab., Professor **M.V. Zhiyar**[2]
Associate Professor **O.V. Romenskaya**[3]
Suli Taha[4]
[1]Chengdu Sports University, Chengdu, Sichuan, China
[2]Russian State University of Physical Education, Sports, Youth and Tourism (SCOLIPE), Moscow
[3]Tolyatti State University, Togliatti
[4]Moscow City Pedagogical University, Moscow

Corresponding author:

Abstract

Objective of the study was to theoretically substantiate, develop and test benefits of a new movement coordination skills training model for the 11-13 year-old female handball players in advanced training stage.

Methods and structure of the study. We sampled for the study the 11-13 year-old female handball players from CYSS #53 in Moscow and split them up into Experimental and Reference Groups (EG, RG) of 20 people each. The movement coordination skills training model included the following two training versions: focused/ emphasized movement coordination skills training with a special priority to selected movement coordination skill in a training session; and unspecific/ combined movement coordination skills trainings integrating different movement coordination skills within training session or training micro-cycle. The new movement coordination skills model assigned 15 to 30 minutes in the total Experimental Group training time for the movement coordination trainings. And the Reference Group was trained with a traditional emphasis on the key movement coordination skills.

The movement coordination skills training and excelling model was designed to attain a few general and special goals in the movement coordination skills quality and movement sequence control domain. The key objective with the subordinated special goals was to secure fast progress in the movement control abilities with every motor skill phase execution quality and due movement coordination skills / pacing skills.

The movement coordination skills training and excelling model included sets of special exercises with a special focus on the movement harmony, sequencing and integration into a perfect motor skill. The exercises were designed to offer coordination stepping difficulties for the trainees; new untraditional/ unexpected elements; a wide range of movement options and unusual solutions for the motor tasks; and priority to the movement coordination skills control, management and self-rating goals with every individual analyzer system being mobilized or inactivated when the occasion requires. In the special/ focused movement coordination skills trainings, a high priority was given to the special conditioning practices with/ without the ball, with the lead/ non-lead-limb handling elements, movement coordination skills executions on the lead/ non-lead sides, lower-limbs assisted ball handling practices etc.

Results and conclusion. The new movement coordination skills training model testing experiment found the model beneficial as verified by the EG versus RG progress, particularly in the unspecific movement coordination skills training version. Both movement coordination skills training versions were tested beneficial for the team sport advanced training stage as they were found to facilitate the movement coordination progress in a harmonized manner (provided the individual movement coordination skills training times are kept equal); with optional focused trainings of some individual key movement coordination skills.

Keywords: *11-13-year-old female handball players, movement coordination skills, advanced training, unspecific/ focused movement coordination skills training.*

Background. Women's handball sport community gives a growing priority to the movement coordination skills in the context of the spatial orientation qualities critical for success under heavy competitive pressures with the response time/ space limitations and multiple unexpected game situations. Modern advanced training systems basically train players for promotion to the sports excellence groups, with a special attention to their progresses in the sport-specific motor skills including movement coordination skills.

Objective of the study was to theoretically substantiate, develop and test benefits of a new movement coordination skills training model for the 11-13 year-old female handball players in advanced training stage.

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Table 1. *Pre- versus post-experimental EG/ RG movement coordination skills test data*

Movement coordination skills test	RG		p*	EG		p*
	Pre-exp.	Post-exp.		Pre-exp.	Post-exp.	
	$\overline{(X \pm \sigma)}$	$\overline{(X \pm \sigma)}$		$\overline{(X \pm \sigma)}$	$\overline{(X \pm \sigma)}$	
20m sprint, s	3,50±0,27	3,53±0,27	>0,05	3,52±0,22	3,49±0,30	>0,05
20m backward sprint, s	5,03±0,43	5,03±0,67	>0,05	5,03±0,67	4,82±0,75	<0,05
20m ball control, s	4,42±0,41	4,07±1,11	<0,05	4,27±1,12	4,08±0,86	<0,05
20m backward ball control, s	7,09±1,07	7,93±2,32	<0,05	8,93±2,32	7,80±2,29	<0,05
T-test, s	10,30±0,46	10,65±0,93	<0,05	10,85±0,93	10,19±0,94	>0,05
3x10m shuttle sprint, s	8,20±0,46	8,08±0,34	>0,05	8,18±0,34	7,98±0,38	<0,05
Standing long swing jump, m	1,76±0,17	1,79±0,08	<0,05	1,77±0,08	1,87±0,15	<0,05
Standing long non-swing jump, m	1,46±0,13	1,49±0,13	<0,05	1,48±0,13	1,54±0,13	<0,05
Backward jump, m	0,95±0,11	0,90±0,13	<0,05	0,93±0,11	0,92±0,12	>0,05
Left bipodalic jump, m	1,17±0,14	1,25±0,14	<0,05	1,16±0,11	1,24±0,18	<0,05
Right bipodalic jump, m	1,16±0,14	1,27±0,15	<0,05	1,17±0,16	1,31±0,20	<0,05
7m target throws, count	5,40±1,43	5,50±1,51	>0,05	5,45±1,49	5,80±1,48	<0,05
30s short passes, count	29,70±1,06	29,80±3,08	>0,05	29,81±3,02	30,50±2,80	>0,05
30s long passes, count	20,00±0,94	20,30±0,42	>0,05	20,20±0,42	22,00±1,05	<0,05

*Note: *Wilcoxon test rate*

movement coordination skills executions on the lead/ non-lead sides, lower-limbs assisted ball handling practices etc.

Results and discussion. The group progresses in the movement coordination skills training model testing experiment were rated by the pre- versus post-experimental unspecific/ specific movement coordination skills tests: see Table 1.

The RG was tested with meaningful progresses in a few specific movement coordination skills including the 20m ball handling, 3x10m sprint, and the right/ left bipodalic jump tests – versus the EG making a significant progress in 10 tests out of 14. The test data give the grounds to rate both of the training models beneficial, with an expressed advantage of the EG training model. In the individual progress percentage terms, the RG and EG made progresses in the pre- versus post-experimental movement coordination skills tests of 35% and 75% of the group numbers, respectively. This finding gives the grounds to rate the new movement coordination skills training model beneficial.

The RG and EG average progresses in the individual movement coordination skills tests were the following: in the zigzag sprint test 4% and 22%, respectively; in the shuttle sprint test 2% and 9%, respectively. In the 7m target shooting (10 attempts) test, 10% and 50%, respectively, with the progress secured by the special movement coordination skills training tools focused on muscular effort kinesthetic control accuracy. These test data provide a fair measure of the age-specific progresses in different movement coordination skills – that may be interpreted as indicative of the movement coordination skills training model benefits that make it recommendable for application in youth women's handball.

It should be emphasized that the above movement coordination skills progress was associated with fast improvements in the specific technical motor skills in both of the groups. Thus, the pre- versus post-experimental motor skills tests found the EG progress in the two-hand ball catching from 2.5 to 4.4 points – versus the RG progress from 2.4 to 3.3 points.

Conclusion. The new movement coordination skills training model testing experiment found the model beneficial as verified by the EG versus RG progress, particularly in the unspecific movement coordination skills training version. Both movement coordination skills training versions were tested beneficial for the team sport advanced training stage as they were found to facilitate the movement coordination progress in a harmonized manner (provided the individual movement coordination skills training times are kept equal); with optional focused trainings of some individual key movement coordination skills.

The study was sponsored by Chengdu Sports University (Sichuan, China)

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Psychographic model for beginner chess trainings: benefits analysis

UDC 796.012.37

PhD, Associate Professor **I.V. Mikhaylova**[1]
PhD, Associate Professor **E.D. Bakulin**[1]
O.G. Rysakova[1]
[1]Russian State Social University, Moscow

Corresponding author: chessy07@mail.ru

Abstract
Objective of the study was to develop and test benefits of a standard psychographic model for analysis to facilitate the psychological and educational control service in chess training systems.
Methods and structure of the study. The psychographic method testing experiment was run in 2012-2015 at the RSSU Chess House. We sampled the 18-22 year-old student chess players from the beginner training and competitive groups. Psychographs were produced using clustered mnemonic and intellectual functionality tests data and analyses rating the individual psychological traits and operational psycho-emotional states. The EG (n=508) training service was managed based on the W. Stern longitudinal psychographic test data with analysis of variations in the individual mental and physiological test rates in three test clusters visualized by the traditional ray psychographs. The RG (n=510) was trained as required by the traditional training system without psychographic method support.
The mnemonic and intellectual functionality test database with the psychological traits and current actual psycho-emotional states was formed of the C.D. Spielberger anxiety; WAM (wellbeing, activity, mood); physical and mental health (Short Form 36); and D. Russell and M. Ferguson Subjective Loneliness Feel Test data. The test data were clustered with the test data converted on the 10-point scale and represented on ray psychographs.
Results and conclusion. The psychographic method model with its training methods and psychographic test tools makes it possible to fairly track the individual functional progresses in the training and competitive process. The new psychographic method model testing experiment found the model beneficial as it brings new quality to the beginner chess sport trainings with its comprehensive and individualized test toolkit making it possible to profile variations in the individual mental and physiological test rates and effectively cluster and visualize the test data for analyses by segmented ray psychographs.

Keywords: *chess sport, psychographic method, psychological and educational control, combined tests, physical training intensity.*

Background. The U. Stern's psychographic method with its individual emotionality and resource testing toolkit was applied for the chess trainings by I.N. Dyakov, N.V. Petrovsky, P.A. Rudik who developed a chess player psychograph back in 1925 [4, 7, 16]. When analyzing the academic athletes' (including those with health limitations) needs for psychological and educational support, researchers tend to appreciate benefits of the Dyakov-Petrovsky-Rudikane psychograph compliance with the key principle of fair tests since the psychographic test data are non-predetermined and the test toolkit is unlimited and never certain in its outcomes [5, 7-11]. Analysis of the modern re-

search in the sports psychographs and mental test methods shows that the qualitative competences of the psychographs need to be converted into the quantitative ones for the purposes of the statistical analyses [1-3, 5-7, 9, 12,17].

Objective of the study was to develop and test benefits of a standard psychographic model for analysis to facilitate the psychological and educational control service in chess training systems.

Methods and structure of the study. The psychographic method testing experiment was run in 2012-2015 at the RSSU Chess House. We sampled the 18-22 year-old student chess players from the beginner training and competitive groups. Psychographs were produced using clustered mnemonic and intellectual functionality tests data and analyses rating the individual psychological traits and operational psycho-emotional states. The EG (n=508) training service was managed based on the W. Stern longitudinal psychographic test data with analyses of variations in the individual mental and physiological test rates in three test clusters visualized by the traditional ray psychographs. The RG (n=510) was trained as required by the traditional training system without psychographic method support.

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Results and discussion. Modern chess sport requires the training system being highly effective in mobilizing the individual intellectual and psycho-emotional resource to facilitate progress in the strategic thinking and intellectual competitive qualities and skills for success [10, 17]. The EG training service was designed in compliance with the modern psychological and educational support concept with its key training system design principles, and with systematic mental/ physiological health tests designed on a clustering and deterministic basis [12-15]. A special priority was given to the progress facilitating constructive and democratic coach-trainee relationship and communication styles.

Given on Figure 1 is the standard comparative interpretation of the individual psychophysical fitness progresses in the EG and RG represented by ray psychographs segmented by the functionality test clusters.

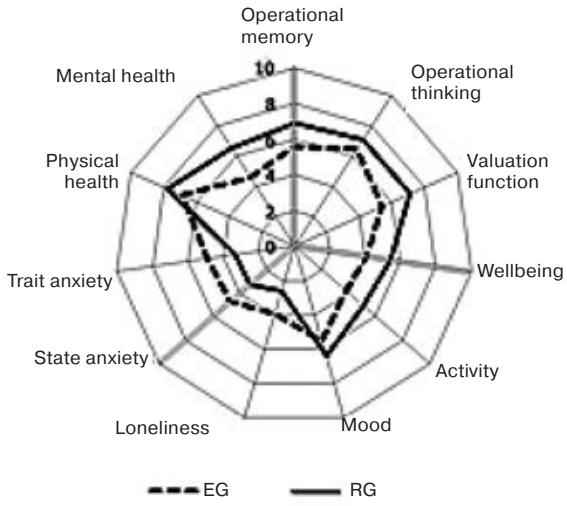

Figure 1. *Comparative psychographs of the EG and RG test data of 2015*

The above psychograph shows the key test clusters with the relevant individual mnemonic and intellectual functions test data, psychological traits and psycho-emotional states in the RG and EG, with the test data converted on the ten-point scale for convenience. It should be emphasized that the EG was tested 9-40% better than RG in every test. This finding demonstrates benefits of the comprehensive psychographic model as verified by the significant progress of the EG on the Operational memory, Operational thinking Valuation function scales tested 21% higher than the RG; on the Wellbeing, Activity and Mood scales 27.5% higher; on the Loneliness, State and Trait anxiety test scales 32% lower than the RG; with the average progress of the EG in psycho-emotional states estimated 29.8% higher than in the RG. And the combined Physical health and Mental health (SF-36) tests ranked the EG 27% higher than the RG.

The yearly averaged physical training intensity tests found the EG making 3-12% better progress than the RG at the final stage of the psychographic method model testing experiment: see Figure 2.

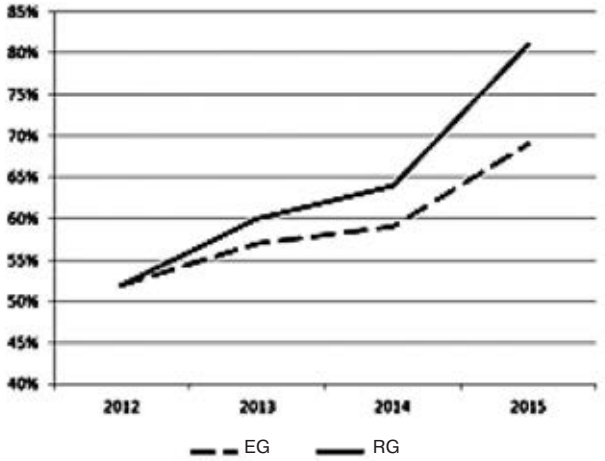

Figure 2. *Averaged yearly physical training intensity in EG and RG in 2012-15*

Conclusion. The psychographic method model with its training methods and psychographic test tools makes it possible to fairly track the individual functional progress in the training and competitive process. The new psychographic method model testing experiment found the model beneficial as it brings new quality to the beginner chess sport trainings with its comprehensive and individualized test toolkit making it possible to profile variations in the individual mental and physiological test rates and effectively cluster and visualize the test data for analyses by segmented ray psychographs.

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Mental conditioning service in paralympic elite sports: design and contents

UDC 796.01:159.9

PhD, Head of department **A.A. Banayan**[1]
PhD, Associate Professor, Director **S.A. Vorobev**[1]
Researcher **E.A. Kiseleva**[1]
PhD **A.S. Kryuchkov**[2]
[1]Saint-Petersburg Physical Education Research Institute
[2]Federal Science Center for Physical Culture and Sports, Moscow

Corresponding author: abanayan@spbniifk.ru

Abstract

The aim of the article is to reveal the features of the structure and content of general psychological training in Paralympic sports at various stages considernosologies.

Research results and conclusions. The methodological foundations, modern approaches and concepts for effective planning, organization and implementation of general psychological training in elite Paralympic sports have been determined. The necessity of paying respect to the international Paralympic sports classification was revealed, in accordance with which athletes belong to different sports classes (functional), which determine the specificity of the organization and conduct the psychological training of high-class Paralympic athletes. The features of the structure and content of the general psychological training of Paralympians at the stages of sports specialization and elitehave been revealed.

Keywords: *sports psychology, training system stages, Paralympic sports, top sportsmanship.*

Background. Modern sports psychology tends to integrate elements of many knowledge fields (psychology, pedagogy, psychophysiology, physical education theory and practice) and different psychological service schools (prioritizing the cognitive, behavioral, individualized, gestalt, existential, clinical and other aspects) as demonstated by a wide range of issues addressed by the national and foreign research communities [1]. These variations result in contradictions in many specific terms and definitions related to different phenomena and processes in the athletic psychological/ mental conditioning service with its test methods and focused impacts.

The approach we offer herein prioritizes the professional growth paradigms typical of elite sports that require the inborn gifts and qualities being advanced for the sport-specific purposes to shape up and excel necessary knowledgebase, skills and experiences for competitive successes. In this context, a training system may be interpreted as the progress facilitation environment and toolkit with the specific inherent principles, standards and requirements including training system periods, stages and cycles.

Modern sports discipline are rather specific and different in their requirements to the individual mental qualities and mental control skill sets. Multiiple relevant national and foreign studies offer athletic performance psychography analyses with psychosportograms and mental conditioning models that cover every aspect of the training and competitive processes; and we believe that it is the combined psychological and educational analysis of athletic progress that provides a basis for the most effective mental conditioning methods [4].

With emergence of Paralympic sports and some other specific sports disciplines, the research community has given a growing priority to the discipline-specific and diagnose-sensitive mental conditioning service at every athletic progress period and training system stage. The growing database of the Olymians' psychosportograms can unlikely be fully applicable to the Paralympic sports elite and, hence, requires special research to find the most relevant and beneficial mental conditioning methods, models and tools.

Objective of the study was to analyze modern mental conditioning (service models for the Paralympic sports elite customizable for the individual diagnoses and progress stages.

Result and discussion. Since the overall competitive mental fitness is determined by the training system design and management and mental control improvement service plus the individual qualities, gifts, skills experiences and the actual training progress – with a special priority to the staged mental conditioning skills mastering, the Paralympic sports elite mental conditioning service should be sensitively customized to the actual athletic progress stages.

Thus the sports specialization training system stage will be designed with a special attention to progress in basic mental control skills and sports-specific psychological qualities formed by the prior trainings. The mental conditioning models will be designed to develop due athletic discipline and determination for trainings, with growing reliance on the independent hard work supervised by an expert/ coach when necessary. Of special benefit at this training system stage may be the Russian version of the Swedish mental conditioning model by L.E. Unestal advanced by the Saint-Petersburg Physical Education Research Institute research team – that has proved effective by quite a few studies [2].

The mental conditioning systems applied in the elite training system with their growing competitive workloads and experiences will give a special priority to the competitive performance analyses in the mental fitness contexts. Individual psychological consulting and support will be designed to analyze successes and failures, particularly in the transitional athletic training periods when the training and competitive workloads are reduced.

To secure the modern mental conditioning service for the Paralympic sports elite being successful, its should be designed with respect to the Y.L. Khanin's individual functionality peak zones concept that has proved effective in many elite sports as verified by some foreign studies [5]. Such mental conditioning service model requires the athlete to mentally immerse as full as possible in the past competition to reconstruct in full own feelings and emotional experiences prior to and during the starts, and comprehensively realize and analyze the causes and effects of the own solutions and actions under competitive stressors. This mental exercise should help the athlete find and fix the own individual functionality peak zone as the core target in the emotional flow – to effectively model thereafter the similar competitive situations and responses and, hence, forecast and manage own competitive performance within the actual mental fitness limitations.

We run a new mental conditioning model testing experiment on the Paralympic sports elite samples in archery and track and field athletics for two annual training cycles, with the mental conditioning service customized for the precompetitive and transitional training system periods. The mental conditioning progress tests included the galvanic skin response tests of the wheelchaired athletes with spinal cord injuries and multiple functional disorders of the trunk and limbs. The galvanic skin response tests found lower background galvanic skin response levels ($p \leq 0.05$, $p \leq 0.01$) and shorter relaxation-activation ranges ($p \leq 0.05$). It also found that in the transitional training system periods the background galvanic skin response levels were expressly different for the athletes with dysmelia and amputations after injuries versus athletes with the cerebral palsy related health disorders [3]. These test data demonstrate the need for the Paralympic sports elite training service to be prudently individualized with a special emphasis on the customizable mental conditioning tools to develop good mental control with the timely progress tests by experts.

Conclusion. The Paralympic sports elite trainings with mental conditioning models will be designed as required by the professional progress paradigms and training system staging concept applied on a discipline- and diagnose-specific basis, with due attention to the actual mental anf functional fitness. We recommend the target mental conditioning models with application of modern psychological and educational toolkits customizable for the innate individual qualities, gifts, skills and predispositions, athletic physical and mental performance, social relations and environmental impacts on the mental aspects of the training and competitive performance.

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Effects of academic training curricula on cadets' mental and physical health

UDC 796.01:159.9

PhD, Associate Professor **A.A. Tretyakov**[1, 2]
Dr. Hab., Professor **I.F. Isaev**[1]
PhD, Associate Professor **L.A. Kadutskaya**[1, 2]
PhD, Associate Professor **E.S. Nikolaeva**[1]
[1]Belgorod State National Research University, Belgorod
[2]Putilin Belgorod Law Institute of the Ministry of Internal Affairs of Russia, Belgorod

Corresponding author: tretyakov@bsu.edu.ru

Abstract
Objective of the study was to test and analyze the cadets' nervous-emotional stress by an academic weekly experiment.
Methods and structure of the study. The 4-year cadets (n=50, including 30 males and 20 females) from Putilin Belgorod Law Institute of the Ministry of Internal Affairs were sampled for the nervous-emotional stress testing experiment. The sample nervous-emotional stress and mental/ physical health was tested for a week by "Biomysh" (KPF-01b/c) Test System. We also analyzed the contents and stressors of the academic lectures, workshops and practical PR classes and tested the cadets' motor activity by Omron Walking Style III pedometers.
Results and conclusion. The test data generally showed difference between the week start (warm-up time) and weekend (fatigue accumulation) states.
The academic education service contents and stresses were found to seriously affect the cadets' mental/ physical health standards, with the sample tested with the nervous-emotional stress peaks in the theoretical learning times. We would recommend the curricula being well designed and managed to make the classes lively, active and enjoyable, with a special priority to reasonable motor activity to level down the inactivity-related stressors. The cadets' motor activity in classes will be encouraged by regular active rest breaks, physical activation minutes, gymnastics etc. These revisions should still give room for the service stressors modeling situations to help the cadets develop due attention controls and mobilize the individual mental/ physical health resources for progress and success in the future service careers. Such situational trainings should be geared to attain specific service goals albeit kept under a certain mental stress threshold to avoid potential mental/ physical health disorders and pathologies.

Keywords: *motor activity, cadets, nervous-emotional stress, physical education , academic training curriculum.*

Background. Modern academic education can unlikely be fully cleared of high intellectual and mental stressors, with the academic curricula being increasingly specific and challenging due to multiple education process goals, updates to the education materials, time pressures and the rapidly expanding physical inactivity [1, 2]. It should be mentioned that departmental and special academies set their specific and challenging requirements to discipline and service duties [3], with the cadets expected to develop efficient decision-making skills to find solutions to the learning and training problems to be perfectly fit for their future service missions and duties [4]. Since the cadets have to meet multiple requirements in the fast changing environments and situations, they need to digest and process growing data flows in the learning process in the mostly physically inactive settings being increasingly exposed to risks of nervous-emotional stress, and, hence, they need to develop good stress tolerance [5].

Table 1. *Motor activity and academic workloads of the sample (F – females, M – males)*

Time/ session		Monday		Tuesday		Wednesday		Thursday		Friday	
		F	M	F	M	F	M	F	M	F	M
Session 1	08.30-10.00	Workshop		Lecture		Workshop		Lecture		Workshop	
	Motor activity	424±79	531±61	121±19	153 ±25	384±99	501±81	172±24	213±31	301±48	422±62
Session 2	10.15-11.45	Workshop		Workshop		Lecture		Lecture		Workshop	
	Motor activity	631±62	703±59	301±56	412±28	150±39	212±21	185±28	240±25	534±82	651±91
Session 3	12.00-13.30	PE class		Workshop		Workshop		Lecture		PE class	
	Motor activity	5330±342	6860±658	340±24	391±35	404±59	546±41	151±23	232±28	4260±251	6460±364
Total motor activity		6385±284	8094±375	762±98	956±85	938±92	1259±103	508±56	685±64	5095±319	7533±401

Objective of the study was to test and analyze the cadets' nervous-emotional stress by an academic weekly experiment.

Methods and structure of the study. The 4-year cadets (n=50, including 30 males and 20 females) from Putilin Belgorod Law Institute of the Ministry of Internal Affairs (BLU) were sampled for the nervous-emotional stress testing experiment. The sample nervous-emotional stress and mental/ physical health was tested for a week by "Biomysh" (KPF-01b/c) Test System. We also analyzed the contents and stressors of the academic lectures, workshops and practical PR classes and tested the cadets' motor activity by Omron Walking Style III pedometers.

Results and discussion. Analyzed in Table 1 hereunder are the theoretical training sessions and two practical physical education sessions.

In the theoretical learning time, the motor activity was tested to vary within 1500 steps that may be qualified as physical inactivity with the relevant stressors. The practical physical education classes were found to partially cover the movement deficit, with the females and males tested to make 5330±342 steps and 6860±658 steps, respectively. This motor activity, however, is occasional and uneven in the academic week and, consequently, associated with its own stressors of effect on the mental/ physical health standards.

Given in Table 2 are the mental/ physical health test data yielded by the "Biomysh" Test System, including a simple response test. The female group latent sensorimotor response was tested to peak at 218ms on Wednesday, with the motor sensorimotor response peaking on Monday and Friday, with the average sensorimotor response following the same trend. The latent sensorimotor response in the males group was tested to fall from Monday to Friday. The physical activity influences on these test rates were found to be gender-specific.

The complex sensorimotor response test rated the same qualities plus errors. The latter are omitted in Table 2 since none of the subjects made errors. Generally the complex sensorimotor response data analysis found the same trend. The Table also gives the flash detection threshold test data – indicative of the functional mobility of individual nervous processes – sensitive to the nervous-emotional stress variations in their turn. The flash detection threshold data are indicative of the high stress in the midweek time partially leveled down by the practical physical education classes on Mondays and Fridays.

The correction test data helped profile the attention control in the sample, with registration of errors. The latter were tested to peak on Monday and Thursday, with the success rate being the lowest on the same days in the female group, albeit the response pace was still about the weekly average. The male group was tested with the success variations over the week, with the error-free execution tested only on Thursday, and with the response pace relatively high all the time. These test data are indicative of the academic learning process impacts on the group mental/ physical health standards.

The sample was also tested by the Luscher test to rate the overall trait anxiety, autonomic responses and deviations from the suggestive norm. The test data generally showed difference between the week start (warm-up time) and weekend (fatigue accumulation) states. The galvanic skin response test showed peaks on Monday and Friday in both of the gender groups – apparently due to the practical physical education classes. The galvanic skin response test rate was found to fall in the midweek time – that may be inter-

Table 2. *Mental/ physical health and galvanic skin response test data of the sample*

Test	Simple sensorimotor response		Complex sensorimotor response		Flash detection threshold		Correction test		Luscher test				Galvanic skin response
Test rate	Latent SR time	Motor SR time	Latent CR time	Motor CR time	Threshold period	Threshold frequency	Success	Errors	Pace	Total	Ratio	Sugges-tive norm	
	ms	*ms*	*ms*	*ms*	*ms*	*Hz*	*%*	*n*	*ms*				*kOhm*
Females													
Mon	250	95,6	289,6	145,6	23,44	43,2	92	0,6	3162	1,33	1,04	13,3	25
Tue	221	71	255	113	19,69	50,7	100	0	3876	1	1,1	12	25
Wed	218	76	257	110	19,69	50,7	100	0	2425	3	0,82	12	14
Thu	231	85	335	103	25,31	39,5	77	2	2854	2	1,86	12	16
Fri	233	98,5	313	125	24,38	41,0	100	0	3125	1	1,09	15	30
Males													
Mon	261,4	80,2	281,6	132,8	21,56	46,5	92,8	0,6	3306	4	0,96	19,2	24,8
Tue	254	126,6	288,3	169,3	28,13	36,5	96	0,3	3843	6,33	1,26	22,6	8,67
Wed	253,1	107,4	290,8	133,4	21,25	48,8	98,2	0,1	3168	2,57	0,78	18,8	13,86
Thu	222,3	96,83	265,6	132,8	24,19	42,3	100	0	3427	5,17	1,01	23	13,33
Fri	228,3	91,33	273,1	139,5	22,31	48,2	96	0,3	2673	6,17	0,81	23,6	15,17

preted as indicative of the inactivity with the mounting stress and fatigue.

Conclusion. The academic education service contents and stresses were found to seriously affect the cadets' mental/ physical health standards, with the sample tested with the nervous-emotional stress peaks in the theoretical learning times. We would recommend the curricula being well designed and managed to make the classes lively, active and enjoyable, with a special priority to reasonable motor activity to level down the inactivity-related stressors. The cadets' motor activity in classes will be encouraged by regular active rest breaks, physical activation minutes, gymnastics etc. These revisions should still give room for the service stressors modeling situations to help the cadets develop due attention controls and mobilize the individual mental/ physical health resources for progress and success in the future service careers. Such situational trainings should be geared to attain specific service goals albeit kept under a certain mental stress threshold to avoid potential mental/ physical health disorders and pathologies.

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Track and field athletics elite: discipline-specific psychomotor tests and analysis

UDC 796.01:159.9

PhD, Associate Professor **O.V. Petrenko**[1]
Applicant **L.A. Nerubenko**[1]
PhD, Associate Professor **T.V. Sulima**[1]
PhD, Associate Professor **G.L. Nesterenko**[1]
[1]Belgorod State National Research University, Belgorod

Corresponding author: petrenko_o@bsu.edu.ru

Abstract
Objective of the study was to obtain and analyze discipline-specific psychomotor data of the national track and field athletics elite.
Methods and structure of the study. The psychomotor tests qualities of the sample were tested by the UPFT-1/30 "Psychophysiologist" Test System to obtain the simple visual-motor response, simple sensorimotor response, nervous functions mobility, dynamic visual response speed, accuracy and nervous control test rates; plus the nervous system strength rating hand tapping test; and sensorimotor dynamic coordination test rates (dynamic tremorometry). We sampled for the study Masters of Sports (n=12) and Candidate Masters of Sports (n=26) from every track and field athletics discipline (n=38 on the whole) to produce an inclusive psychomotor tests database for analysis.
Results and conclusion. Sprinters were tested high on the simple visual-motor response and simple sensorimotor response test scales. The middle-distance runners were tested high on the nervous functions mobility and tapping test scales. The jumpers (pole vault and high jump) and all-round competitors were tested very high on the nervous function mobility test scale and high on the sensorimotor dynamic coordination test scale i.e. with the high assessment and differentiation accuracy verified by the spatial and power movement control parameters. Therefore, such psychomotor rates and analyses may be effectively used to select and specialize young and adult athletes in every track and field sports discipline and every progress stage. The coaching teams may use the psychomotor data and analyses to prudently design and manage the general and special physical fitness models for different types of physique; and forecast individual competitive progresses.

Keywords: *track and field sports, psychomotor tests, psychomotor characteristics, physique type, psychophysiologist.*

Background. Modern elite sports are rapidly progressing, with the individual athletic progress secured by individualized training systems – that give a special priority to the psychomotor tests and analyses as a basis for training system design and management [2, 3]. The training systems are increasingly designed to factor in multiple training progress components [5], with the individual psychomotor test rates playing a special role for the sports selection theory and practice and the long-term psychomotor tests design and management aspects. The psychomotor rates of the sport elite (MS and CMS) may be used as reference points for selections in the primary and advanced stages of the long-term training service [1]. The psychomotor characteristics rating databases make it possible to analyze the strengths and weaknesses in the individual athletic fitness to implement effective corrective and progress management training models for success [4].

Objective of the study was to obtain and analyze discipline-specific psychomotor data of the national track and field athletics elite.

Methods and structure of the study. The psychomotor tests qualities of the sample were tested by the UPFT-1/30 "Psychophysiologist" Test System to obtain the simple visual-motor response, simple sensorimotor response, nervous functions mobility, dynamic visual response speed, accuracy and nervous control (RMO) test rates; plus the nervous system strength rating hand tapping test; and sensorimotor dynamic coordination test rates (dynamic tremorometry). We sampled for the study Masters of Sports (n=12) and Candidate Masters of Sports (n=26) from every track and field athletics discipline (n=38 on the whole) to produce an inclusive psychomotor tests database for analysis.

Results and discussion. The psychomotor data analysis made it possible to group the psychomotor rates by qualifications (MS and CMS) and athletics disciplines and offer progress recommendations based on the mean discipline-specific psychomotor characteristics and standard deviations: see Figures 1-5.

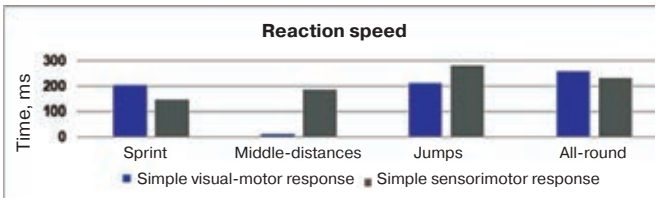

Figure 1. *Simple response test rates*

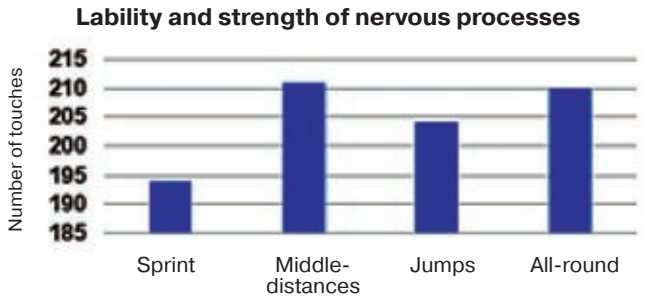

Figure 2. *Nervous functions mobility and strength – nervous functions mobility*

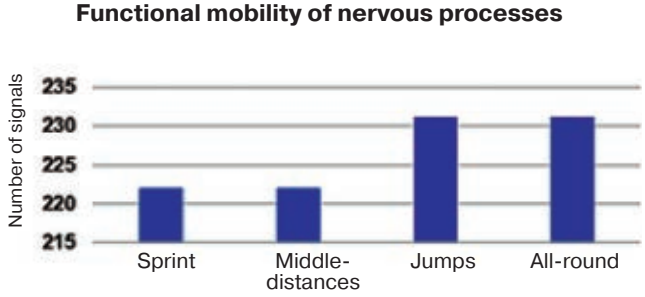

Figure 3. *Dynamic visual response speed*

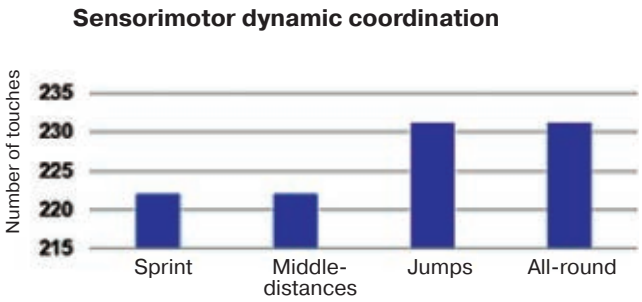

Figure 4. *Tapping test – TT*

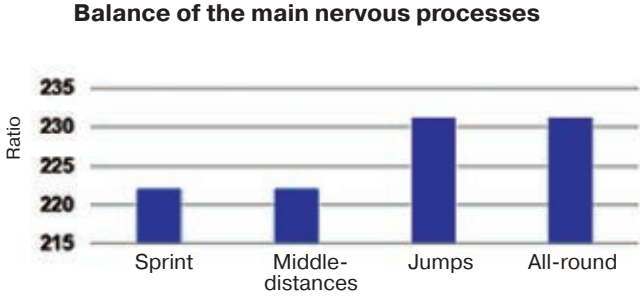

Figure 5. *Sensorimotor dynamic coordination - sensorimotor dynamic coordination*

Our analysis of the psychomotor rate of the sample ranked the sampled sprinters high on the simple visual-motor response, simple sensorimotor response, and nervous functions mobility test scales. They were also tested above the average in the RMO and tapping test. The RMO test found some shift of the balance in the response speed and accuracy of the main nervous processes.

The middle-distance runners were tested high on the nervous functions mobility and tapping test scales, plus the RMO test scale; above the average in the simple visual-motor response and simple sensorimotor response tests; and mean on the sensorimotor dynamic coordination test scale.

The jumpers (pole vault and high jump) were tested very high on the nervous functions mobility test scale and high on the sensorimotor dynamic coordination test scale. The tapping tests and simple visual-motor response tests yielded the above the average results. And the simple sensorimotor response test rates were below average; whilst the RMO test found some shift of the balance in the response speed and accuracy of the main nervous processes.

The all-round competitors were tested very high on the nervous functions mobility test scale and high on the nervous process lability and strength (endurance) sensorimotor dynamic coordination scale. They showed moderate results in the simple visual-motor response and simple sensorimotor response tests;

whilst the RMO test found some shift of the balance in the response speed and accuracy of the main nervous processes.

Conclusion. Sprinters were tested high on the simple visual-motor response and simple sensorimotor response test scales. The middle-distance runners were tested high on the nervous functions mobility and tapping test scales. The jumpers (pole vault and high jump) and all-round competitors were tested very high on the nervous functions mobility test scale and high on the sensorimotor dynamic coordination test scale i.e. with the high assessment and differentiation accuracy verified by the spatial and power movement control parameters. Therefore, such psychomotor rates and analyses may be effectively used to select and specialize young and adult athletes in every track and field sports discipline and every progress stage. The coaching teams may use the psychomotor data and analyses to prudently design and manage the general and special physical fitness models for different types of physique; and forecast individual competitive progresses.

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Psychological features of female ice hockey players at start of their sports careers

UDC 796.01:159.9

Dr.Med., professor of the Department of medical rehabilitation and adaptive physical culture **Yu.K. Rodygina**[1]
Dr.Med., head of the Department of medical rehabilitation and adaptive physical culture **A.A. Potapchuk**[1]
Dr.Med., professor of the Department of physical methods of treatment and sports medicine **S.V. Matveev**[1]
Dr.Med., professor, head of the Department of physical methods of treatment and sports medicine **M.D. Didur**[1]
[1]Federal State Budgetary Educational Institution of Higher Education "The First St. Petersburg State Medical University" named after academician I.P. Pavlov of the Ministry of Healthcare of the Russian Federation, St. Petersburg

Corresponding author:
yurodygina@yandex.ru

Abstract
Objective of the study was to determine psychological and psycho-physiological features of girls during competitions at the start of their sports careers in order to obtain data about the dynamics of changes of these factors and developing guidelines regarding psychological training in women's ice hockey.
Methods and structure. In order to achieve our study aims we conducted psychological and psycho-physiological examination of 28 girls playing for the team SKA Aurora (St. Petersburg) (both the first and the second strings of players), average age 9,1 y.o., with up to 1 year exposure to ice hockey training. In order to determine psychological and psycho-physiological factors of girls as compared to boys we conducted a comparative experiment with the participation of 17 boys – ice-hockey players, aged 8-9, born in 2009 (team SKA Strelna, St. Petersburg). All techniques used were based on the computer software "Psychotest" by Neurosoft.
The paper discusses some important issues of women's ice hockey. Ice hockey instructors working with children do not have enough knowledge about differential features of boys and girls who regularly play hockey, therefore the aim of our work was to determine psychological and psycho-physiological factors of female ice hockey players and delineate approaches to psychological training in women's ice hockey at the start of a sports career. Psychological and psycho-physiological examination of twenty-eight girls playing for the SKA Aurora team (St. Petersburg) was conducted, as well as the comparative experiment involving seventeen boys of the same age from the same sports club.
Results and conclusion. Standardized psychological techniques were used during the ascertaining experiment, which revealed that girls are less aggressive than boys ($p<0,05$), do not tend to be very competitive and aggressive in everyday life and on the hockey pitch. At the same time, they have a higher anxiety level, are more sensitive and introverted. The children from the two groups under comparison possess the same degree of emotional instability and motivational changeability. Inhibitory reactions prevail in psycho-physiological characteristics of girls-hockey players, at the level of high statistical significance compared to boys. Psychological training should be based on comprehensive positive reinforcement of achieved results, as well as the control of actual working capacity and the training aimed at the development of the degree of neural processes excitement.

Keywords: *women's ice hockey, psychological and psycho-physiological factors of female ice hockey players, start of sports career.*

Introduction. Women's ice hockey is still gaining popularity in many Russian cities. It should be noted that in ice hockey girls do not have as many injuries as in figure skating, where they learn to move on ice without any protective gear. One feature of women's ice hockey is that it does not involve a lot of fighting – on the contrary, success here is based on good skating skills, mental speed and agility. However, psychological and psycho-physiological factors of female ice hockey players, such as response speed, dynamic peculiarities of working capacity and reaction to competitive environment, have not been studied well enough, which makes our research quite relevant [1,3,4]. Coaches of women's ice hockey teams do not

have enough knowledge about girls' peculiarities and very often transfer their techniques of working with boys onto girls, which leads to problems with psychological and pedagogical aspects of training and, eventually, to poor results in competitions [5].

Objective of the study was to determine psychological and psycho-physiological features of girls during competitions at the start of their sports careers in order to obtain data about the dynamics of changes of these factors and developing guidelines regarding psychological training in women's ice hockey.

Methods and structure. In order to achieve our study aims we conducted psychological and psycho-physiological examination of 28 girls playing for the team SKA Aurora (St. Petersburg) (both the first and the second strings of players), average age 9,1 y.o., with up to 1 year exposure to ice hockey training. In order to determine psychological and psycho-physiological factors of girls as compared to boys we conducted a comparative experiment with the participation of 17 boys – ice-hockey players, aged 8-9, born in 2009 (team SKA Strelna, St. Petersburg).

The following techniques were used (all of them were based on the computer software "Psychotest" by Neurosoft): in order to determine psychological characteristics of girls ice-hockey players we used the individual typological questionnaire (L. Sobchik's technique, children's version); in order to assess psycho-physiological potential of girls starting their ice-hockey careers we used the computer version of the technique "Response to a moving object" (RMO), which reveals accuracy and promptness of sensomotor reactions, as well as the predominance of forestalling or retardation of a sensomotor reaction, which testifies to the predominance of excitative and retardation processes in the central nervous system, correspondingly [2].

Results and discussion. The main psychological characteristics, reflecting the differences at the statistical significance level between boys and girls with regular ice hockey training, demonstrated that girls (2,52 points) are less aggressive than boys (3,73 points), do not tend to be competitive and aggressive in everyday life and on the hockey pitch (figure 1); they are much more predictable (on the "spontaneity scale" girls score 2,57 and boys - 3,4 points). At the same time girls have higher anxiety and sensitivity levels, they are more introverted, susceptible and pessimistic about perspectives; they are more vulnerable and emotional. Boys and girls have equal degrees of temper uncertainty (emotional lability) and changeability of motivation for different types of activity (including sport).

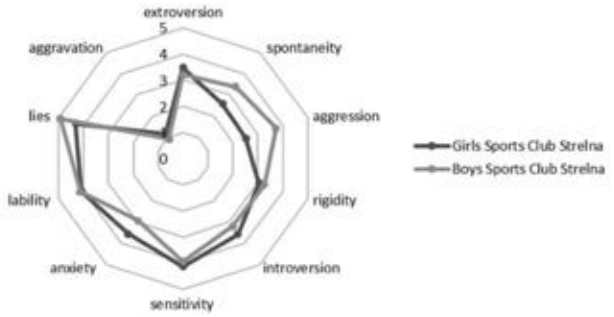

Figure 1. I*ndividual typological features of girls from ice-hockey team SKA "Aurora", points*

The results of our psycho-physiological study revealed that female ice hockey players have predominantly retarding neural processes, at the level of high statistical significance, as compared to boys (the average reaction time is 127 ms vs -57 ms (figure 2). The number of exact reactions is also more characteristic of boys. Also, males have nearly twice as many antedating reactions as females.

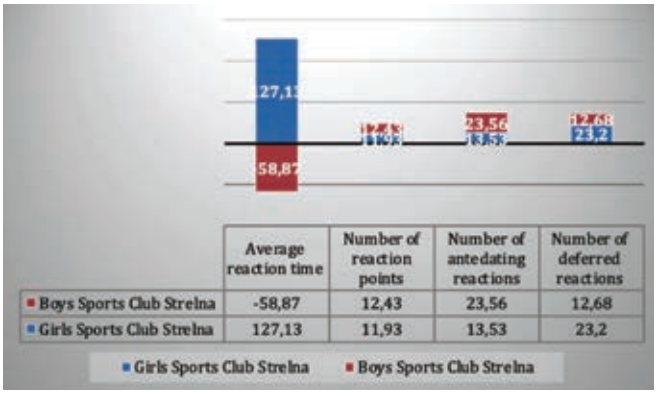

Figure 2. P*sycho-physiological features of women's ice hockey team SKA "Aurora", points (ms, c.e.)*

Based on the ratio of deferred and antedating reactions, a conclusion can be made that retardation processes prevail in the central nervous system of females.

Conclusion. Our study revealed a high degree of motivational changeability in both groups – girls and boys–ice hockey players. When females start their ice hockey careers it is important to spark their interest in the selected sport, accentuating its positive aspects and counter-balancing the negative ones (risk of injury, necessity of tough physical contact, sophisticated sports gear). Females are more sensitive and anxious,

which makes them very diligent and responsive to praise. Praise and positive socio-psychological background in women's teams contribute to better results of women's children and youth teams. At the start of players' sports careers in women's ice hockey teams actual working capacity must be controlled. Moreover, an optimal training mode should be selected in order to avoid over-training and exhaustion.

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Running speed tests for female students grouping and customized speed trainings for gto complex tests

UDC 378.016:796.42

PhD, Associate Professor **E.A. Alenurov**[1]
Dr. Hab., Associate Professor **A.A. Mikhailov**[2]
PhD, Associate Professor **M.A. Petrova**[1]
PhD, Associate Professor **D.A. Kazakov**[1]
[1]Russian State Social University, Moscow
[2]Shuya Branch of Ivanovo State University, Shuya

Corresponding author: alenurov@mail.ru

Abstract
Objective of the study was to find the most beneficial speed training models complementary to the academic physical education classes for female students to facilitate their success in the GTO Complex tests, with the speed training tools customized for the primary running speed test groups.
Methods and structure of the study. We sampled for the study the second-year Russian State Social University female students (n=156) to test their speed qualities by the 20m/ 30m/ 60m/ 100m sprints in 2018-2019 academic year.
Results and conclusion. The tests found minorities of the first- and second-year students (19.2% and 23.1%, respectively) fit for the 100m GTO Complex test. The actual speed fitness variations were as follows for the first- and second-year groups: 12.0% versus 11.7% in the 20m; 15.3% versus 14.7% in the 30m; 14.6% versus 12.7% in the 60m; and 12.8% versus 12.3% in the 100m sprint tests, respectively. These test data demonstrate the need for the speed training tools being customized for these running speed groups.
Authors recommend the high running speed group trainings being dominated by combined 20-100m sprints; whilst the moderate and low running speed group trainings should include other close distances. On the whole, the running speed tests of the female student population were found beneficial for the academic speed training tools customizing in the regular physical education classes for success in the GTO Complex tests.
The university female student sample was grouped into the running speed test groups to find the following intergroup differences: the higher is the running speed level, the higher are the significant tests data correlations – that means that the speed training tools in the regular academic physical education curricula need to be effectively customized for success in the GTO Complex tests.

Keywords: *GTO Complex, structure of speed qualities, female students, correlations, running speed tests, interrelation of indices, running speed level.*

Background. As things now stand in the academic physical education system, the female student population is mostly tested with low physical fitness levels [3-6] giving little chances for success in the GTO Complex tests [1, 6]. Of special concern is the fact that many female students (save for the sporting ones) show regress in the speed tests over the academic training period [5]. One of the key reasons for the poor efficiency of the traditional speed training elements in the regular physical education service curricula, as we believe, is the need for modern speed training tools customizable to the running speed test groups [1, 2].

Objective of the study was to find the most beneficial speed training models complementary to the academic physical education classes for female students to facilitate their success in the GTO Complex tests, with the speed training tools customized for the primary running speed test groups.

Methods and structure of the study. We sampled for the study the second-year Russian State Social University female students (n=156) to test their speed qualities by the 20m/ 30m/ 60m/ 100m sprints in 2018-2019 academic year.

Results and discussion. The tests found minorities of the first- and second-year students (19.2% and 23.1%, respectively) fit for the 100m GTO Complex test. The actual speed fitness variations were as follows for the first- and second-year groups: 12.0% versus 11.7% in the 20m; 15.3% versus 14.7% in the 30m; 14.6% versus 12.7% in the 60m; and 12.8% versus 12.3% in the 100m sprint tests, respectively. These test data demonstrate the need for the speed training tools being customized for these running speed groups: see Table hereunder.

To further analyze the reasons for poor speed training efficiency of the regular physical education service to female students, the sample of basically equally fit students was grouped by the 20m running speed test rates, with the high, moderate and low running speed groups including 20, 23 and 20 girls, respectively. We analyzed the group correlations of the running speed qualities in the sample: see Table 1.

The high running speed group was tested with six significant correlations out of six possible, with the highest correlations found for the 20m versus 30m test rates (r=0.744); followed by the 30m versus 60m (r=0.679); and the 20m versus 60m (r = 0.648) ones; within the 1% significance range. The moderate running speed group was tested with only four significant correlations out of six possible, within the lower significance range. We found only the 20m versus 30m test rates meaningful (r=0.540) within the 1% significance range, with all the other correlations lower. And the low running speed group was tested with three correlations significant only within the 5% significance range.

Therefore, we would recommend the high running speed group trainings being dominated by combined 20-100m sprints; whilst the moderate and low running speed group trainings should include other close distances. On the whole, the running speed tests of the female student population were found beneficial for the academic speed training tools customizing in the regular physical education classes for success in the GTO Complex tests.

Conclusion. The university female student sample was grouped into the running speed test groups to find the following intergroup differences: the higher is the running speed level, the higher are the significant tests data correlations – that means that the speed training tools in the regular academic physical education curricula need to be effectively customized for success in the GTO Complex tests.

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Table 1. *Correlated and grouped running speed test data of the sample*

Tests	Running speed groups	Correlations			
		1	2	3	4
1: 20m sprint	High		744	648	540
	Moderate		540	446	410
	Low		505	348	214
2: 30m sprint	High			679	554
	Moderate			506	406
	Low			486	368
3: 60m sprint	High				474
	Moderate				468
	Low				479
4: 100m sprint	High				
	Moderate				
	Low				

Note: Correlations mean the correlation ratios multiplied by 10^3, with significant values highlighted

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Endurance training model for make female students fit for gto complex tests

UDC 796. 012

PhD, Associate Professor **M.V. Eremin**[1]
PhD, Associate Professor **N.G. Pryanikova**[2]
M.V. Nekrasova[1]
A.Y. Sheveleva[1]
[1]Russian State Social University, Moscow
[2]Moscow City Pedagogical University, Moscow

Corresponding author: eremin-max@mail.ru

Abstract
Objective of the study was to develop and test benefits of an endurance training model for female university students to make them fit for the GTO Complex tests.
Methods and structure of the study. We sampled for the new endurance training model testing experiment (run in 2018-19 academic year) the first-through-fourth-year university females (n=275), with their progress tested by the 100m, 500m, 1000m, 1500m and 2000m running tests.
Results and conclusion. The running results of the sample on the above distances were tested to vary irregularly on a year-specific basis; with the first-year group leading in the 100m sprint; and the second-year group in the 500/ 1000/ 1500/ 2000m run tests; whilst the third- and fourth-year groups were tested with regress in the tests. Furthermore, we tested the sample for sprint endurance and running endurance.
The post- versus pre-experimental tests found the EG making meaningful progress versus the RG in the 100m (6.8%, $p < 0.05$), 500m (5.5%, $p < 0.05$), 1000m (4.7%, $p < 0.05$) and 2000m (4.2%, $p < 0.05$) tests. The progress in the endurance training service made it possible to significantly step up the group success in the GTO Complex run tests. The RG showed a significant progress (plus 5%) only in the 500m test. Therefore, the new endurance training model was tested beneficial due to the special combinations of the adjacent intensity zones in the trainings.
The new endurance training model was tested beneficial due to the special combinations of the adjacent power zone management tools in the trainings – as verified, among other things, by the group success in the GTO Complex run tests. The model testing data and analyses give us the ground to recommend the endurance training model for the first- and second-year female students, with the running practices designed to combine adjacent intensity zones (maximal-to-sub-maximal and sub-maximal-to-top-intensity ones) in every training session.

Keywords: *GTO Complex, endurance training model, female students, experimental training, educational experiment.*

Background. The Russian GTO Complex reinstatement project includes a wide range of actions to modernize the popular physical education and sport systems with the relevant updates to the academic physical education and sports curricula to make them compliant with the state requirements to the trainees' physical education and sports knowledge and skills [1, 2]. As reported by the current university physical education and sport statistics, most of the female students are test physically unfit in many aspects, particularly in the endurance tests, with only 15% of the beginner female students tested fit for the GTO Complex endurance tests [3]. Regretfully, the national research community has still failed to find and offer the most efficient endurance training models for teenage and young population [1, 4, 5], and that was the reason for us to undertake this study.

Objective of the study was to develop and test benefits of an endurance training model for female university students to make them fit for the GTO Complex tests.

Methods and structure of the study. We sampled for the new endurance training model testing experiment (run in 2018-19 academic year) the first-through-fourth-year university females (n=275), with their progress tested by the 100m, 500m, 1000m, 1500m and 2000m running tests.

Results and discussion. The running results of the sample on the above distances were tested to vary irregularly on a year-specific basis; with the first-year group leading in the 100m sprint; and the second-year group in the 500/ 1000/ 1500/ 2000m run tests; whilst the third- and fourth-year groups were tested with regress in the tests. Furthermore, we tested the sample for sprint endurance and running endurance. The sprint endurance was tested to significantly grow in the second-year group (5.8%, $p < 0.05$) and significantly fall in the third- (7.2%, $p < 0.01$) and fourth-year (5.8%, $p < 0.05$) groups. The running endurance was tested to grow significantly in the sub-maximal (6.0%, $p < 0.05$) and high-power (7.1%, $p < 0.05$) intensity zones in the second-year group.

Correlation analysis of the first-year group test data found the highest correlation of the 1000m versus 2000m test data ($r = 0.734$) with six (out of 10 possible) significant correlations. For the second-year group we found eight significant running fitness test data correlations, with the highest ones between the 1000m versus 2000m tests ($r = 0.689$). The third- and fourth-year groups were tested with four and three significant correlations, respectively. Therefore, the numbers of significant running fitness test data correlations were found to fall with the academic years, with their significance ratios falling as well, particularly for the longer test distances.

It should be noted that the first- and second-year groups were tested with sprint endurance rates correlated with running endurance in the sub-maximal power zone, with special endurance shortage in the sub-maximal and high-power zones – in contrast to their third- and fourth-year peers who showed no such correlations. Based on this finding, we would recommend special maximal- and high-power running practices for the group endurance trainings.

We tested benefits of our endurance training model by an experimental training (ET) course for the second-year students split up into Experimental and Reference Groups (EG, RG) of 42 and 40 people, respectively. The RG was trained under the standard academic PE curriculum with the traditional running endurance training elements. And the EG was trained by the new endurance training model including the following combined running practices: 30+60+100+150m; 60+100+150+200m; 150+200+250+300m; and 350+700+1200m ones. Every training session was designed to harmoniously combine the maximal-to-sub-maximal and sub-maximal-to-top-intensity zones.

The post- versus pre-experimental tests found the EG making significant progress versus the RG in the 100m (6.8%, $p < 0.05$), 500m (5.5%, $p < 0.05$), 1000m (4.7%, $p < 0.05$) and 2000m (4.2%, $p < 0.05$) tests. The progress in the endurance training service made it possible to significantly step up the group success in the GTO Complex run tests. The RG showed a significant progress (plus 5%) only in the 500m test. Therefore, the new endurance training model was tested beneficial due to the special combinations of the adjacent intensity zones in the trainings.

Conclusion. The new endurance training model was tested beneficial due to the special combinations of the adjacent power zone management tools in the trainings – as verified, among other things, by the group success in the GTO Complex run tests. The model testing data and analyses give us the ground to recommend the endurance training model for the first- and second-year female students, with the running practices designed to combine adjacent intensity zones (maximal-to-sub-maximal and sub-maximal-to-top-intensity ones) in every training session.

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Customized track-and-field sports training and progress test toolkit for success in gto complex tests

UDC 796.012

Dr. Hab., Professor **V.Y. Karpov**[1]
PhD, Associate Professor **M.V. Eremin**[1]
PhD, Associate Professor **O.A. Razzhivin**[2]
PhD, Associate Professor **A.V. Dorontsev**[3]
[1]Russian State Social University, Moscow
[2]Yelabuga Institute of Kazan (Volga Region) Federal University, Yelabuga
[3]Astrakhan State Medical University, Astrakhan

Corresponding author: vu2014@mail.ru

Abstract
Objective of the study was to find the most effective physical training tools for success in the GTO Complex track-and-field sports tests.
Methods and structure of the study. We sampled the 1-4-year Russian State Social University students (n=126) for the study in April-May 2019. We tested the sample physical fitness to analyze correlations of the physical fitness test rates with successes in the GTO Complex track-and-field sports tests. The physical fitness test set included the 30m sprint, standing long jump, 3x10 shuttle sprint, pull-ups, deadlift dynamometry, front lean, 1000m race and endurance tests; and the track-and-field sports test set included the 100m sprint, long jump, grenade throwing, 3000m race, and 5km cross-country race tests.
Results and conclusion. The 1-2-year student group success in the 100m sprint GTO test was found correlated with the 30m sprint (r = 0.720), standing long jump (r = -0.658), 3x10 shuttle sprint (r = 0.626), pull-ups (r = -0.615) and deadlift dynamometry (r = -0.595) test rates. In the 3-4-year group these correlations were higher for the 30m sprint (r = 0.792) and lower for the 3x10m shuttle sprint (r = 0.595), standing long jump (r = 0.542) and deadlift dynamometry (r = -0.515) tests, whilst the pull-ups test correlation stayed virtually unchanged (r=-0,520). This means that the 1-4-year physical fitness service should prioritize the speed and speed-strength intensive sprints in the trainings for success in the 100m sprint test.
Progresses and successes of university students in the GTO Complex track-and-field sports tests are recommended being facilitated by prudently designed and managed versatile and customizable physical fitness service within the academic physical education and sports curriculum.

Keywords: *GTO Complex, physical qualities, optimization, tests, university students, test data correlations.*

Background. The ongoing national Physical Education and Sports “Fit for Labor and Defense” (GTO) Complex reinstatement project gives a special priority to the university and school physical education and sports service modernization initiatives [4, 6] to facilitate progress in the strength, speed and movement coordination aspects for success in the age-specific GTO Complex tests [1-3, 5]. The popular school/ university physical education and sports models, however, are often regretfully distorted in favor of some specific physical qualities/ skills at detriment to the harmonic and synergized physical progress. The available study reports on the academic physical education and sport service harmonization issues are still deficient in quite a few aspects including the modern training toolkits to secure due fitness for the GTO Complex track-and-field sports tests.

Objective of the study was to find the most effective physical training tools for success in the GTO Complex track-and-field sports tests.

Methods and structure of the study. We sampled the 1-4-year Russian State Social University students

(n=126) for the study in April-May 2019. We tested the sample physical fitness to analyze correlations of the physical fitness test rates with success in the GTO Complex track-and-field sports tests. The physical fitness test set included the 30m sprint, standing long jump, 3x10 shuttle sprint, pull-ups, deadlift dynamometry, front lean, 1000m race and endurance tests; and the track-and-field sports test set included 100m sprint, long jump, grenade throwing, 3000m race, and 5km cross-country race tests.

Results and discussion. Good physical fitness is known to lay a sound basis for success in the GTO Complex track-and-field sports tests. The 1-2-year student group success in the 100m sprint GTO test was found correlated with the 30m sprint (r = 0.720), standing long jump (r = -0.658), 3x10 shuttle sprint (r = 0.626), pull-ups (r = -0.615) and deadlift dynamometry (r = -0.595) test rates. In the 3-4-year group these correlations were higher for the 30m sprint (r = 0.792) and lower for the 3x10m shuttle sprint (r = 0.595), standing long jump (r = 0.542) and deadlift dynamometry (r = -0.515) tests, whilst the pull-ups test correlation stayed virtually unchanged (r=-0,520). This means that the 1-4-year physical fitness service should prioritize the speed and speed-strength intensive sprints in the trainings for success in the 100m sprint test.

The 1-2-year student group success in the long jump GTO test was found correlated with the standing long jump (r = 0.782), with all the other test data correlations tested lower albeit still significant, particularly for the 30m sprint (r = -0.699), 3x10m shuttle sprint (r = -0.660), deadlift dynamometry (r = 0.634) and stuffed ball throw (r = 0.596) tests. In the 3-4-year group, the correlations were the highest for the standing long jump (r = 0.862), front lean (r = 0.644) and deadlift dynamometry (r = 0.626) tests; with all the other tests showing lower correlations with success in the long jump GTO test.

The 1-2-year student group success in the grenade throwing GTO test was found correlated with the stuffed ball throwing (r = 0.765), standing long jump (r = 0.740) and pull-ups (r = 0.645) tests. In the 3-4-year group, correlations were significant only for the stuffed ball throwing (r = 0.635) and pull-ups (r = 0.625) tests. We would recommend giving a special attention to the throw technique mastering aspects for success in the test.

The 1-2-year student group success in the 3000m race test was found correlated with the

1000m race (r = 0.883) and endurance rates (r = -0.776) tests, with all the other test correlations found lower with the only exemption for the 30m sprint (r = 0.542) test correlation that was still significant. In the 3-4-year group, correlations of the 3000m race test success were significant mostly for the endurance rates (r = -0.765) and 1000m race (r = 0.733) tests. The 1-2-year student group success in the 5km cross-country race test was found correlated with the endurance rates (r = -0.787), 1000m race (r = 0.653) and deadlift dynamometry (r = -0.547) tests; whilst the 3-4-year group showed significant correlations with the endurance rates (r = -0.827) and 1000m race (r = 0.767) tests.

On the whole, the 1-2-year student group success in the GTO Complex track-and-field tests were found significantly correlated with 19 standard physical fitness test rates; whilst the 3-4-year student group showed 14 significant track-and-field / physical fitness test correlations – apparently due to some differences in the age-specific academic physical fitness service. We would recommend the 1-4 year student physical fitness service being complemented by special training tools to facilitate progress and success in the most individually challenging GTO Complex track-and-field sports tests.

Conclusion. Progresses and successes of university students in the GTO Complex track-and-field sports tests are recommended being facilitated by prudently designed and managed versatile and customizable physical fitness service within the academic physical education and sports curriculum.

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Academic worldskills physical development technology competence: testing benefits for elementary school physical education service

UDC 796.011.3

PhD **E.D. Bakulina**[1]
PhD **I.V. Mikhailova**[1]
O.G. Rysakova[1]
[1]Russian State Social University, Moscow

Corresponding author: bakulina-lena@yandex.ru

Abstract

Objective of the study was to test benefits of the WorldSkills physical development technology competence training model in application to the quest-game-driven physical fitness / physical development service for second-year elementary schoolchildren.

Methods and structure of the study. The valid academic physical education bachelor training curriculum allocates many hours for physical education training practices in general education school system, with such practices scheduled on an extracurricular basis at no detriment to the regular academic training. We sampled for the physical training model testing experiment the 2-3-year Russian State Social University students majoring in physical education discipline of the Pedagogical Education course. We complemented their trainings with the WorldSkills physical development technology competence mastering standards in close cooperation with our partner schools and university practical training management service, to effectively train them for the elementary school physical education service. Progress of the student sample was tested at practical physical education classes at elementary school. The second-year elementary school sample was subject to the pre- versus post-experimental physical fitness tests. The student sample was split up into Experimental and Reference Groups (EG, RG) to practice physical education service at elementary school A, B, C, D, D and E classes. The RG trained the school sample as required by the traditional physical education program; and EG training was complemented by the WorldSkills physical development technology competence training model. The school physical education classes included B module run once a week. This module offers a physical education quest game geared to facilitate physical progress by the prudently selected and managed modern sporting quest game tools customized for the ages and physical fitness standards, with a special priority to interdisciplinary connections with Literary Reading, Mathematics and the World around us.

Conclusion. The elementary school physical education model dominated by sporting quest game format was found beneficial as verified by the significant progress of the EG versus RG in the pre-versus post-experimental strength, speed-strength flexibility, speed and movement coordination tests. The academic WorldSkills physical development technology competence training was found beneficial for the vocational training standards with special benefits for the physical development technologies mastering domain. Future physical education teachers, coaches and instructors are strongly recommended joining the WorldSkills Championships that provide high motivations and impetuses for the physical education service to facilitate physical fitness / physical development progress of the school trainees.

Keywords: *WorldSkills, professional competence, physical development, physical fitness tests, elementary school physical education program, quest game.*

Background. The WorldSkills Russia promoted by the Young Professionals Union is actively progressing with more and more enthusiasts involved in the movement. The Ministry of Education and Science supports many academic education establishments in their WorldSkills implementation efforts, with the

WorldSkills Interuniversity Championships proved to facilitate progress and accomplishments of the best students. Academic Physical Education Departments give a special priority to physical development competency in the physical education training service [2]. Progress tests rate the research skills, physical development / physical fitness testing and analyzing knowledge and skills, and skills in the physical education / sporting quest game design and management at elementary schools. The academic physical education module subject to analysis herein is designed to test the physical development benefits of the academic WorldSkills physical development technology competence training model for quest-game physical education application at elementary schools.

Objective of the study was to test benefits of the WorldSkills physical development technology competence training model in application to the quest-game-driven physical fitness / physical development service for second-year elementary schoolchildren.

Methods and structure of the study. The valid academic physical education bachelor training curriculum allocates many hours for physical education training practices in general education school system, with such practices scheduled on an extracurricular basis at no detriment for the regular academic training. We sampled for the physical training model testing experiment the 2-3-year Russian State Social University students majoring in physical education discipline of the Pedagogical Education course. We complemented their trainings by the WorldSkills physical development technology competence mastering standards in close cooperation with our partner schools and university practical training management service, to effectively train them for the elementary school physical education service. Progress of the student sample was tested in practical physical education classes at elementary school. The second-year elementary school sample was subject to the pre- versus post-experimental physical fitness tests [1, 2, 4]. The student sample was split up into Experimental and Reference Groups (EG, RG) to practice physical education service at elementary school A, B, C, D, D and E classes. The RG trained the school sample as required by the traditional physical education program; and EG training was complemented by the WorldSkills physical development technology competence training model.

The school physical education classes included B module run once a week. This module offers a physical education quest game geared to facilitate physical progress by the prudently selected and managed modern sporting quest game tools customized for the ages and physical fitness standards, with a special priority to interdisciplinary connections with Literary Reading, Mathematics and the World around us [3]. The physical education service was designed based on the script and pre-experimental physical fitness / physical development test data. The physical education classes were found very interesting and entertaining by the school sample. The experiment was finalized by the post-experimental physical fitness tests from Module A of the WorldSkills physical development technology competence including:

- Strength rating prone push-ups and 1-min sit-ups tests;
- Speed-strength rating standing long jump tests;
- Flexibility rating front lean on a gymnastics bench test; and
- Speed and movement coordination rating 3x10m shuttle sprint tests.

Results and discussion. The pre-experimental strength rating push-ups tests found no meaningful intergroup differences, with the reps averaging 8 in the EG and RG. The post-experimental tests found progress in the RG and EG to 10 and 12 push-ups, i.e. 25% versus 50% respectively. The second strength rating pre-experimental 1-min sit-ups test found no significant intergroup differences, with the reps averaging 26 and 27 in the RG and EG, respectively. The post-experimental tests found progress in the RG and EG to 29 and 35 reps, i.e. 12% versus 30%, respectively.

The pre-experimental speed-strength rating standing long jump tests found no significant intergroup differences, with the results averaging 133.5 cm and 132 cm in the RG and EG, respectively. The post-experimental tests found progress in the RG and EG to 137 cm and 140 cm, i.e. 3% versus 6%, respectively.

The pre-experimental flexibility rating front lean on a gymnastics bench test found insignificant intergroup differences, with the results averaging 1.5 cm and 2.5 cm in the RG and EG, respectively. The post-experimental tests found progress in the RG and EG to 5.5 cm and 11 cm, i.e. 260% versus 340%, respectively.

And the pre-experimental speed and movement coordination rating 3x10m shuttle sprint tests found insignificant intergroup differences, with the results

averaging 11.3 s and 11.5 s in the RG and EG, respectively. The post-experimental tests found progress in the RG and EG to 10.5 s and 9.4 s, i.e. 14% versus 44%, respectively. It should be emphasized that the EG trainings in the quest game format were rather emotional and entertaining for the school sample.

Conclusion. The elementary school physical education model dominated by the sporting quest game format was found beneficial as verified by the significant progress of the EG versus RG in the pre- versus post-experimental strength, speed-strength flexibility, speed and movement coordination tests. The academic WorldSkills physical development technology competence training was found beneficial for the vocational training standards with special benefits for the physical development technologies mastering domain. Future physical education teachers, coaches and instructors are strongly recommended joining the WorldSkills Championships that provide high motivations and impetuses for the physical education service to facilitate physical fitness / physical development progress of the school trainees.

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Body conditioning to build speed endurance in female students

UDC 796.011

O.A. Safonova[1]
PhD, Professor **K.N. Dementyev**[1]
[1]Saint Petersburg State University of Architecture and Civil Engineering, Saint Petersburg

Corresponding author: safonov812@yandex.ru

Abstract
Objective of the study was to experimentally prove the effectiveness of the program of physical training with the use of the speed-strength exercises in application to the female architecture and civil engineering students engaged in track and field athletics.
Methods and structure of the study. The educational experiment lasted from September through December 2020. Subject to the experiment were the female architecture and civil engineering students engaged in the track and field athletics specializing in the 100-1500 m races and having mass categories.
The training sessions were conducted according to the developed program of complex orientation, which was based on the series of speed-strength exercises. The program included cyclic and acyclic exercises that combined static and dynamic workloads, with the predominance of the latter. An interval method was applied in developing the training program: 20 sec for exercises, 10 sec for rest in-between the exercises. A total of 4 exercise blocks were compiled.
Results and conclusions. The new speed-strength endurance training model was tested beneficial as verified by the progress of the sample in the competitive speed endurance and post-stress recovery tests. The speed-strength endurance training model and its elementary practice modules may be recommended for application in the academic physical education curricula, conditional on the individual progress tested by at least the most accessible functionality/ physical fitness tests including the Ruffier test and 6-point functionality test.

Keywords: *sports, physical load (PL), physical working capacity, speed-strength endurance (SSE), progress tests, physical fitness (PF), functionality, track sports*

Background. Improvements in functions of the muscular energy generation mechanisms secured by the ontogenesis-customized athletic training toolkits normally come in a complex non-linear manner. They are associated with cardinal changes in structure and functionality of the muscle fibers; significant transformations in the enzyme systems and vegetative systems responsible for the oxygen/ substrates supply and performance of regulatory centers. Such healthy transformations heavily contribute to the physical performance efficiency and reliability [1]. Progress in special physical working capacity may be achieved by prudently selected sets of exercises sensitive to the individual physiological effects of every training tool. Persistent trainings may facilitate progress in the bodily systems as verified by the special physical working capacity, physical fitness and functionality tests. Research communities need to mobilize untapped resources in this domain by analyzing benefits of new combined training systems, models and tools, with every individual effect in the training process tested to have the training system customized to the relevant individual functions and progresses. This is at least one of the reasons why the modern sports need accurate, customizable and adequate physical working capacity test tools and systems [2-4].

Objective of the study was to experimentally test benefits of the speed-strength endurance training model for women's track sports groups at engineering university.

Methods and structure of the study. Physical working capacity is commonly defined as the individual performance within some timeframe and physical efficiency range rated by a set of criteria indicative of the individual responses to specific workloads and the relevant physiological costs. We sampled for the new speed-strength endurance training model testing experiment (run in September through December 2020) Class I-III women track athletes specializing in the 100m-1500m running events at Saint Petersburg State University of Architecture and Civil Engineering. Prior to the experiment, the sample was examined by a medical commission and attributed to the main health group and normotonic constitution.

The speed-strength endurance training model was designed to combine cyclic/ acyclic/ static/ dynamic exercises with prevalence of the latter in an interval training system with every 20s exercise followed by a 10s rest break. The system included four training modules of four different exercises each, with two repetitions of every exercise; and with 2-min rest breaks after every module. Every such training session took 20 minutes; with the modules alternated on a weekly basis as follows:

• Module 1 (20+ cycles): jumping rope; prone rock climber drill; squat to high jump; and high-hip standing run;

• Module 2 (20+ cycles): jumping onto 40cm bench; standing split jump alternating drill; standing knees-to-chest jumps; run with hands on the wall;

• Module 3: squat to prone rest to squat to high jump drill: 7+ reps; prone push-ups: 10+ reps; 40cm bench crossing jumps: 10+ reps; 5m shuttle alternated run: 5+ reps; and

• Module 4: 3-5kg fitball chest-to-the-wall throws; standing high jumps with a fitball: 10+ reps; prone to squat to high jump to squat with the fitball drill: 7+ reps; and prone run with a fitball.

The sample was tested by the Deshin-Kotov Functionality Test to rate the cardiovascular system adaptability to the speed-strength endurance trainings by the following procedure: pre-stress (resting) heart rate and blood pressure test; followed by a 2-min high-hip standing run (with the hip parallel to the floor in the top point) rated at 180 steps per minute; and the post-stress 3-min sitting heart rate / blood pressure tests.

Results and discussion. Individual progresses in the sample were rated by the pre- versus post-experimental tests. The pre-experimental functionality tests found the following: pre-stress heart rate and blood pressure test rates averaged 66.2±3.1 beats per min (bpm) and 122.5±2.9/ 72.9±7.2 mmHg, respectively. The post-stress test rates varied as follows: minute 1: 123.1±12 bpm and 150±24.6/ 92±17.6 mmHg; minute 2: 106±14 bpm and 131.6±9.9/ 86±7.4 mmHg; and minute 3: 101.8±13.3 bpm and 135.9±16/ 81±10 mmHg, respectively. These test rates may be interpreted as indicative of the good post-stress recovery capacity in the sample, with the total recovery time tested to average 3 to 6min: see Table 1.

The post-experimental functionality tests found the following: the pre-stress heart rate and blood pressure test rates averaged 73.7±4.5 bpm and 118±9.8/

Table 1. *Pre-experimental heart rate/ blood pressure test data: Deshin-Kotov Functionality Test*

Athlete	Results								Heart rate/ blood pressure recovery time
	Pre-stress		Post-stress						
	Heart rate	Blood pressure	Heart rate			Blood pressure			
			Min 1	Min 2	Min 3	Min 1	Min 2	Min 3	
1	65	118/71	121	111	104	183/116	140/99	148/103	5
2	68	125/73	123	80	79	165/101	131/87	123/87	4
3	70	121/72	128	109	100	196/127	149/86	140/86	3
4	68	120/70	123	109	105	121/77	120/80	122/74	4
5	70	110/72	123	108	100	151/70	129/93	163/70	6
6	64	125/78	124	117	117	128/74	135/72	117/67	4
7	59	121/74	104	89	94	134/81	116/83	110/74	3
8	67	123/80	105	90	86	129/85	125/81	123/77	3
9	66	125/73	131	128	123	150/98	140/94	137/87	4
10	65	120/70	149	121	110	145/90	131/84	130/85	6

Table 2. *Post-experimental heart rate / blood pressure test data: Deshin-Kotov Functionality Test*

Athlete	Results								Heart rate/ blood pressure recovery time
	Pre-stress		Post-stress						
	Heart rate	Blood pressure	Heart rate			Blood pressure			
			Min 1	Min 2	Min 3	Min 1	Min 2	Min 3	
1	72	127/71	114	79	75	169/96	143/86	128/88	4
2	70	120/70	120	78	72	129/110	121/106	118/84	4
3	75	130/71	104	95	71	137/84	127/76	126/71	3
4	75	124/70	135	83	75	142/84	131/71	127/70	3
5	83	92/62	110	100	83	126/80	120/80	120/70	3
6	69	114/76	84	75	69	150/76	128/74	124/72	3
7	74	121/83	110	110	74	164/83	155/74	145/76	3
8	67	120/70	111	90	87	156/80	125/76	116/74	3
9	79	117/68	87	83	79	135/86	118/65	114/63	3
10	73	117/66	111	91	83	120/76	118/74	117/70	3

We averaged and visualized the above functionality test data for analysis: see the Figure hereunder.

70±5.3 mmHg, respectively. The post-stress test rates varied as follows: minute 1: 108±14.5 bpm and 142±15.6/ 85±9.8 mmHg; minute 2: 80±26.7 bpm and 125±46.7/ 71±24 mmHg; and minute 3: 76.8±5.6 bpm and 112±35/ 67±21 mmHg, respectively. The post-experimental total recovery time averaged 3-4min versus 3-6min in the pre-experimental test. The post-stress heart rate test rates were found to grow by 4% to 37% - that is indicative of the functional progress. The leading athletes were tested with the lower heart rate / blood pressure variation ranges and 3min recovery times: see Table 2.

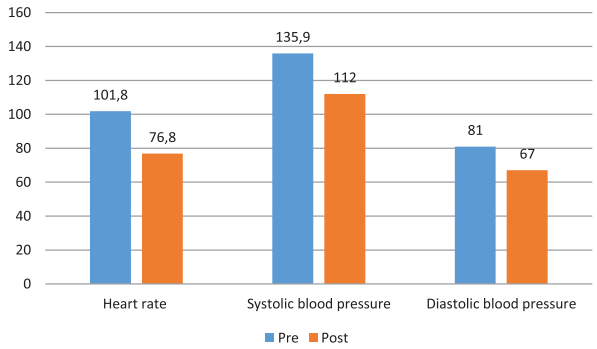

Figure 1. *Pre- versus post-experimental heart rate/ blood pressure post-stress (minute 3) test rates*

Benefits of the speed-strength endurance training model for the sample were additionally verified by the 2019/ 2020 competitive success data of the sample: see Table 3.

Conclusion. The new speed-strength endurance training model was tested beneficial as verified by the progress of the sample in the competitive speed endurance and post-stress recovery tests. The speed-strength endurance training model and its elementary practice modules may be recommended for application in the academic physical education curricula, conditional on the individual progress tested by at least the most accessible functionality/ physical fitness tests including the Ruffier test and 6-point functionality test.

Table 3. *2019/ 2020 competitive progress of the sample in the track events, s*

Athlete	Event	2019	2020	Progress
1	60m	9,4	8,7	0,7
2	100m	14,1	13,4	0,7
3	200m	32,0	31,1	0,9
4	400m	68,1	64,3	3,8
5	800m	152,4	148	4,4
6	1500m	325,0	315,0	10,0

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Independent physical training models for architecture and civil engineering university: design logics

UDC 796.01

PhD, Professor **K.N. Dementyev**[1]
[1]Saint Petersburg State University of Architecture and Civil Engineering, Saint Petersburg

Corresponding author: dementevkn2013@yandex.ru

Abstract
Objective of the study was to theoretically generalize the specific features of the content-related and operational components of independent physical education activity of architecture and civil engineering students.
Methods and structure of the study. The peculiarities of organization of independent physical education activity of the future engineering students were determined based on the professiograms of the major specialties characterizing the specifics of work activities.
Results and conclusions. Given the meaningful role of independent physical training in the formation and improvement of the professionally important motor abilities, the authors divide independent trainings into special training sessions under individual physical training programs of professional-applied orientation; independent physical training in the vocation-related sports discipline; amateur and professional trainings aimed at improving professionally important qualities.
A key aspect of effective independent physical training of students may be the development of the author's methods that ensure the formation of personal professional physical culture of students taking into account the level of their motor activity and motivation.

Keywords: *independent physical training, professional competency, professionally important motor abilities, professionally important psychophysiological qualities.*

Background. Independent service models generally include the following components: individual service motivations with the relevant progress goals; design and operations to develop the relevant knowledgebase and skills using the relevant training methods; willpower to attain the goals; and responsibility for the progress and results. National educational system gives a growing priority to the independent physical training models to develop the service-specific motor skills based on the relevant knowledgebase and independent physical training design skills/ competences need to be mastered by students. An independent physical training system will be designed to secure the professional service fitness with the relevant progress missions and goals and independent physical training methods and tools.

It is traditional to classify the physical education service goals into the physical health improvement, educational and cultural ones. A special emphasis in the traditional physical education service curriculum made on the health improvement and practical physical exercising aspects, whilst the service-specific provisions for the physical education models are virtually never addressed separately. It holds true, above all, for the academic independent physical training models [1].

Objective of the study was to theoretically analyze the independent physical training system design and operations logics for an architecture and civil engineering university.

Methods and structure of the study. Provisions for academic independent physical training models complementary to the regular academic physical education and sports curriculum may be basically grouped as follows:

- training sessions as a matter of special priority;
- independent physical training design with a special attention to the interdisciplinary links of the physical education and sports service with the other academic disciplines; and
- Health aspects of the independent physical training models.

It should be mentioned that the independent physical training modeling process will secure harmonic transition from the purely physical fitness goals with the gradual progress in service-specific motor skills and physical qualities to habitual healthy lifestyle formation with improvements in the individual adaptabilities to the academic education standards and requirements. The independent physical training models for future engineers need to be designed with a special consideration for the service standards and requirements ('profession-graphs') of the key specialties, on the following design principles:

- independent physical training model customization principle for the trainings being timely optimized as required by the service missions and goals;
- independent physical training consistency principle, with the physical and mental workloads being stepped up in a controlled manner to harmonize the specific loads on individual bodily systems, organs and muscle groups critical for the service; and
- harmonious development principle in application to the key motor systems.

An engineering service quality and efficiency largely depends on the individual service fitness i.e. working capacity, rehabilitation qualities, stress tolerance, etc. Many service standards and requirements are common for different engineering specialties, albeit every specialty has its own service fitness requirements and standards; with an engineer expected to make progress in the service-specific mental and physiological functions and physical qualities critical for performance – within the frame of the objective service factors.

Thus foremen and process engineers need to develop the relevant service-specific mental and physiological functionalities including: high mental stress tolerance with the relevant geo-climatic and vestibular stress tolerance aspects; excellent memorizing skills classifiable into the verbal, visual, auditory ones; eye control with the direct and peripheral vision control elements; good auditory, visual-motor and tactile responses within the service-specific physical qualities including the general and dynamic endurance, strength, response speed, dexterity, movement coordination, postural controls etc.

Design engineers, economy engineers and process engineers are expected to develop excellent nervous stress tolerance, attention controls, auditory-motor and visual-motor responses, perfect memorizing skills with the visual/ verbal data memorizing elements; eye controls; general and static endurance; static strength; fine hand/ wrist movement coordination; and other service-specific skills.

Operational engineers need to develop high nervous stress tolerance; attention control; perfect memorizing skills with the visual/ verbal data memorizing elements; excellent visual field control; good general and static endurance; high static strength, response speed; fine hand/ wrist movement coordination; and other service-specific skills. And operations managers and executives are expected to develop excellent nervous stress tolerance; attention controls; perfect memorizing skills with visual/ verbal data memorizing elements; good general and static endurance, and response speed.

Results and discussion. Analyses of the regular academic physical education and sports design generally emphasize the health-improvement and cultural elements of the service [2, 3]. However, knowing the modern specialist service fitness standards and requirements, we have every reason to believe that the academic physical education and sports service should be efficiently customized and complemented by the relevant application service fitness models to facilitate the service-specific physical education so as to develop the service-specific mental qualities and physiological functions for success of the engineering service. The service-specific physical education service goals will be attained using versatile special independent physical training models and tools designed and managed with consideration for the future service standards and requirements, with the service-specific physical progress tests. Basically, the modern independent

physical training theory and practices are relatively well developed, and the independent physical training models are successfully implemented in the academic education process.

However, the individual physical progress agendas need to be put on a theoretically sound design and management basis since the independent physical training system benefits largely depend on the system design and management quality. A key objective of an independent physical training system is to control the individual service-specific physical fitness to meet the service standards and requirements; with the individual physical progress agendas focused on the service-specific mental qualities and physical fitness goals. The specific self-perfection goals may include: versatile service-specific physical fitness secured by the individual independent physical training model complementary to the regular academic physical education and sports curriculum; health protection and improvement; occupational disease prevention and control; high physical and mental performance goals; and high and stable motivations for physical trainings.

Conclusion. In the context of the growing contribution of the modern independent physical training systems in the service-specific motor skills and qualities formation process, we would recommend classify the independent physical training models and tools into:

• Special individual physical training programs with the service-specific application training elements;

• Academic sports to facilitate the service-specific skills training; and

• Amateur sports and professional service centered sporting practices for progress in the service-specific skills and qualities.

For success of the academic independent physical training models, they need to be designed on a sound theoretical and practical research basis to facilitate individual physical fitness agendas focused on the actual service-specific motor activity and driven by high physical fitness motivations.

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Motor action accuracy training technology for schoolchildren with minor mental retardation

UDC 796/799

PhD, Associate Professor **D.M. Pravdov**[1]
Dr. Hab., Professor **M.A. Pravdov**[1]
PhD, Associate Professor **A.V. Kornev**[1]
PhD, Associate Professor **Y.B. Nikiforov**[2]
[1]Russian State Social University, Moscow
[2]Armavir State Pedagogical University, Armavir

Corresponding author: pravdov@mail.ru

Abstract
Objective of the study was to develop and test benefits of a new motor action accuracy training model for the 12-13 year-old minor-mental-retardation-diagnosed children, with a set of exercise balls varied in weights and sizes and postural control tools.
Methods and structure of the study. We sampled the 12-13 year-old minor-mental-retardation-diagnosed children (n= 42) from a correctional boarding school in Shuya (Ivanovo Oblast) for a 5-month motor action accuracy training model testing experiment. The Experimental Group was training was complemented by the motor action accuracy advancement model using a set of exercise balls varied in weights and sizes with a special postural control toolkit geared to help improve the motor controls by exercises with spatial control requirements and limitations including fixations of limbs and other parts of the musculoskeletal system. The ball throwing exercises were grouped basically by the ball sizes and weights into five groups: see Table 1. The ball surfaces and elasticity (leather, plastic, rubber, pimpled etc.) were also different to excel the tactile sensations.
Conclusion. The new motor action accuracy training model for the minor-mental-retardation-diagnosed 12-13 year-old schoolchildren was tested beneficial as verified by the Experimental Group making significant progress versus Reference Group in the motor control and balls throw on target tests. Thus the post-experimental target hitting accuracy tests with the 3/ 5/ 7m far targets yielded 89%/ 76%/ 74% accuracy rates for the Experimental Group, respectively, that were significantly higher than in the Reference Group.

Keywords: *motor action accuracy, ball throws on target, exercise balls varied in weights and sizes, muscular control, schoolchildren with minor mental retardation.*

Background. Modern adaptive physical education theory and practice gives a high priority to the motor action accuracy training in schoolchildren with minor mental retardation [1-3]. The relevant correctional education institutions for the minor-mental-retardation-diagnosed children report that team sports elements are of special difficulties for the trainees due to the poor motor action accuracy and muscular control. Our analysis of the study reports on the subject showed that the adaptive sports theory and practice are still underdeveloped in the muscular control training technologies on the whole and throwing techniques improvement technologies in particular in application to the minor-mental-retardation-diagnosed schoolchildren [5, 7].

Benefits analyses of the basketball ball throwing on target and other team sports technologies for the minor-mental-retardation-diagnosed schoolchildren have demonstrated the typical motor errors due to inefficiencies of the individual movement spacing and pacing control mechanisms i.e. muscular control [5, 7], with these motor disorders traditionally ranked

among the minor mental retardations symptoms. Some analysts of the adaptive sports technologies and their special technical and physical training tools for the minor-mental-retardation-diagnosed trainees have proved benefits of a few motor action accuracy training methods to improve the situational responses in the health group [1, 4]. Therefore, we believe that focused studies to develop motor action accuracy by versatile tools including exercise ball throwing techniques may be beneficial for motor progress of the minor-mental-retardation-diagnosed underage trainees.

Objective of the study was to develop and test benefits of a new motor action accuracy training model for the 12-13 year-old minor-mental-retardation-diagnosed children, with a set of exercise balls varied in weights and sizes and postural control tools.

Methods and structure of the study. We sampled the 12-13 year-old minor-mental-retardation-diagnosed children (n= 42) from a correctional boarding school in Shuya (Ivanovo Oblast) for a 5-month motor action accuracy training model testing experiment. The EG was training was complemented with the motor action accuracy advancement model using a set of exercise balls varied in weights and sizes with a special postural control toolkit geared to help improve the motor control by exercises with spatial control requirements and limitations including fixations of limbs and other parts of the musculoskeletal system. The ball throwing exercises were grouped basically by the ball sizes and weights into five groups: see Table 1. The ball surfaces and elasticity (leather, plastic, rubber, pimpled etc.) were also different to excel the tactile sensations.

The exercise balls throws were varied in spatial aspects to include right/ left/ front/ back ones; on large and small targets from 1-2m distances. The ball sizes, weights and throw distances were customized to the individual motor action accuracy progress and finalized, when the motor action accuracy training goal was attained, by standard (basketball, volleyball, tennis) balls throwing practices and tests.

Furthermore, with the individual motor action accuracy progress we increased the exercise balls throw distances to maximums, with the throws made by the lead/ non-lead/ both hands and with open/ closed eyes, with the latter practices taking up to 65% and 35% of the total training time, respectively. First, we used the standard ball long throws to find the individual maximums and mark the , and points within the maximal range. We marked the volleyball and basketball courts with the latter individual marks plus the 3/ 6/ 9/ 18m marks and 1-3m height marks. The ball throws were made on the marks-fixed targets, with every subject making 5-7 throws with 20-35 repetitions. The distances and heights were increased in a stepped manner by 1m and 3-18m, respectively. With the individual motor action accuracy progress, the variation step was reduced from 1m to 50cm (with the minimal step of 10cm). The repetitions were increased from 15-20 to 30-40 per session at the warm-up and core training stages finalized by the standard (volleyball, basketball and tennis) balls throwing practices.

The 60-min group trainings were run twice a week, with the new motor action accuracy training model averaging 40% of the total training time per year. Initially the motor action accuracy trainings took 25% of the training time followed by 36% in the advanced and 39% at the excellence stages, respectively. The individual motor action accuracy progress was tested by a special test set including 10 eyes-closed and 10 eyes-open throws on horizontal 3/ 5/ 7m far and 1m high target (30cm ring).

Results and discussion. The new motor action accuracy training model for the minor-mental-retardation-diagnosed children was tested beneficial as verified by the EG progress of 2.3/ 2.2/ 2.13 times in the 3/ 5/ 7m far target hitting accuracy tests, respectively. The RG progress in the motor action accuracy tests was less expressed and significantly lower than in the

Table 1. *Customized exercise balls throwing tools to excel the motor action accuracy in the minor-mental-retardation-diagnosed sample*

Exercise balls throwing options			Exercise balls size, cm	Exercise balls weight, g	Reps per training session, %
Left/ right/ both hand throws	Vertical target on different distances	Sitting/ standing, prone, recumbent throws with closed/ open eyes	50-70	150-300	10-15
			5-10	300-400	25-30
			5-10	50-100	30-40
			20-30	400-500	20-25
			27	275	15-20

Table 2. *Pre- versus post-experimental target hitting accuracy test data in the exercise balls throwing tests of the minor-mental-retardation-diagnosed sample (10 attempts per test)*

Exercise balls throw versions		RG		EG	
		Pre-exp.	Post-exp.	Pre-exp.	Post-exp.
3m far target	Eyes open	3,9±1,2	4,3±1,1	3,8±1,2	8,9±1,3
	Eyes closed	0,5±0,8	1,1±0,9	0,6±0,9	3,7±1,1
5m far target	Eyes open	3,6±1,1	3,9±1,2	3,5±1,2	7,6±1,2
	Eyes closed	-	0,3±0,9	-	3,1±1,1
7m far target	Eyes open	3,1±0,7	4,2±1,2	3,2±1,1	7,4±1,3
	Eyes closed	-	0,2±0,7	-	2,3±1,1

EG ($p<0.05$). The varied-size-and-weight exercise balls throwing practices facilitated progress of the EG in the muscular control and spatial control domains. The post-experimental eyes-closed target hitting accuracy was tested to grow significantly to 37%/ 31%/ 23% for the 3/ 5/ 7m far targets, respectively; versus the RG test rates that were significantly ($p <0.05$) lower: see Table 2.

Practical competitive accomplishments of the EG in the post-experimental period in the basketball, pioneer-ball and outdoor 'hunters and ducks' matches once again proved progress of the EG versus RG in the motor action accuracy, as the EG won every match.

Conclusion. The new motor action accuracy training model for the minor-mental-retardation-diagnosed 12-13 years old schoolchildren was tested beneficial as verified by the EG making significant progress versus RG in the motor control and balls throw on target tests. Thus the post-experimental target hitting accuracy tests with the 3/ 5/ 7m far targets yielded 89%/ 76%/ 74% accuracy rates for the EG, respectively, that were significantly higher than in the RG.

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Ground skills mastering model for deaf sambo trainees

UDC 796.814

A.V. Zhalilov[1]
Dr. Hab., Associate Professor **A.S. Makhov**[1]
PhD, Associate Professor **D.M. Pravdov**[1]
[1]Russian State Social University, Moscow

Corresponding author: alexm-77@list.ru

Abstract
Objective of the study was to analyze the existing deaf sambo training systems to design and test benefits of the new deaf sambo ground skills training model.
Methods and structure of the study. We have analyzed, for the purposes of the study, the relevant theoretical and practical materials and practical coaching experiences accumulated at Ivanovo Correctional Boarding School No. 1 for deaf adolescents; and designed and tested on this basis a new accessible and effective ground skills training model for deaf sambo.
Results and conclusion. The ground skills training model offered a few standard few repositioning options with the submission attempt stopped and the defending athlete taking a standing position as provided by the rules of competitions. The ground skills trainings of defenses from takedowns and turnovers gave a special priority to counter-grappling skills, releases from holds with repositioning skills to seize the initiative. Of special interest for such trainings were the practical competitive situations when the defenders were successful in countering the grappling attempts to immediately start a counterattack.
The ground wrestling skills training model for deaf sambo trainees was found beneficial conditional on the coach using in the attack/ defense skills mastering service a wide variety of specific training methods and sing language with clear explanations, demonstrations and illustrations. Such deaf ground skills training methods need to be driven by specific communication toolkit including explanations, clarifications in the sign language with expressed articulation, special sport-specific and new conventional signs for success of the coach-trainee communication and, hence, the training/ competitive progress.

Keywords: *ground skills, deaf sambo wrestlers, training methods, training process.*

Background. For the last few decades, sambo has been widely recognized the world over as demonstrated by the growing numbers of highly competitive world tournaments hosted by Russia and other countries, with the sport discipline increasingly respected by the global mixed martial arts community. The competitive events on the sports arenas lure growing populations of the sambo fans, amateurs and professionals [1, 5, 6]. It should be emphasized in this context that deaf sambo is still in need of a sound diagnoses-respecting theoretical and practical framework for progress. The deaf sambo coaching community has to heavily rely on its own practical experiences serving the healthy athletes in application to the deaf/ hearing-impaired ones [2-4].

Objective of the study was to analyze the existing deaf sambo training systems to design and test benefits of a new deaf sambo ground skills training model.

Methods and structure of the study. We have analyzed, for the purposes of the study, the relevant theoretical and practical materials and practical coaching experiences accumulated by the Ivanovo

Correctional Boarding School No. 1 for deaf adolescents; and designed and tested on this basis a new accessible and effective ground skills training model for deaf sambo.

Results and discussion. We grouped the deaf training methods into two main groups to design the theoretical and practical training model on a systemic basis: see Table 1.

As demonstrated by the above Table, the training model is dominated by specific methods to facilitate understanding of the coach's explanations and commands in practical ground practices on the mat. The deaf trainings are always specific, since the trainers have to struggle with the communication barrier by a variety of special tools – versatile enough to effectively consult, guide and control the deaf athletes.

Every motor skill mastering element in the new model was introduced by a high-quality demonstrative trainers' execution with normally three-four repetitions to form a holistic picture from different viewpoints. Explanations of the learning material were preceded by light/ noise signals to attract attention using lights in the gym or stamping/ clapping, with the explanations facilitated by the sign language when necessary plus special conventional signs (quickly, strongly, clearly, carefully etc.) with clear articulation of every word. The practical demonstrative executions were explained using illustrations: diagrams, sketches, elementary drawings, with the key technical points highlighted and detailed. The practical skill mastering trainings were run in couples with close weight classes and skill levels.

The ground skills mastering trainings were started from the grappling, holding and submission techniques. At first the groups mastered the key sambo holds including side/ cross/ reverse holds and mounts on a non-resisting partner. With progress in the elementary ground holds, the practices were complemented with the easiest holding attempts, with one athlete in mount and the other resisting in a lukewarm manner. Alternatively, both fighters would start from the same position (backs to back, prone or on all fours) and fight for control on the coach's command (clapping, stamping, light signal) trying to hold the opponent. Every success in the holds was signaled by the coach's sign to save time on explanations when possible.

Going second in the ground skills mastering trainings were the submission techniques training elements using every tool in the communication toolkit (demonstrations, light/ noise signals, sign language, illustrations), with a special emphasis on the execution safety to avoid any injuries. The trainees were instructed in the sign language to (a) avoid rushes, make sure the execution is as smooth as possible; (b) free the attacked limb as soon as the opponent taps-out on the floor or attacker; (c) stop as soon as the coach commands. The submission holds mastering was facilitated by the sambo-specific sign language and special conventional new signs. A special priority in the submission holds set was given to the elbow/ shoulder/ Achilles tendon twists. With progress in the submission basics mastering process, the athletes were allowed to wrestle in standard elementary positions – with one athlete having a positional advantage on a limb hold to make a submission attempt, and the other partially resisting.

Later on the trainees mastered more sophisticated offensive techniques including takedowns and turnovers – viewed as secondary skills as they are never scored in real competitions albeit give a positional advantage for a scoring hold or submission. The turnovers mastering elements gave a special priority to the firm grips and mobilized muscles to facilitate turnovers and holding the opponent on the ground. First of all every takedown skill was mastered on a non-resisting opponent. When the execution sequence was explained in a sign language, a special emphasis was made on the final position as the core goal of any attack and initiative winning attempt in the fight.

With progress in the offensive skills, subject to special ground skills trainings were defenses from

Table 1. *Deaf sambo training methods*

Group 1: visual methods	Group 2: specific methods
Practical demonstration	Sign language toolkit
Illustrations: schemes, drawings, process charts	Clear articulation to simplify lip reading and understanding of the training material and commands
	Sambo-specific sign language with specific conventional new signs for the deaf athletes
	Light/ noise signals in the gyms, plus floor clapping/ stamping

grappling, holds, submissions, takedowns and turnovers. Every skill mastering practice was started from the coach's demonstration with illustrations using sketches and drawings, and with every move articulated in the sign language for clarity. A special attention in the counter-grappling skills trainings was given to the firm grips and the key muscle groups mobilized in the movements. Initially every skill was trained on a partially resisting partner, with a high focus on safety in the counter-submission skills, with every athlete strongly instructed to tap-out immediately in danger, plus trained to effectively release the attacked limb.

The ground skills training model offered a few standard few repositioning options with the submission attempt stopped and the defending athlete taking a standing position as provided by the rules of competitions. The ground skills trainings of defenses from takedowns and turnovers gave a special priority to counter-grappling skills, release from holds with repositioning skills to seize the initiative. Of special interest for such trainings were the practical competitive situations when the defenders were successful in countering the grappling attempts to immediately start a counterattack.

Conclusion. The ground wrestling skills training model for deaf sambo trainees was found beneficial conditional on the coach using in the attack/ defense skills mastering service a wide variety of specific training methods and sing language with clear explanations, demonstrations and illustrations. Such deaf ground skills training methods need to be driven by specific communication toolkit including explanations, clarifications in the sign language with expressed articulation, special sport-specific and new conventional signs for success of the coach-trainee communication and, hence, the training/ competitive progress.

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Children with digestive system dysfunctions: mental and physical health tests and analysis

UDC 796.012.2

PhD, Associate Professor **I.N. Bakay**[1]
PhD, Associate Professor **N.P. Konstantinova**[1]
PhD, Associate Professor **V.P. Kartashev**[1]
PhD, Associate Professor **N.V. Karpova**[1]
[1]Russian State Social University, Moscow

Corresponding author: irinasyazina@mail.ru

Abstract
Objective of the study was to test and analyze mental and physical health of the 5-6 year-olds diagnosed with digestive system dysfunctions.
Methods and structure of the study. We run the study at Combined Preschool Establishment No. 809, Rehabilitative Preschool Establishment No. 2185, Preschool Establishment No. 1678 in the Central and North-Eastern Administrative Districts of Moscow.
We sampled the 5-6 year-old children (n=99) on written parental consents for the study based on their 99 dispensary observation files. The sample was randomly split up into EG1, EG2 and RG. The RG was composed of healthy children (n=48, including 22 girls and 26 boys); EG1 of digestive-system-dysfunction-diagnosed individuals (n=27, including 13 girls and 14 boys); and EG2 of digestive-system-dysfunction-diagnosed individuals (n=24, including 13 girls and 11 boys), with the digestive system dysfunctions dominated by bybiliary dyskinesia of mixed type at remission stage as reported by the local pediatricians. Dynamic observation service under the study was provided by staff pediatricians from Preschool Establishments 809, No. 2185 and No. 1678.
The digestive system dysfunction group progresses were tested by the relevant biomedical methods including anthropometric tests (to rate body mass, height, and vital capacity); health rating Kettle, Skibinski and Ruffier tests; and mental health rating Nonexistent Animal Drawing test. The test set was selected based on recommendations for Preschool Establishments so as to rate every aspect of the mental and physical health.
Conclusion. The study tested the 5-6 year-old digestive-system-dysfunction-diagnosed EG1/2 children lower on the anthropometric characteristics, functionality and health test scales than their healthy RG peers – to demonstrate their urgent need for efficient health correction and improvement service. The digestive-system-dysfunction-diagnosed children were also tested with the poorer mental health rates, with 46 individuals tested with anxiety, 24 with depression, 16 with aggression and 9 with asthenia.

Keywords: *preschoolers, physical development, children's health, digestive system dysfunctions.*

Background. Recent national statistics have reported growth of the 3-7 year-old preschool population diagnosed with health disorders, with only 15% tested virtually healthy, 50% having different morphological/ functional issues and health disorders, and 42% diagnosed with chronic diseases, including digestive system dysfunctions [2, 3, 6].

The children's digestive system dysfunctions pathophysiology is still underexplored at this juncture, with progress of the diseases known to be spurred up by different factors including variations in the digestive system physiology and genetic, environmental and psychosocial factors [6]. Mental and physical health standards of the digestive-system-dysfunction-diagnosed 5-6 year-olds are known to lag behind that that of their basically healthy peers ranked with the main health group. Most of them are tested with mental health issues in need of special mental and physical

health correction programs that shall be well customized for the actual etiology and severity of every disease plus the individual physical development, mental health, age and durations of the diseases.

Objective of the study was to test and analyze mental and physical health of the 5-6 year-olds diagnosed with digestive system dysfunctions.

Methods and structure of the study. We run the study at Combined Preschool Establishment No. 809, Rehabilitative Preschool Establishment No. 2185, Preschool Establishment No. 1678 in the Central and North-Eastern Administrative Districts of Moscow.

We sampled the 5-6 years old children (n=99) on written parental consent for the study based on their 99 dispensary observation files. The sample was randomly split up into EG1, EG2 and RG. The RG was composed of healthy children (n=48, including 22 girls and 26 boys); EG1 of digestive-system-dysfunction-diagnosed individuals (n= 27, including 13 girls and 14 boys); and EG2 of digestive-system-dysfunction-diagnosed individuals (n=24, including 13 girls and 11 boys), with the digestive system dysfunctions dominated by bybiliary dyskinesia of mixed type in remission stage as reported by the local pediatricians. Dynamic observation service under the study was provided by staff pediatricians from Preschool Establishments 809, No. 2185 and No. 1678.

The digestive system dysfunction group progresses were tested by the relevant biomedical methods including anthropometric tests (to rate body mass, height, and vital capacity); health rating Kettle, Skibinski and Ruffier tests; and mental health rating Nonexistent Animal Drawing test [1, 2, 4, 5]. The test set was selected based on recommendations for Preschool Establishments so as to rate every aspect of the mental and physical health.

Results and discussion. We analyzed the available research data on the mental health test rates of the digestive-system-dysfunction-diagnosed and healthy children and health test data reported by different analysts for the 5-6 year-olds to select the most inclusive and relevant tests indicative of the physical development and vital systems functionalities; see Tables 1 and 2 hereunder.

The EG1/2 anthropometric characteristics were found different from the RG in the boys and girls groups ($p < 0.05$), with the EG1/2 body lengths and masses tested to average 4% and 10% lower than in the RG. The right carpal strength in the EG1 girls averaged 5.84+2.21kg versus 7.07+2.53kg in the RG peers ($p < 0.05$). The RG was also tested higher than EG1/2 on the vital capacity test scale ($p < 0.05$) that may be interpreted as indicative of the respiratory system dysfunctions in the digestive-system-dysfunction-diagnosed children.

Table 1. Anthropometric characteristics of the 5-6 year-old sample

Test rates	EG1 Xcp ±σ	EG2 Xcp ±σ	p	RG Xcp ±σ	p
Boys					
Body mass, kg	22,8+1,84	22,6+2,78	>0,05	26,3+3,47	<0,05* <0,05**
Body length, cm	118,6+ 2,46	119,2+2,43	>0,05	127,4+2,68	<0,05* <0,05**
Right carpal strength, kg	8,98+1,81	8,68+2,17	>0,05	9,9+1,33	>0,05* >0,05**
Left carpal strength, kg	7,21+1,51	7,08+1,64	>0,05	9,93+1,99	<0,05* <0,05**
Vital capacity, ml	1094+105	1113+97,3	>0,05	1236+95,1	<0,05* <0,05**
Girls					
Body mass, kg	21,6+1,49	22,3+3,9	>0,05	27,8+2,14	<0,05* <0,05**
Body length, cm	119,2+ 2,31	120,2+2,72	>0,05	125,3+2,79	<0,05* <0,05**
Right carpal strength, kg	5,84+2,21	6,03+2,11	>0,05	7,09+2,54	<0,05*
Left carpal strength, kg	4,53+1,73	4,80+1,61	>0,05	5,8+1,30	<0,05* <0,05**
Vital capacity, ml	1098+108	1102+93,3	p<0,05	1398+107	<0,05*

*Note: *EG2 versus RG difference significance rate; ** EG1 versus RG difference significance rate*

Table 2. *Health test rates of the sample*

Health test rates	EG1 Xcp ±σ	EG2 Xcp ±σ	p	RG Xcp ±σ	p
Boys					
Ruffier index, points	17,1±1,3	16,8+0,7	>0,05	10,1+0,7	<0,05* <0,05**
Skibinski index, points	178,3±25,7	184,7+34,8	>0,05	198,2+0,01	<0,05* <0,05**
Kettle index, kg/cm	17,1±0,01	17,0+0,02	>0,05	18,6+0,02	<0,05* <0,05**
Girls					
Ruffier index, points	15,6±1,2	16,2+1,3	>0,05	9,6+0,9	<0,05* <0,05**
Skibinski index, points	169,1±26,1	171,7+26,5	>0,05	189+0,17	<0,05* <0,05**
Kettle index, kg/ cm	17,0±0,03	17,1+0,02	>0,05	18,9+0,02	<0,05* <0,05**

*Note: *EG2 versus RG difference significance rate; ** EG1 versus RG difference significance rate*

The health tests ranked the EG1/2 lower than the RG on every test scale, with the highest gap found on the Ruffier test scale. Thus the boys and girls scored in the Ruffier scale the following results: in EG1 17.1±1.3 and 15.6±1.2 points; in EG2 16.8+0.7 and 16.2+1.3 points; versus 10.1+0.7 and 9.6+0.9 points in the RG, respectively. In the Skibinsky test, the EG1 and EG2 boys scored 178.3±25.7 and 184.7+34.8 points, respectively; and the EG1 and RG girls scored 169.1±26.1 and 198.2+0.01 points, respectively. In the Kettle test, boys and girls scored in EG1 17.1±0.02 and 17.0±0.03 kg/cm; in EG2 17.0+0.02 and 17.1+0.02 kg/ cm; versus their RG peers who scored 18.6+0.02 and 18.9+0.02 kg/cm, respectively. The lower health test rates in EG1/2 versus RG may be indicative of the poorer health standards and pathologies that suppress the digestive-system-dysfunction-diagnosed children's physical activity and physical stress tolerance.

Conclusion. The study tested the 5-6 year-old digestive-system-dysfunction-diagnosed EG1/2 children lower on the anthropometric characteristics, functionality and health test scales than their healthy RG peers – to demonstrate their urgent need for efficient health correction and improvement service. The digestive-system-dysfunction-diagnosed children were also tested with the poorer mental health rates, with 46 individuals tested with anxiety, 24 with depression, 16 with aggression and 9 with asthenia.

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Myostatin as "bodybuilding gene" (brief overview)

UDC 796.01:61

Dr.Hab., Associate Professor **M.O. Aksenov**[1, 2]
E.A. Krylasova[2]
PhD **I.I. Starkova**[2]
Postgraduate **A.O. Zaitseva**[2]
[1] Plekhanov Russian University of Economics, Moscow
[2] Banzarov Buryat State University, Ulan-Ude

Corresponding author: aksenov.mo@rea.ru

Abstract
Objective of the study was to analyze the latest scientific research to identify associations of the K153R polymorphism in the myostatin (MSTN) gene (rs1805086) with skeletal muscle hypertrophy and athletes' strength.
Methods and structure of the study. The research articles to be analyzed were searched in the databases of PubMed, WebofScience, eLIBRARY.ru, SNPedia, Wiley Online Library, and Europe PMC resource. The following keywords were used during the search: myostatin, MSTN, GDF-8, K153R, rs1805086. We compiled a list of publications about myostatin, including 81 scientific papers published in the above databases before February 2020. We used Clarivate Analytics's EndNote Viever X9.2 software to analyze and systematize the publications.
Results and conclusions. Subject to the study were 94 healthy untrained Chinese males aged 8-22 years. The study showed that the increase in the biceps girth =0.300±0.131 cm and quadriceps girth =0.421±0.281 cm ($p<0.01$ for both muscle groups) was significantly higher in the subjects carrying the KR genotype, rather than in those carrying the KK genotypes of the K153R polymorphism in MSTN. Therefore, the data obtained prove that this polymorphism may not only promote the increase of muscle size in the absence of trainings but is also associated with a more pronounced increase in the muscle mass of the subjects carrying the R allele (arginine) after strength trainings. Hence, screening of this polymorphism can be considered as a genetic marker of sports selection in weightlifting sports (Li et al., 2014).
It is only in the past 15 years that genetic polymorphisms controlling the skeletal muscle mass and function in athletes, and the mechanisms of their manifestation within the phenotype have begun to be clarified. It is not surprising that new mechanisms and associations of these genes continue to be discovered, and indeed, there has recently been considerable progress in this area. Besides, the discovery of genes that significantly improve the aptitude for sports, such as myostatin, will significantly enhance the quality of sports selection and orientation.

Keywords: *sports, training, systematic review, myostatin, skeletal muscles, gene, strength, athletic training, hypertrophy, MSTN, K153R, rs1805086.*

Background. Since its initial discovery in 1997 (McPherron et al., 1997), myostatin (encoded by the MSTN gene) has made a significant progress in the study of various genetic factors of strength development of athletes. The MSTN gene is located on the long arm (q) of chromosome 2 at position 32.2 (2q32.2); more than 260 polymorphisms have been described to date in its sequence; it occupies a region of about 8 kb, and has 3 exons (Rodriguez et al., 2014). It was found that mutations in the MSTN gene lead to a significant increase in muscle mass (Kollias and McDermott, 2008). MSTN is an important gene that affects myogenesis and plays a key role in the process of regulation of muscle tissue growth and differentiation (McFarlane et al., 2011). In particular, the genetic predisposition to muscle mass gain is due to

the decreased myostatin expression and is an advantage in the display of strength abilities in sports (Ferrell et al., 1999).

This gene was named myostatin for its ability to inhibit muscle tissue differentiation and growth (Yamada et al., 2012), while increased myostatin expression was associated with muscle atrophy (Dalbo et al., 2011). Together, these studies confirmed the central, decisive role of myostatin in muscle growth inhibition (Allen et al., 2011; Zheng et al., 2019).

Earlier studies showed that a number of missense mutations in exons 1 and 2 of the MSTN gene (A55T, K153R, E164K, P198A, and I225T) are of the main interest in confirming the association between athletes' strength and muscle hypertrophy (Thomis et al., 2004). Of particular interest is the K153R polymorphism in this gene (Garatachea et al., 2013; Gonzalez-Freire et al., 2010; Santiago et al., 2011).

Objective of the study was to analyze the latest scientific research to identify associations of the K153R polymorphism in the myostatin (MSTN) gene (rs1805086) with skeletal muscle hypertrophy and athletes' strength.

Methods and structure of the study. The research articles to be analyzed were searched in the databases of PubMed, WebofScience, eLIBRARY.ru, SNPedia, Wiley Online Library, and Europe PMC resource. The following keywords were used during the search: myostatin, MSTN, GDF-8, K153R, rs1805086. We compiled a list of publications about myostatin, including 81 scientific papers published in the above databases before February 2020. We used Clarivate Analytics's EndNote Viever X9.2 software to analyze and systematize the publications.

Results and discussion. Subject to the study were 94 healthy untrained Chinese males aged 8-22 years. The study showed that the increase in the biceps girth =0.300±0.131 cm and quadriceps girth =0.421±0.281 cm ($p<0.01$ for both muscle groups) was significantly higher in the subjects carrying the KR genotype, rather than in those carrying the KK genotypes of the K153R polymorphism in MSTN. Therefore, the data obtained prove that this polymorphism may not only promote the increase of muscle size in the absence of trainings but is also associated with a more pronounced increase in the muscle mass of the subjects carrying the R allele (arginine) after strength trainings. Hence, screening of this polymorphism can be considered as a genetic marker of sports selection in weightlifting sports (Li et al., 2014).

Santiago C., Ruiz J.R., Rodr guez-Romo G., et al. (2011) studied the associations between the K153R polymorphism in MSTN and explosive strength of the legs, and managed to prove that in untrained males, the K153R polymorphism in MSTN is associated with the ability to produce "peak" power during muscle contractions, as assessed in the vertical jump test. The authors reported that of the identified MSTN variations in humans, the Lys (K) 153Arg® polymorphism located in exon 2 (rs1805086, 2379 A>G replacement) is a candidate to affect skeletal muscle phenotypes. The Lys (K) 153Arg® amino acid replacement is found within the active mature peptide of the MSTN protein; it could theoretically influence proteolytic processing with its propeptide, or affinity to bind with the extracellular activin type II receptor (ActRIIB), which in turn induces myoblast proliferation and differentiation, as well as muscle mass.

According to the authors, the frequency of the mutant R allele was about 3-4% in the Chinese males, with the frequency of mutant homozygotes (RR) below 1%, which definitely prevents from studying large groups of people carrying the R variant, especially in sports.

The authors found that the existing data on MSTN K153R polymorphisms and human muscle phenotypes give contradictory results (Seibert et al., 2001). A number of studies indicated a significant effect of the MSTN variants and muscle mass response to strength trainings regardless of gender. The 153R allele was associated with a larger muscle hypertrophic response to training loads (Ivey et al., 2000).

Ivey F.M., Roth S.M., Ferrell R.E., et al. reported that the K153R genotype of MSTN tended to affect the hypertrophic reaction of the skeletal muscles of heterozygous females to strength trainings. The experiments proved that the increase in the leg muscle mass in response to strength trainings was 68% higher in the females carrying the KR genotype than in those carrying the KK genotype (P=0.056) (Ivey et al., 2000). These data indicate that the K153R rare allele plays an important role in the hypertrophic muscle response. The authors noted that more research is still needed on the Lys 153 Arg allele in the human myostatin gene in the muscle response to strength trainings, especially in females with large body mass.

Ferrell R.E. et al. did not found a single person with the RR genotype of MSTN among the Caucasians engaged in strength sports (Ferrell et al., 1999). However, the authors stated that the A55T and K153R

variants may affect the functions of the gene products and the distribution of nutrients in humans, both heterozygous and homozygous to the rare allele, which, in turn, can manifest itself in the phenotypic signs of the body associated with the increase in muscle mass in response to strength trainings. As in any other study, the authors pointed out the need for further study of this polymorphism.

Conclusion. It is only in the past 15 years that genetic polymorphisms controlling the skeletal muscle mass and function in athletes, and the mechanisms of their manifestation within the phenotype have begun to be clarified. It is not surprising that new mechanisms and associations of these genes continue to be discovered, and indeed, there has recently been considerable progress in this area. Besides, the discovery of genes that significantly improve the aptitude for sports, such as myostatin, will significantly enhance the quality of sports selection and orientation.

The study was performed with the financial support from the Russian Foundation for Basic Research and the Republic of Buryatia under Project No. 18-413-030001.

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Legal and regulatory provisions to facilitate professional progress of physical education teachers in pirdnestrovian moldovan republic: efficiency survey

UDC 796:034

Dr.Hab., Professor **V.N. Irkhin**[1]
Postgraduate **M.G. Tymchek**[2]
PhD, Associate Professor **O.V. Amurskaya**[1]
P.P. Kondratenko[1]
[1]Belgorod State National Research University, Belgorod
[2]Taras Shevchenko Transnistria State University, Tiraspol

Corresponding author: v_irkhin@list.ru

Abstract
Objective of the study was to rate benefits of the beginner physical education teacher's professional development (physical education teacher's professional development) facilitating legal and regulatory provisions in the Pridnestrovian Moldavian Republic educational system.
Methods and structure of the study. The study was completed in 2017–2021 at the republican general/ advanced/ sports education organizations including sports schools. We used analysis of the study reports on the subject, questionnaire surveys and experiments for the purposes of the study. We sampled for the study 67 beginner physical education teachers and 192 beginner trainers from the republican advanced and regular sports education institutions and schools.
Results and conclusion. The test data and analysis demonstrated success of the beginner physical education teacher's professional development facilitating legal and regulatory provisions in every their component including the peer mentoring service formats, professional competency competitions and development encouragement workshops, etc., with special benefits for the professional development agendas of the sample based on the critical assessments of own professional strengths and weaknesses, growing physical education teacher independence and responsibility for the service quality, etc.
Our analysis of the physical education teacher' professional development facilitating legal and regulatory provisions implementation experience in the Pridnestrovian Moldavian Republic found the legal and regulatory provisions being beneficial at every governmental level, including the transitional public-communal management forms – due to meaningful improvements in the peer mentoring, professional competency contests and interactive professional development workshops, good feedbacks etc. – that have been of great encouragement effects on the beginner physical education teacher professional and personality development agendas.

Keywords: *young physical education teacher, Republic educational system, professional progress, professional fitness legal and regulatory provisions.*

Background. Modern socio-cultural challenges are responded by the Pridnestrovian Moldavian Republic government by special legal and regulatory provisions to facilitate the beginner physical education teachers' professional progress with special elements to encourage their adaptation to the service and qualitative and quantitative improvements in the professional and personality domains [3]. The legal and regulatory provisions for beginner physical education teachers have been formed by the republican, municipal and departmental law-makers since 2017 and proved beneficial since then in every physical education teacher's professional service component, with special benefits for prevention of unacceptable deficiencies and shortages in the physical educa-

tion teacher's professional fitness standards in the Pridnestrovian Moldavian Republic [2].

Objective of the study was to rate benefits of the beginner physical education teacher's professional progress facilitating legal and regulatory provisions in the Pridnestrovian Moldavian Republic educational system.

Methods and structure of the study. The study was completed in 2017–2021 at the republican general/ advanced/ sports education organizations including sports schools. We used analysis of the study reports on the subject, questionnaire surveys and experiments for the purposes of the study. We sampled for the study 67 beginner physical education teachers and 192 beginner trainers from the republican advanced and regular sports education institutions and schools.

Results and discussion. The legal and regulatory provisions for beginner physical education teachers have been formed by the republican, municipal and departmental relevant officers since 2017 after the physical education teacher's professional service tests rated only 11.3% of the beginner physical education teachers 'optimal' on the professional fitness scales. The professional fitness tests rated the theoretical and practical service knowledge and skills; practical accomplishments of trainees in the studies and sports; actual progress needs in the theoretical and practical knowledge and skills etc. The professional fitness tests also rated 57.1% of the sample 'acceptable' (good professional service knowledge and skills, sound professional value systems, positive attitudes and motivations, expressed progress needs and success motivations); although 25.3% of the sample was rated 'critical' on the professional fitness scale (low theoretical and practical service quality; unfitness for the modern training technologies and teaching methods; progress motivations strongly dependent on external pressures; professional indifferences etc.). And 6.3% of the beginner physical education teacher sample were tested 'unacceptable' on the professional fitness scale (i.e. unfit for an independent theoretical and practical service; having poor professional values systems, attitudes and motivations; poor if any progress agendas and pedagogical reflections; poor if any success motivations in the theoretical and practical training domains etc.).

The physical education teacher's professional progress facilitation legal and regulatory provisions design stage was intended to establish a set of the relevant legal and regulatory provisions with the implementation conditions. The have been implemented since then; and their practical benefits were tested by a questionnaire survey of the beginner physical education teachers and education system management officers; with a special attention to practical application of the legal and regulatory provisions, requirements and standards, plus progress tests and monitoring.

Our experimental work was designed to facilitate the physical education teacher's progress by the legal and regulatory provisions and motivate them for the service by: (1) Material incentives (Presidential awards, monthly bonuses, etc.); 2) Moral and psychological motivations for the professional progress including professional skills contests for the titles of "Best teacher", "Best coach", "Sports week" winners, "Best athlete", best tournament managers, etc.); social appreciation with positive responses from the trainees and families, media coverage, appreciations on the governmental official websites, formal meetings with the republican leaders, etc.; motivational support from the experienced colleagues (peer mentors) to facilitate professional service accomplishments; promotions to the higher qualification categories; trainees' successes at the republican and municipal competitions; invitations to physical education teachers conferences, etc.

Based on analyses of the relevant study reports [1, 4], we classified the beginner physical education teacher's professional fitness test rates as follows. The pre- versus post-experimental (2017 versus 2021) *motivations-and-values tests* rated 18.2%, 23.2%, 42.9% and 15.7% optimal, acceptable, critical and unacceptable, respectively; and the post-experimental tests found growth of the optimal and acceptable shares by 22.5% and 14.7%; whilst the critical share was found to drop from 42.9% to 11.4%; and the unacceptable share from 15.7% to 10%.

On the *technological competence and skills test* scale, the 2017 pre-experimental tests rated 10.4%, 67.8%, 20% and 1.8% of the sample optimal, acceptable, critical and unacceptable, respectively; whilst the 2021 post-experimental tests found the optimal share to grow by 8.3% to 18.7%; acceptable share by 7.6% to 75.4%; whilst the critical share was found to drop from 20% to 5.4%; and unacceptable one from 1.8% to 0.5%.

On the *professional adaptation test* scale, the optimal and acceptable shares of the sample were found to grow from 10% to 21% and from 18.4% to

59.7%; and the critical and unacceptable shares were found to drop from 50, 6% to 18.3% and from 21% to 1%, respectively, in the pre- versus post-experimental tests.

And the *progress rating/ reflection skills tests* found the optimal and acceptable shares to grow from 15% to 45% and from 18.6% to 33.6%; and the critical and unacceptable shares dropping from 37.9% to 15.4% and 28.5% to 6%, respectively, in the pre- versus post-experimental tests.

The above test data and analyses demonstrated success of the beginner physical education teacher's professional progress facilitating legal and regulatory provisions in every their component including the peer mentoring service formats, professional fitness competitions and progress encouragement workshops, etc., with special benefits for the professional progress of the sample based on the critical assessments of their own professional strengths and weaknesses, growing physical education teacher's independence and responsibility for the service quality, etc.

Conclusion. Our analyses of the physical education teacher's professional progress facilitating legal and regulatory provisions implementation experience in the Pridnestrovian Moldavian Republic found the legal and regulatory provisions being beneficial at every governmental level, including the transitional public-communal management forms – due to meaningful improvements in the peer mentoring, professional fitness contests and interactive professional progress workshops, good feedbacks etc. – that have been of great encouragement effects on the beginner physical education teacher's professional and personality progress agendas.

The study was completed under the "BSU university grant support bidding tour for the public service and humanitarian research studies" Project No. 826-OD dated August 14, 2020

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Combat sports elements to intensify physical training of police cadets

UDC 796.011.3

E.Y. Domracheva[1, 2]
Dr. Hab., Professor **N.N. Severin**[1, 2]
PhD, Associate Professor **I.N. Nikulin**[1]
A.A. Oleynik[1]
[1]Belgorod State National Research University, Belgorod
[2]Belgorod Law Institute of the Ministry of Internal Affairs of Russia named after I.D. Putilin, Belgorod

Corresponding author: domracheva@bsu.edu.ru

Abstract
Objective of the study was to rate and analyze benefits of modern combat sports elements for physical training service at police academies.
Methods and structure of the study. The study was run at Belgorod Law Institute of the Ministry of Internal Affairs of Russia named after I.D. Putilin in the academic year of 2019-20. The cadet sample was split up into two groups, and their physical fitness was tested in the experiment by the standard pre- versus post- experimental physical fitness tests recommended by the valid academic physical training curriculum. The group physical training service included the following three modules: (1) physical training theory; (2) Combat sports elements; and (3) Standard physical trainings.
Module 3 in both groups included the same speed, coordination and strength (Sp, Co, St) training exercises; general/ special endurance and flexibility training practices and a combined obstacle course.
Module 2 included a range of sambo, judo, boxing and hand-to-hand fighting elements excelled in the controlled sparring bouts. The Group 1 physical training service was intensified by the controlled sparring bouts sessions once a week. And the Croup 2 physical training service gave a special priority to combat sports skills excellence trainings with controlled sparring bouts once a month. The group physical fitness was tested by the standard 100m sprint, 10x10m shuttle sprint, 1km cross-country race, pull-ups and prone push-ups, plus a combined strength test.
Results and conclusion. The academic physical training service intensified by the combat sports elements with controlled sparring bouts on a weekly basis was found to secure significant ($p<0.05$) progress in every strength test; and therefore, this physical training model may be recommended for application in the academic physical training curriculum.

Keywords: *intensification, physical training, combat sports elements, cadets.*

Background. Modern combat sports elements including judo, sambo, boxing and hand-to-hand fights are ranked among the key physical training service components by the national police academies under the Ministry of Internal Affairs [5]. We assumed that the modern combat sports elements and tools complementary to the standard physical training service may be highly beneficial for special physical fitness of police cadets.

Objective of the study was to rate and analyze benefits of modern combat sports elements for physical training service at police academies.

Methods and structure of the study. The study was run at Belgorod Law Institute of the Ministry of Internal Affairs of Russia named after I.D. Putilin in the academic year of 2019-20. The cadet sample was split up into two groups, and the physical fitness was tested in the experiment by the standard pre-

versus post- experimental physical fitness tests recommended by the valid academic physical training curriculum. The group physical training service included the following three modules: (1) physical training theory; (2) Combat sports elements; and (3) Standard physical trainings.

Module 3 in the both groups included the same speed, coordination and strength (Sp, Co, St) training exercises; general/ special endurance and flexibility training practices and a combined obstacle course [1].

Module 2 included a range of sambo, judo, boxing and hand-to-hand fighting elements excelled in the controlled sparring bouts [2, 3]. The Group 1 physical training service was intensified by the controlled sparring bouts sessions *once a week*. And the Croup 2 physical training service gave a special priority to combat sports skills excellence trainings with controlled sparring bouts *once a month*. The group physical fitness was tested by the standard 100m sprint, 10x10m shuttle sprint, 1km cross-country race, pull-ups and prone push-ups, plus a combined strength test.

Results and discussion. The group physical fitness progress was tested by the pre- versus post-experimental tests. Group progress in the *speed qualities* was tested by the 100m sprint test that rated the pre-experimental speed 'low' (satisfactory) in both groups; versus the post-experimental tests that found insignificant ($p>0.05$) progress in both groups to the 'average' (good) level. The 10x10m shuttle sprint test ranked the pre-experimental speed 'low' in both groups; versus the post-experimental tests that found insignificant ($p> 0.05$) progress in both groups.

The group *endurance* was tested by the 1km race test that rated the pre-experimental endurance 'low' (satisfactory) in both groups; versus the post-experimental tests that found significant ($p<0.05$) progress in both groups to 'excellent' levels.

The group *strength* was tested by the pull-ups, prone push-ups and combined strength tests. The pre-experimental strength tests rated 'low' both groups; versus the post-experimental tests that found significant ($p<0.05$) progress in Group 1 to 'excellent' level, whilst Group 2 showed insignificant ($p>0.05$) progress in these tests. The combined strength tests found progress in both groups, albeit only Group 1 made significant ($p<0.05$) progress to 'excellent' level – versus noticeable although insignificant ($p>0.05$) progress in Group 2

Conclusion. The academic physical training service intensified by the combat sports elements with controlled sparring bouts on a weekly basis was found to secure significant ($p<0.05$) progress in every strength test; and therefore, this physical training model may be recommended for application in the academic physical training curriculum.

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First year infant motor asymmetry origins and prevention: parental awareness survey

UDC 796.01:316

Dr. Hab., Professor **L.N. Voloshina**[1]
Dr. Hab., Professor **V.L. Kondakov**[1]
PhD, Associate Professor **E.N. Kopeikina**[1]
N.S. Nikitina[2]
[1]Belgorod State National Research University, Belgorod
[2]Ivanovo State University, Shuya Affiliate

Corresponding author: nikulin_i@bsu.edu.ru

Abstract
Objective of the study was to survey the parental awareness of the origins of infant motor asymmetry and its prevention methods.
Methods and structure of the study. We have analyzed the relevant study reports by the national and foreign researchers to design and run a parental survey. We sampled for the survey parents (n=50) of 0-1 year-olds diagnosed with torticollis. The questionnaire survey was run on the Vkontakte online platform in the "Parents and Teachers! Our children" category. The survey data were grouped and ranked by the formula.
Results and conclusions. As found by our survey, postnatal and congenital torticollis was diagnosed in 54% and 46% of the infant motor asymmetry sample, respectively, with the postnatal torticollis diagnosed within the first two months in 77% of the group ($p \leq 0.05$).
Dominating among the origin of infant motor asymmetry in the parental opinions are the muscle tone disorders and poor physical development (ranked 1 and 2, respectively); whilst the visual and auditory system disorders are ranked the last by the parents who obviously underestimate these causes of infant motor asymmetry. In the infant motor asymmetry prevention toolkit, the parents mostly favored massage and postural corrections (ranked 1 and 2, respectively), with only a few respondents believing that visual and auditory analyzers should be trained to effectively prevent infant motor asymmetry.
The parental awareness survey data and analysis found that the families are mostly unaware of influences of the visual, auditory and vestibular system progress on the infant motor asymmetry, with only a few respondents knowing the importance of these systems for motor skills and movement coordination development by sensitive infant-motor-asymmetry-prevention trainings. We believe that the first-year infant motor asymmetry issues deserve further special studies, with a special priority to new promising asymmetry prevention and correction methods, models and tools accessible for physical education at home.

Keywords: *symmetry, asymmetry, preventive care, first year infant, motor development.*

Background. Notions of "symmetry" and "asymmetry" are relevant for many modern sciences from mathematics to philosophy. The first-year infant physical development theory and practice widely apply the concepts of postural and motor symmetry/ asymmetry [5] ratable by mirror images of specific bodily parts [4]. Infant motor asymmetry can be interpreted as the clinical condition with notable abnormalities in the bodily shape, posture or mobility of different etiologies, locations and severity classes. It is the idiopathic asymmetry due to unclear reasons that are presently ranked the most common, followed by symptomatic asymmetry known to arise from many structural or systemic disorders [11]. It is not unusual that a newborn child is immediately diagnosed with some asymmetry in

the head inclination in either preferred direction in prone position due to the protective reflex, or preference of some leg in the stepping reflex tests.

Infant motor asymmetry is normally diagnosed in the 1-3 months and includes asymmetric tonic cervical reflex due to the child feeling stable in this position upon testing the extremes within the individual movement range to find the midline [1, 7]. The midline posture development process goes via the left/ right, front/ back and upper/ lower bodily parts being balanced. This is the first step in the body balance mastering process [8]. To attain due symmetry, the extensor and flexor muscles need to be activated in the most harmonious and balanced manner, with signals from the analyzer systems processed by the central nervous system [7].

As far as the symmetry/ dissymmetry concept by P. Curie is applied for interpretation of the infant movement development process, it should be mentioned that postural/ motor dissymmetry is always associated with asymmetry of the origins of this condition [3]. For example, a dissymmetric effect of the preferred head inclination gives rise to child torticollis. When asymmetry develops, it alters the income data flow from the visual analyzer; plus the distorted position of the head affects operations of the vestibular apparatus; and the data flow from proprioceptors via muscles of the neck and body is also distorted by asymmetry in this relevant bodily part(s). The habitual distortions in the visual analyzer and vestibular system operations result in the bodily asymmetry [9].

Objective of the study was to survey the parental awareness of the origins of infant motor asymmetry and its prevention methods.

Methods and structure of the study. We have analyzed the relevant study reports by the national and foreign researchers to design and run a parental survey. We sampled for the survey parents (n=50) of 0-1 year-olds diagnosed with torticollis. The questionnaire survey was run on the Vkontakte online platform in the “Parents and Teachers! Our children” category. The survey data were grouped and ranked by the following formula:

$$\Sigma = \frac{(n+1)n}{2} = \frac{(6+1)6}{2} = 21,$$

with n – questions, and $\Sigma = 21$ – total questions corresponding to the total points scored by the responses.

Results and discussion. Torticollis is one of the most common motor asymmetry in the infants, with congenital muscular torticollis ranked the third most common congenital musculoskeletal abnormality after hip dislocation and clubfoot [10, 12]. Postnatal torticollis is the health condition that can be prevented by corrective practices in the 0-1 year period, with special efforts to exclude asymmetric moves. Analysis of the most popular asymmetry prevention method finds 20% of them designed in the 0-1 year-olds. However, families are still largely unaware of how important it is to control motor progress of their infants in this period with a special emphasis on motor symmetry. Families normally excuse themselves by “home chores”, “shortage of knowledge and skills” and “shortage of practical experience for physical education at home”, and this is the reason why we believe that parental awareness surveys could be beneficial in this situation [2].

It should be emphasized that torticollis is classified into the congenital and acquired/ postnatal, albeit both of them are much similar in the symptoms and diagnostic and therapeutic methods [6].

Table 1. *Parental awareness of the origins of infant motor asymmetry and its prevention methods*

Question	Options	Option number: 1 to 6	Average score: 1 to 6 points
What is the origin of infant motor asymmetry?	Muscle tone disorders	1	2,5
	Poor physical development	2	2,64
	Forced and prolonged postural constraints	3	3,9
	Joint dysfunctions with limitations for the amplitudes	4	3,94
	Nervous control disorders	5	3,94
	Visual and auditory system disorders	6	4,08
How the infant motor asymmetry may be prevented?	Massage	1	2,5
	Postural corrections	2	2,74
	Gymnastics	5	3,56
	Shants Collar	4	3,88
	Motor development and coordination training	3	4
	Visual and auditory system development practices	6	4,32

As found by our survey, postnatal and congenital torticollis was diagnosed in 54% and 46% of the infant motor asymmetry sample, respectively, with the postnatal torticollis diagnosed within the first two months in 77% of the group ($p \leq 0.05$). We tested and profiled by parental awareness of the origins of infant motor asymmetry and its prevention methods: see the survey data in Table 1 hereunder.

Dominating among the origin of Infant motor asymmetry in the parental opinions are the muscle tone disorders and poor physical development (ranked 1 and 2, respectively); whilst the visual and auditory system disorders are ranked the last by the parents who obviously underestimate these causes of infant motor asymmetry. In the infant motor asymmetry prevention toolkit, the parents mostly favored massage and postural corrections (ranked 1 and 2, respectively), with only a few respondents believing that visual and auditory analyzers should be trained to effectively prevent infant motor asymmetry.

Conclusion. The parental awareness survey data and analysis found that the families are mostly unaware of the influence of visual, auditory and vestibular system progress on the infant motor asymmetry, with only a few respondents knowing the importance of these systems for motor skills and movement coordination development by sensitive infant-motor-asymmetry-prevention trainings. We believe that the first-year infant motor asymmetry issues deserve further special studies, with a special priority to new promising asymmetry prevention and correction methods, models and tools accessible for physical education at home.

The study was sponsored by a grant financing from RFRF under Project № 19-013-00173 'Combined research of motor progress with growth facilitated by customized physical education system'.

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Digital technologies driven physical activity education service in distance learning formats during covid-19 pandemic: questionnaire survey

UDC 796.011.3

Dr.Sc.Psych., Associate Professor **E.A. Shmeleva**[1, 2]
Dr.Sc.Psych., Associate Professor **P.A. Kislyakov**[1]
PhD N.P. **Konstantinova**[1]
PhD V.V. **Pchelinova**[1]
[1]Russian State Social University, Moscow
[2]Ivanovo State University, Shuya

Corresponding author: noc_shmeleva@mail.ru

Abstract
Objective of the study was to analyze, based on questionnaire survey data, popularity and benefits of the most popular physical education digital technologies applicable for students' physical activation during the COVID-19 pandemic.
Methods and structure of the study. For the physical education digital technologies study purposes, we run the questionnaire survey and processed and analyzed the questionnaire survey data using mathematical SPSS Statistics 22 software toolkit. We sampled physical education teachers (n=72) including university physical education teachers (25.0%); children and youth sport school coaches (23.6%); school physical education teachers (19.4%); physical education instructors (18.1%); college physical education teachers (8.3%); and personal trainers (5.6%).
Results and conclusion. The most popular physical education digital technologies for physically active and sporting lifestyles were ranked as follows: video lessons/ training models available on Youtube, etc. (16.7%); physical education guides for self-training in the social networks (15.6%); real-time online classes using Zoom and Skype (15.6%); theoretical physical education support via Viber, WhatsApp, Telegram and other messengers (14.0%); mobile physical education tools (13.4%); and emailed practical physical education guidelines (9.7%). Less popular were the following physical education platforms: Russian electronic school, Uchi.ru, YaKlass, Google Classroom, Moodle, etc. (8.1%); and the university/ school/ college physical education websites (7.0%).
The questionnaire survey found most of the physical education teacher sample largely unfit for the modern digital-technologies-driven physical education service. Since the survey was run in the fall of 2020 after the first wave of the pandemic in Russia, it is unlikely that the physical education teacher sample was able to bridge the gaps in their digital-technologies-driven physical education service fitness by the time of the second wave. We recommend special digital technologies training service for the physical education teachers to make them fit for the modern digital-technologies-driven physical education service.

Keywords: *physical activity, physical inactivity, physical education teacher, COVID-19 pandemic, social isolation, distance learning, digital technologies, questionnaire survey, social networks, mobile applications.*

Background. In responses to the pandemic-triggered global economic and social crises, national governments and health agencies give a special priority to the mental/ emotional and physical health of people on the whole and students in particular as the social group highly exposed to risks of physical inactivity in the self-isolation environments [2, 5]. Thus the WHO recommends at least 150-min of moderate or 75-min of intense *physical activity* per week to counter the health risks of physical inactivity [1]. Physical practices and healthy *physical activity* during the COVID-19 pandemic is ranked among the key mental and social health protection methods [4, 7]. The global physical education community has made resort to online physical education technologies to continue the physical education service during the school lockdown periods

[3]. Modern digital technologies offer immersive training environments with virtual/ augmented realities that help at least improve the functions of the immune and cardiovascular systems [6].

Objective of the study was to analyze, based on questionnaire survey data, popularity and benefits of the most popular physical education digital technologies applicable for students' physical activation during the COVID-19 pandemic.

Methods and structure of the study. For the physical education digital technologies study purposes, we run the questionnaire survey and processed and analyzed the questionnaire survey data using mathematical SPSS Statistics 22 software toolkit. We sampled physical education teachers (n=72) including university physical education teachers (25.0%); children and youth sport school coaches (23.6%); school physical education teachers (19.4%); physical education instructors (18.1%); college physical education teachers (8.3%); and personal trainers (5.6%).

Results and discussion. The most popular physical education digital technologies for physically active and sporting lifestyles were ranked as follows: video lessons/ training models available on Youtube, etc. (16.7%); physical education guides for self-training in the social networks (15.6%); real-time online classes using Zoom and Skype (15.6%); theoretical physical education support via Viber, WhatsApp, Telegram and other messengers (14.0%); mobile physical education tools (13.4%); and emailed practical physical education guidelines (9.7%). Less popular were the following physical education platforms: Russian electronic school, Uchi.ru, YaKlass, Google Classroom, Moodle, etc. (8.1%); and the university/ school/ college physical education websites (7.0%).

The school/ college physical education teachers were found to favor in the above toolkit the email for self-learning physical education purposes, whilst the university physical education teachers favor the social networks; sport club/ sport school coaches (around 33% of the group) give preference to Zoom and Skype tools – in contrast to the school physical education teacher group where only 5% reported using the latter. 14.8% of the sport club coaches and 16.3% of the university physical education teachers reported using mobile equipment for the service. And the Youtube video classes/ trainings were most popular among the school physical education teachers and coaches. On the whole, the university physical education teachers were ranked the most active users of the physical education digital technologies.

Therefore, the school physical education teachers favor Youtube video classes/ trainings (23.1%); physical education instructors prefer Zoom/ Skype physical education digital technologies (18.5%), links to video lessons / training on Youtube and others (18.5%); Viber, WhatsApp, Telegram and other messengers for the physical education theory (18.5%). Most of the sports school coaches and university physical education teachers report preference for the Zoom/ Skype tools (29.5%); and the college physical education teachers favor e-mail and Youtube for the physical education service. The university physical education teachers reported downloading physical education instructions in the social networks (18.4%) and on the university websites (16.3%), plus using the mobile communication tools (16.3%).

As far as the physical education digital technologies hardware, most popular in the physical education and sports teaching community are the computers

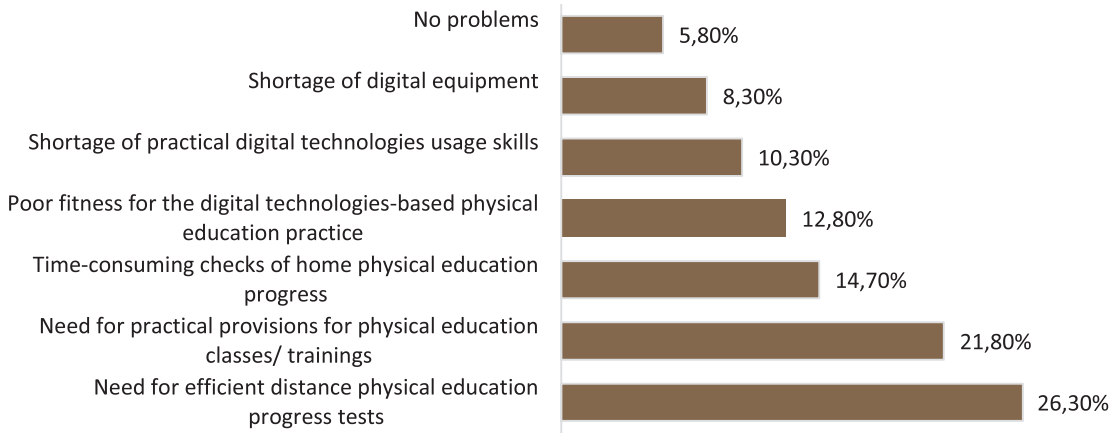

Figure 1. *What problems have you faced in your physical education practice during the Covid-19 pandemic? (%)*

with cameras and microphones and mobile applications – reported by 40.4% of the sample. Only 13.2% of the sample report using fitness bracelets for distance learning; whilst 6.1% report avoiding use of any digital hardware. The computers/ tablets with cameras and microphones were found most popular among the school (52.2%) and college physical education teachers (45.5%), followed by at least 33% in every other physical education teacher group. Mobile applications were most popular among the club coaches and university physical education teachers (44.4% and 44.1%, respectively). It appears increasingly common for the sporting student groups to use digital devices in the self-reliant trainings, although above 33% of the school/ college physical education teachers also report using special training mobile applications; although some digital systems (e.g. fitness bracelets) are still not much popular among the physical education digital technologies. Of special interest is the fact that about third of the physical education instructors are still reluctant to use digital technologies, mobile applications and internet physical education applications.

In their own physical fitness maintenance practices, the physical education teachers report favoring smart-phones with training mobile applications including training schedules and progress/ health tests, plus fitness bracelets. A correlation analysis found the mobile-applications-preferring physical education teachers widely using them for their distance physical education service ($r= 0.243$, $p <0.01$); and taking benefit of their own practical experience in using the physical education digital technologies to manage the trainees' self-trainings: see Figure 1.

Every physical education teacher in the sample ranked the need for efficient distance physical education progress tests the highest: see Figure. It may be beneficial to address the problem by the self-test skills and tools need to be mastered by the trainees – all the more that the modern physical education digital technologies often include such physical education progress/ physical activity test toolkits. Highly problematic for the sample was also the need for practical provisions for the physical education classes/ trainings reported by 78.6% of the school physical education teachers, half of the physical education instructors and 40% of the coaches and college physical education teachers. And 35.7% of the school physical education teachers ranked on top the shortage of digital equipment as barriers for their distance physical education practice.

Conclusion. The questionnaire survey found most of the physical education teacher sample largely unfit for the modern digital-technologies-based physical education practice. Since the survey was run in the fall of 2020 after the first wave of the pandemic in Russia, it is unlikely that the physical education teacher sample was able to bridge the gaps in their digital-technologies-based physical education practice fitness by the time of the second wave. We recommend special digital technologies training service for the physical education teachers to make them fit for the modern digital-technologies-based physical education practice.

The study was completed under Research Contract № 037310011042000008 for "Modern physical activity methods and models development to lure people in the age- and gender-specific habitual physical education and sports practices" by the All-Russian Physical Education Research Institute.

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