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Discussing the key issues of modern sports science

Digital-transformation-based technologization of sports training process

Nowadays digitalization of sports activity is a new technological solution to involve masses of people in regular sports practices. The vector of digitalization of the physical education and sports movement is consolidated at the state level and is already being successfully implemented in the activities of organizations, sports federations and sports educational institutions.

Digital technologies make it possible to efficiently collect, process and transmit information, qualitatively change the methods and organizational forms of training of both top and amateur athletes, motivating them for healthy lifestyle. Mobile applications in the physical education and sport sector are becoming an integral part of people's life, helping them organize their daily routine, eat right, and train effectively on their own. Companies' websites and fitness platforms offer individual sports training programs, a personalized service, within which trainees can get information about the latest sports equipment, inventory, nutrition, health self-monitoring methods. For example, intelligent equipment such as high-tech helmets, T-shirts, sports shoes, and shorts enable athletes of different fitness levels to monitor their condition online, avoiding overload and injuries.

The study conducted by a group of scientists headed by Professor S.E. Bakulev (St. Petersburg), the results of which are presented in this issue of the journal, serve an example of effective digitalization in the organization of sailing practices.

The digital transformation of sports training, based on the use of the potential of artificial intelligence, cloud, infocommunication architecture and successfully performing the information and analytical function, makes it possible to improve athletes' technical and tactical skills and coaches' professional competences. The key aspect of the effective implementation of the digital transformation of sports training can be the training of personnel with the digital competences and creativity developed well enough to meet the modern challenges of the technological progress.

We will be happy to see on our pages the scientific articles aimed to make a new breakthrough in the theory and methodology of sports training and physical education.

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105122 Moscow,
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Functional capabilities of neuromuscular system of top-class female boxers

UDC 796.015

PhD **A.O. Akopyan**¹Researcher **L.A. Kulagina**¹Distinguished Master of Sports of Russia **O.V. Domulajanova**¹General Secretary of the Russian Boxing Federation **U.N. Kremlev**¹¹Federal Science Center for Physical Culture and Sport, Moscow

Corresponding author: acop1@yandex.ru

Abstract

Objective of the study was to determine the level of development of the aerobic and anaerobic energy supply mechanisms and physical capacity of the main muscle groups of top-class female boxers aged 15-16: chest and back muscles, shoulder muscles, thigh muscles, as well as their explosive force.

Methods and structure of the study. The training and testing methodology for 30 top-class female boxers was aimed to assess the aerobic and anaerobic energy potential and speed-strength capabilities of their main muscle groups: chest and back muscles, shoulder muscles, thigh muscles, as well as the explosive force of the neuromuscular system in general. The female athletes performed 12 exercises in the mode as follows: 15" - work + 15" - rest. At the beginning and at the end of testing, the subjects' heart rate was measured (beats per minute). The test results were analyzed using a special computer program, where the standard units were calculated in the test for the aerobic and anaerobic energy supply, as well as the speed-strength capabilities of their main muscle groups: chest and back muscles, shoulder muscles, thigh muscles, as well as the explosive force.

Results and conclusions. The studies identified the weak spots in the development of the speed-strength capabilities of the neuromuscular system of the top-class female boxers. It is shown that it is only the back muscles that are well developed relative to the model level (+3.6%). The functional state of the remaining muscle groups are below the model level, with an average delay of 18.5%. This fact confirms the shortcomings or lack of systematic and rational development of special speed-strength capabilities of the neuromuscular system of the 15-16 year-old female boxers.

Keywords: *boxing, female boxers, neuromuscular system, speed-strength capabilities, test, exercises, energy supply.*

Background. Boxing is among the most popular sports in the world that has gained Olympic recognition in both men's and women's programs. The inclusion of women's boxing in the Olympic program has played a positive role in the development of boxing worldwide. There are currently more than 200 female athletes in the World Women's Championships, representing at least 57 countries. This competition naturally leads to the constant search for new and effective opportunities in the system of training of top-class

athletes in all age groups participating in major competitions. The group of female boxers aged 15-16 is not an exception. To develop programs of training of 15-16 year-old female boxers for the main competitions, it is necessary to provide scientific and methodical substantiation for the organization of the training process. One of the major aspects of practical planning of training is the knowledge of the functional and physical fitness of athletes throughout the period of centralized training. In view of this, our studies use

the functional state rating methods based on the data on the functionality training reserve, while the speed-strength capabilities of the neuromuscular system are evaluated by testing the sequence of exercises performed at constant time shortage [3, 4].

Objective of the study was to determine the level of development of the aerobic and anaerobic energy supply mechanisms and physical capacity of the main muscle groups of top-class female boxers aged 15-16: chest and back muscles, shoulder muscles, thigh muscles, as well as their explosive force.

Methods and structure of the study. The study involved 30 strongest female athletes trained for the international tournament. The testing was carried out under centralized training of top-class female boxers of 15-16 years of age at the sports base "Lake Krugloe" after a day of active rest at the beginning of the second training micro-cycle. According to the data on the functionality training reserve, at the time of testing, the team average functional state equaled to 27.6 ± 6.7 c.u., which was lower than the model level for this stage by 8.2% [1, 2]. This fact suggested that the female boxers had a rather high level of functional fitness at the time of testing. The female athletes performed 12 exercises in the mode as follows: 15" – work (number of reps) + 15" – rest.

The test exercises included:

1. I.P. (initial position) – normal stand position: squats with hands forward;
2. I.P. – with the left foot first: kicking the right leg forward and up, with the simultaneous left-hand blow;
3. I.P. – front plank: pull-ups;
4. I.P. – normal stand position: squat – front plank - I.P.
5. I.P. – prone position: simultaneous straight arm and leg raises;
6. I.P. – front plank: pull-ups with claps;
7. I.P. – with the right foot first: kicking the left leg forward and up, with the simultaneous right-hand blow;
8. I.P. – front plank: alternating knee-to-elbow raises;
9. I.P. – supine position: simultaneous straight arm and leg raises;
10. I.P. – normal stand position: alternating knee-to-chest tuck jumps and kicking the straight leg forward and up;
11. I.P. – normal stand position with the wrist-lock grip on top: "wood chop" to the sides (while twisting the heel);
12. I.P. – main "combat stance": dive handsprings with half turn vault.

The test results were analyzed using a special computer program, where the standard units were calculated in the test for the aerobic and anaerobic energy supply, as well as the speed-strength capabilities of their main muscle groups: chest and back muscles, shoulder muscles, thigh muscles, as well as the explosive force.

Results and discussion. The test results revealed the following patterns in the functional and physical fitness of the 15-16 year-old top-class female boxers. The level of development of the energy systems suggests similar levels of development of aerobic (48.1 c.u.) and anaerobic mechanisms of energy supply (45.6 c.u.).

This fact indicates that the training of female athletes of this age is focused on specialized technical and competitive training in terms of a clearly insufficient amount of functional and physical work.

The analysis of the speed-strength capabilities of the main muscle groups showed: posterior muscle group - 1.7 c.u., anterior muscle group - 1.65 c.u., shoulder muscles - 1.34 c.u., muscles of the thigh - 1.1 c.u. The average level of the neuromuscular system functionality in the 15-16 year-old top-class female boxers was below the model level. On average, there was a 18% gap between the capabilities of the muscle groups and the model characteristics, except for the posterior muscle group.

The test results indicated the uniformity of strength training, which is mainly focused on the development of back strength with a relatively large weight. This direction of physical training of the 15-16 year-old top-class female boxers also leads to the low explosive force of the neuromuscular system, which is essential in boxing. The explosive potential of the neuromuscular system of the female boxers of this age group was 35.4% below the model level.

Conclusion. The studies identified the weak spots in the development of the speed-strength capabilities of the neuromuscular system of the top-class female boxers. It is shown that it is only the back muscles that are well developed relative to the model level (+3.6%). The functional state of the remaining muscle groups is below the model level, with an average delay of 18.5%. This fact confirms the shortcomings or lack of systematic and rational development of special speed-strength capabilities of the neuromuscular system of the 15-16 year-old female boxers.

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Triple jump phases: competitive progress specific pace and rhythm analysis

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Dr. Hab., Associate Professor **A.L. Oganjanov**¹Dr. Hab., Professor **V.G. Nikitushkin**¹Dr. Hab., Professor **A.P. Strizhak**¹PhD, Associate Professor **N.G. Mikhailov**¹¹Moscow City Pedagogical University, Moscow

Corresponding author: Oga2106@mail.ru

Abstract

Objective of the study was to analyze the competitive progress specific triple jump control rhythm and aerial/ground phase ratios for the men's triple jump elite.

Methods and structure of the study. We used for the purposes of the study photodiode video capturing Brower system with the triple jump replay analysis (using Dartfish software), with the tests and analyses assisted by marks in the triple jump sector. Subject to the analysis were the spatial and temporal rates of the aerial and ground phases in the triple jump sequence. 52 elite triple jump competitors qualified Class I to WCMS were sampled for the study to fix and analyze their individual best triple jump attempts to produce the temporal and spatial control rates. A total of 160 triple jump attempts were analyzed during the Russian and international competition.

Results and conclusions. The study found the hop and jump phase ratios (%) in the men's elite triple jump sequence coming closer with the competitive progress, with the hop phase sagging and the jump phase growing. The aerial/ground phase ratios for the triple jump leaders including the four-time world champion K. Taylor (18.21 m) and world record holder D. Edwards (18.29 m) were found close to 35+30+35%. Therefore, we recommend a model triple jump phase ratio for the triple jump elite (WCMS) with the hop, step and jump phases close to 35+30+35%. It should be emphasized that with the competitive progress the men's triple jump elite demonstrate the hop and jump phase ratios coming closer to ideally model the D. Edwards' (18,29 m) standard of 30+30+40%. With the 15.1% competitive progress (from 15.48 to 17.82 m), the triple jump time was found to grow insignificantly by 3.4% only – that may be interpreted as indicative of the competitive progress in the triple jump depending rather on the sprint speed and aerial/ground phase speeds in every triple jump element, i.e. the individual ability to keep the top horizontal speed in every triple jump phase. Note that the competitive progress with speed correlation ratio for the last approach segment was estimated to average 0.93 in our study.

Keywords: triple jump, jumping rhythm, phase, triple jump phase ratios, temporal and spatial control rates.

Background. The issue of triple jump phasing for efficiency has long been among the top priorities for the triple jump sport specialists since the early days of the sport discipline and the first Olympic Games when the triple jump was ranked on top of the track and field athletics program of the Olympic Games in Athens in 1896. Understanding of the ideal triple jump phase and pace structure has significantly changed with time and multiple world records, and the relevant innovations in the triple jump styles, techniques and training

methods [1, 2, 4]. It should be mentioned that the triple jump rhythmic structure that primarily refers to the movement sequence phases and their ratios rather than phase lengths only, has virtually never been analyzed by the sport community [3, 5].

Objective of the study was to analyze the competitive progress specific triple jump control rhythm and aerial/ground phase ratios for the men's triple jump elite.

Methods and structure of the study. We used for the purposes of the study photodiode video capturing

Brower system with the triple jump replay analysis (using Dartfish software), with the tests and analyses assisted by marks in the triple jump sector [3]. Subject to the analysis were the spatial and temporal rates of the aerial and ground phases in the triple jump sequence. We sampled for the study 52 elite triple jump competitors qualified Class I to WCMS to fix and analyze their individual best triple jump attempts to produce the temporal and spatial control rates. On the whole, we analyzed more than 160 competitive triple jump with 75 individual bests selected for special analysis, with the temporal and spatial control rates of 12 sport leaders obtained from the relevant video materials of the World Championships and the Olympic Games [6]. Subject to analysis were also the municipal, national and international competitive performances in the period of 2003-2019.

Results and discussion. The first stage of the study was designed to fix the competitive triple jump phases and their ratios – for the traditional hop, step and jump phases. The group rhythm and pace ratios were fixed for five approximately identical group ranges of the triple jump results (with 15 attempts in each of the five ranges) within the 14.98-18.10 m total. We fixed the actual triple jump length irrespective of the actual accuracy on the takeoff mark. Our competitive progress specific analysis of the triple jump hop, step and jump phases found the percentage shares of the hop and jump phases coming closer with the competitive progress, with the jump phase tending to grow for

account of the hop phase (see Fig. 1). This last-phase growth trend was found typical of the individual bests of the sport leaders including the four-time world champion K. Taylor (18.21 m) and world record holder D. Edwards (18.29 m): 34+29+37% [6]. It should be noted that the modern men's triple jump model for the 17.25-17.30 m range (WCMS) recommends the hop, step and jump phase ratios close to 35+30+35% (see Table 1).

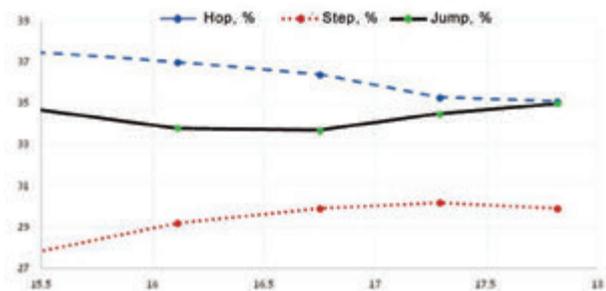


Figure 1. Competitive progress specific triple jump phase length ratios, % to the triple jump length

The competitive progress specific analysis of the hop, step and jump phase length ratios showed that the hop and jump phases tend to come closer in the triple jump rhythmic structure, with the jump phase being fairly stable at around 40% in every triple jump range subject to analysis (see Figure 2). Thus the trend of the hop and jump phase times coming closer is found for the world record holder D. Edwards (18.29

Table 1. Competitive progress specific aerial/ ground triple jump phase structure, lengths, m

Group, m	Group average	Sprint speed	Hop length	Step length	Jump length	Group phase ratios, %		
						Hop	Step	Jump
14,98–15,75 (n=15)	15,48±0,29	9,49±0,41	5,81±0,21	4,31±0,39	5,36±0,29	37,5±1,6	27,8±2,3	34,7±1,7
15,78–16,41 (n=15)	16,11±0,21	9,69±0,36	5,86±0,17	4,70±0,22	5,55±0,22	37,0±1,2	29,2±2,0	33,8±2,0
16,44–17,03 (n=15)	16,75±0,19	9,87±0,32	6,10±0,23	5,01±0,17	5,64±0,27	36,4±1,4	29,9±1,9	33,7±2,3
17,04–17,59 (n=15)	17,29±0,17	10,17±0,18	6,10±0,16	5,22±0,19	5,97±0,19	35,3±1,5	30,2±2,1	34,5±1,9
17,60–18,10 (n=15)	17,82±0,13	10,52±0,11	6,26±0,23	5,32±0,12	6,23±0,28	35,1±1,3	29,9±1,8	35,0±1,6

Table 2. Competitive progress specific aerial/ ground triple jump rhythm structure

Group, m	Group average	Sprint speed	Hop time	Step time	Jump time	Phase time, % of the total		
						Hop	Step	Jump
14,98–15,75 (n=15)	15,48±0,29	9,49±0,41	0,67±0,04	0,53±0,05	0,84±0,04	32,8±1,9	26,0±2,2	41,2±2,1
15,78–16,41 (n=15)	16,11±0,21	9,69±0,36	0,67±0,03	0,55±0,03	0,84±0,05	32,5±1,7	26,7±1,9	40,8±2,4
16,44–17,03 m (n=15)	16,75±0,19	9,87±0,32	0,64±0,05	0,57±0,04	0,84±0,05	31,2±1,9	27,8±2,2	41,0±2,3
17,04–17,59 (n=15)	17,29±0,17	10,17±0,18	0,63±0,03	0,61±0,04	0,86±0,04	30,0±2,1	29,0±1,9	41,0±2,4
17,60–18,10 (n=15)	17,82±0,13	10,52±0,11	0,63±0,05	0,62±0,03	0,86±0,03	29,9±2,2	29,4±2,0	40,7±2,6

m), with the individual bests generally found to vary within 30+30+40% range.

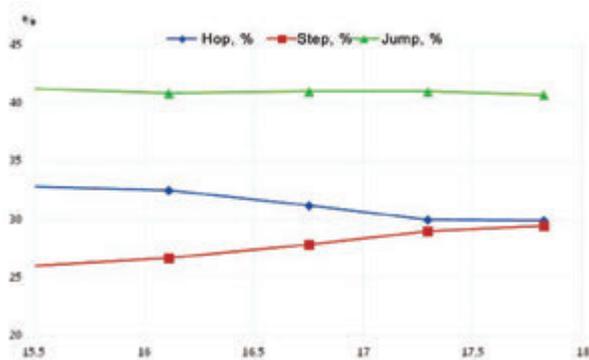


Figure 2. Competitive progress specific aerial/ground triple jump phase times, %

The study data give grounds to recommend the youth triple jump training systems giving a special priority to the right triple jump phase, pace and time control in every aerial and ground element of the movement sequence – so as to develop the perfect triple jump timing and pacing skills typical of the modern aggressive triple jump style, with the virtually the same hop and jump phases.

Conclusion. The study found the hop and jump phase ratios (%) in the men's elite triple jump sequence coming closer with the competitive progress, with the hop phase sagging and the jump phase growing. The aerial/ ground phase ratios for the triple jump leaders including the four-time world champion K. Taylor (18.21 m) and world record holder D. Edwards (18.29 m) were found close to 35+30+35%. Therefore, we recommend a model triple jump phase ratio for the triple jump elite (WCMS) with the hop,

step and jump phases close to 35+30+35%. It should be emphasized that with the competitive progress the men's triple jump elite demonstrate the hop and jump phase ratios coming closer to ideally model the D. Edwards' (18,29 m) standard of 30+30+40%. With the 15.1% competitive progress (from 15.48 to 17.82 m), the triple jump time was found to grow insignificantly by 3.4% only – that may be interpreted as indicative of the competitive progress in the triple jump depending rather on the sprint speed and aerial/ ground phase speeds in every triple jump element, i.e. the individual ability to keep the top horizontal speed in every triple jump phase. Note that the competitive progress with speed correlation ratio for the last approach segment was estimated to average 0.93 in our study.

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Coordination determinants of technical skills of young female tennis players

UDC 796.015



Ewa Waldzinska¹

PhD **Tomasz Waldzinski**²

Dr.Hab., Professor **Tomasz Niznikowski**³

^{1,2}Lomza State University of Applied Sciences

³Jozef Pilsudski University of Physical Education in Warsaw,
Department of Physical Education and Health in Biala Podlaska, Poland

Corresponding author: tomasz.niznikowski@awf-bp.edu.pl

Abstract

Objective of this study was to obtain knowledge on coordination determinants of technical skills of female tennis players aged 9 and 11.

Materials and methods. The study included female tennis players ($n=60$), body height (9 yrs $\pm 6.1 - 137 \pm 5.7$ cm; 6; 11 yrs $\pm 7.2 - 148 \pm 5.2$ cm), body mass (9 yrs - 34 ± 1.9 kg; 11 yrs - 43 ± 2.3 kg).

To assess the female tennis players' technical skills the test of 100 balls was applied. To control coordination motor abilities, the following tests were used: certain EUROFIT tests (the flamingo test, tapping the discs), the Spalding slalom running test, the shuttle run test, the Spider test, jumps over a skipping rope, jumps in the hexagon, the Starosta test, the eye-hand test, the test of simple reaction and the test of complex reaction.

Results. It was discovered that in the group of 9-year-old female tennis players, the simple reaction test result demonstrates the best predictive properties (it accounts for 19% of the variance in the test of 100 balls). In the group of 11-year-old female tennis players, the result of the shuttle run test independently accounts for 38% of the variance of the dependent variable. Conclusion. The effectiveness of performing the test of 100 balls depends on different predictors of coordination motor abilities.

Keywords: tennis, 100 balls test, coordination motor abilities.

Introduction. Tennis is regarded as the kind of sport in which, in addition to showing a high level of concentration and anticipation of the opponent's behaviour, technical skills as well as their coordination determinants play a key role.

Finding ways to achieve great results of sport performance is one of the biggest challenges of modern sport. The willingness to meet this challenge makes us constantly search for and deepen our knowledge of the phenomena accompanying the optimization of the training process in sport at different stages of advancement [1,2,3]. Many professionals believe that in the long-term process of training a young player, apart from teaching and learning about techniques and tactics, it is important to develop fundamental and specific conditioning and coordination motor abilities. The development of the latter favours the develop-

ment of fundamental motor skills, including the basics of technique, which is useful in the subsequent stages of training and makes it possible to achieve a higher level of sports mastery [4,5,6].

There is no doubt that coordination skills are of fundamental value to a tennis player. In the studies on the optimization of the training process, many authors attempted to identify factors determining the level of sports performance in tennis, and they pointed to their diversity. Some of them attribute an important role to such coordinating abilities as body balance, rhythmization, eye-hand coordination, simple and complex reaction time, kinaesthetic differentiation of movements, time of a single movement, frequency of movements and agility [7,8,9,10].

Therefore, it seems useful to search for coordination determinants of technical skills, which will make it

possible to bring additional information to the general training technology and to optimize the training process of female tennis players aged 9 and 11 a comprehensive stage.

Material and methods. The study included female tennis players ($n=60$), body height (9 yrs ± 6.1 - 137 ± 5.7 cm; 11 yrs ± 7.2 - 148 ± 5.2 cm), body mass (9 yrs - 34 ± 1.9 kg; 11 yrs 43 ± 2.3 kg). The players who took part in the study trained tennis three times a week in the clubs of Podlaskie region. The participants were divided according to their age categories.

Technical skills of the female tennis players were evaluated using the test of 100 balls. To control coordination motor abilities, the following tests were applied: some EUROFIT tests (the flamingo test, tapping the discs), the Spalding slalom running test, the shuttle run test, the Spider test, jumps over a skipping rope, jumps in the hexagon, the Starosta test, the eye-hand test, the test of simple reaction and the test of complex reaction. The normality of distributions was evaluated with the Shapiro-Wilk test. As they were normal, parametric tests were applied. Subsequently, correlation analyses were carried out using multivariate linear regression analyses with the stepwise method of inserting predic-

tors into the model. The intention was to find out which coordination model in the two-age groups would be the best to anticipate technical skills. The predictors introduced in the analysis were the results of the subsequent coordination tests, and the dependent variable was the result of the test of 100 balls.

Results. In the group of 9-year-old female tennis players, the simple reaction test result had the best predictive properties (it accounted for 19% of the variance in the test of 100 balls). Adding the jump measurement results to the model led to the fact that a total percentage of the explained variance was 24% (table 1).

In the group of 11-year-old girls, the result of the shuttle run test accounted for as much as 38% of the variance of the dependent variable. However, adding the Spalding slalom running test and the test of tapping the discs to the model resulted in a statistically significant increase in the percentage of the explained variance (by 8% and 4%) to the level of 47% of variations explained by the developed model that consisted of three such predictors. It is worth noting that they are all negatively correlated with the dependent variable. The lower the scores in the test of tapping the discs, the Spalding sla-

Table 1. Results of the linear regression analysis in the groups of 9- and 11-year-old female tennis players that aimed to find coordination predictors of high-level technical skills (the test of 100 balls)

		B	SE	β	R ²	ΔR^2	F _{changes}	P _{changes}	
9 yrs	model 1				0.19	0.19	13.62	<0.001	
	(Constant)	-106.64	58.51						
	Simple reaction test	4.47	1.21	0.44***					
	model 2				0.24	0.07	5.78	0.019	
	(Constant)	-45.51	61.72						
	Simple reaction test	4.78	1.17	0.47***					
	Jumps in hexagon	-4.75	1.98	-0.27*					
11 yrs	model 1				0.38	0.38	36.24	<0.001	
	(Constant)	522.08	59.81						
	Shuttle run test 5 x 8.23m	-26.34	4.38	-0.62***					
	model 2				0.44	0.08	8.07	0.006	
	(Constant)	586.92	60.91						
	Shuttle run test 5 x 8.23m	-17.58	5.16	-0.41**					
		Spalding slalom running test	-16.55	5.82	-0.34**				
	model 3				0.47	0.04	4.03	0.050	
	(Constant)	622.21	61.90						
	Tapping the discs	-3.04	1.52	-0.19*					
Shuttle run test 5 x 8.23m	-16.40	5.06	-0.39**						
	Spalding slalom running test	-15.59	5.70	-0.32*					

* - $p < 0.05$; ** - $p < 0.01$; *** - $p < 0.001$

lom running test and the shuttle run test, the better the scores in the test of 100 balls in this age group.

Conclusion. The effectiveness of performing the test of 100 balls depends on different predictors of coordination motor abilities. It is noteworthy that in the group of 9-year-old female tennis players, 19% of the variance is explained by the test of simple reaction (predictor), and 24% – by the test of simple reaction and jumps in the hexagon. In turn, in the group of 11-year-old female tennis players, the predictors explaining the variance were as follows: the shuttle run test (38%), the shuttle run test and the Spalding slalom running test (44%), the shuttle run test and tapping the discs (47%). The findings confirm the significance of the selected tests and their prognostic value.

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Age-specific dynamics of response rates in football players

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Senior teacher, master's degree student **S.V. Kondratovich**¹
PhD, Professor **A.V. Zakharova**¹
1Ural Federal University, Yekaterinburg

Corresponding author: s.v.kondratovich@urfu.ru

Abstract

Objective of the study was to identify the age-specific dynamics of the response rates in the 10-15 year-old football players.

Methods and structure of the study. Sampled for the study were the 10-15 year-old football players (n=18) training at the Sports School of Olympic Reserve "VIZ-Sinara", winners of the Russian futsal championships (2018; 2019-2020), many-time finalists and medal winners of the regional and national futsal tournaments. The longitudinal study of the subjects' psychomotor system performance indicators was carried out using the hardware and software complex "NS-Psychotest" ("Neurosoft" LLC, Ivanovo city). We analyzed the football players' simple (SVMR) and complex visual-motor response rates. A total of 190 samples were analyzed over 5 years (2014-2019).

The statistical data processing was made using the STATISTICA 23.0 software package. The statistical significance of differences was determined by the parametric Student's t-test.

Results of the study and conclusions. The simple visual-motor response rates in the football players ranged from 226.5±76.46 ms in the 10-11 year-olds to 188.67±33.44 ms in the 15 year-olds. The complex visual-motor response rates were also characterized by an upward trend: from 483.32±45.8 ms in the 10 year-olds to 297.51±27.81ms in the 14-15 year-olds. The results presented can be used as due reference values in monitoring the effectiveness of the training process and selection of junior football players.

Keywords: response rate, age peculiarities, junior football players, simple visual-motor response, complex visual-motor response.

Background. Team sports, among which is football, impose high requirements for athletes' individual psychophysiological characteristics. It can be argued that a response rate, as an aspect of the functional state of the nervous system, is the psychophysiological basis of motor activity in football, and the role of fast-decision making in unexpected extreme situations is growing in importance with age [2].

In experimental psychology, there are empirical materials relating to sensorimotor response in humans. The patterns that express the dependence of the response rate on individual typological qualities, as well as the characteristics of human mental health, were identified earlier [1, 3, 4, 7]. At the same time, the one-time screening of the psychophysiological

characteristics of highly-skilled athletes provided a series of case studies, while the data obtained in the children and adolescents were provided without the interpretation of the findings in view of the level of age-related development or sports specialization. The psychophysiological characteristics of the athletes in ontogenesis were virtually unexplored. Experts in sport psychology consider adolescence to be a sensitive period for the development of a number of mental qualities. Thus, 10-15 years is one of the most important age periods in a teenager's life. It is in this period that objective prerequisites for performing complex, previously unavailable motor tasks are created. In the first half of this period, sensorimotor qualities are developed, in the second half - cognitive ones [5].

The lack of age-specific qualifying standards for sporting children and adolescents makes it difficult to characterize various aspects of the psychophysiological determination of junior athletes' activities for practical purposes. Thus, it seemed relevant to examine the response rate in its long-term dynamics as an aspect that ensures successful sports activities.

To conduct a thorough study of the age-specific dynamics of the response rate and accurately describe the age-specific changes, a longitudinal method is recommended to be used. A longitudinal study is a long-term study of the identified factors in one population, which makes it possible to identify the age-related dynamics and forecast further development.

Objective of the study was to identify the age-specific dynamics of the response rates in the 10-15 year-old football players.

Methods and structure of the study. Sampled for the study was a group of male athletes born in 2004 - trainees of the Sports School of Olympic Reserve "VIZ", Yekaterinburg, with 3-5 years of training experience. The tests were run in the period from November 2015 through December 2019 on the basis of the laboratory "Technologies of Sports Rehabilitation and Selection" of the Common Use Center of Ural State University in the competitive (May 2016 (n=17); April-May 2017 (n=20)); preparatory (November 2015 (n=13); October 2016 (n=15); September 2017/2018 (n=22; 20); October-December 2019 (n=22)) periods, as well as in the pre-season (February 2017/2018 (n=20; 17); March 2019 (n=24)). We analyzed the test

results of 18 athletes who had participated in all the stages of the study.

The individual peculiarities of the response rate in the junior football players were studied using the hardware and software complex "NS-PsychoTest" (LLC "Neurosoft", Ivanovo city, Russia). A red light signal was used to determine the simple visual-motor response rate while the complex visual-motor response rate was measured based on the choice between two alternatives.

Results and discussion. It was found that the simple visual-motor response time in the junior football players was significantly reduced with age (Table 1). This was particularly evident between 10 and 12 years and 14 and 15 years. On the one hand, the identified drivers for change are natural age-related psychomotor function improvement processes and, on the other hand - the effects of regular training.

The decrease in the standard deviation of the response rate with age also indicates an improvement in the response stability. In addition, with each age period, the response rate decreased from 5.56 ± 0.4 errors in the first test (10-11 years) to 2.67 ± 0.29 errors in the final test (14-15 years).

The complex visual-motor response test includes a motor component similar to that in simple visual-motor response, signal detection and decision-making in response to the signal. These parameters can be used to assess the development of the decision-making speed. The central delay rate calculated by the formula the formula $M_{CVMR} - M_{SVMR}$ was used to assess the data processing speed (Table 2).

Table 1. Age-specific rates of athletes' response to a single-type stimulus ($M \pm SD$, (min-max))

Indicators	Age (y.o.)				
	10-11	11-12	12-13	13-14	14-15
Simple visual-motor response, ms	226.50±76.48 (197.75–267.71)	208.32 ±48.16* (178.82–239.57)	198.25±40.04 (174.2–229.7)	196.19±40.12 (177.1–222.88)	188.67±33.44* (154.6–212.6)
Attention span, c.u.	5.56±0.4 (2-9)	4.89±0.57 (2-12)	3.78±0.46 (1-8)	3.39± 0.5 (0-9)	2.78±0.29 (0-6)

Note. * – significance of differences ($p \leq 0.05$) compared to the previous year.

Table 2. Age-specific rates of athletes' reaction of choice between two alternatives ($M \pm SD$), (min-max)

Indicators	Age (y.o.)				
	10-11 (n=18)	11-12 (n=18)	12-13 (n=18)	13-14 (n=18)	14-15 (n=18)
Complex visual-motor response, ms	483.32 ±45.8 (375.4 – 546.65)	439.1±41.4 (378.78 – 487.2)	372.5±40.04* (318.25 – 396.4)	347.3±35.12 (298.99 – 369.3)	297.51±27.81* (235.62 – 341.59)
Central delay rate ($M \pm m$), ms	256.82±37.4	230.78±27.8	174.25±21.5*	151.11± 20.6	108.84±18.3*

Note. * – significance of differences ($p \leq 0.05$) compared to the previous year

Table 3. Simple visual-motor response rates in 10-15 year-old football players, ($M \pm SD$), ms

Contingent	Age (y.o.)				
	10-11	11-12	12-13	13-14	14-15
Football players from «VIZ-2004» team (n= 18)	226.50±76.48	208.32 ±48.16	198.25±40.04	196,19±40,12	188,67±33,44
Football players from Maykop Children and Youth Sports School of Olympic Reserve [2], (n=12)	280.1±2.7	257.2 ±2.2	231.1±2.1	202,3±0,5	176,3±1,2
Athletes from Minsk Children and Youth Football and Ice Hockey Sports School [4], (n=18)	-	-	214.86±19.89		
Response rates in the 11-17 year-olds					
	Low	Below average	Average	Above average	High
Arab football players [6, 8]	271 – 280	271 – 253	253 – 217	217 – 199	199 – 190

The annual increase in the simple visual-motor response rate in the football players from 10-11 to 15 years was 8.1%, 4.8%, 1.1% and 3.8%, respectively, and the annual increase in the complex visual-motor response rate was 9.2%, 15.2%, 6.8% and 14.4%. The detected increase is in sync with the sensitive period for the development of the simple visual-motor response - 10-12 years, and for the development of choice reaction - 13-14 years. At the age of 14-15 years, the visual sensory system is maturing intensively [2, 5, 7]. This ensures better functionality of the athletes, which has a positive effect on their reactivity on the playing ground.

Table 3 presents the study data on the response rates in the football players of “VIZ-2004” and the data obtained by other authors [1, 4, 6, 8] in athletes of different ages. It was found that the pattern of development of athletes' response in ontogenesis is similar to that described in other literary sources.

Conclusions. It was found that the response rates in junior and adolescent athletes are associated with the age-specific psychophysiological features and tend to improve. The results demonstrated by the successful 10-15 year-old football players can be used as due reference values in monitoring of the effectiveness of the training process and selection of junior football players. Age-specific psychophysiological features are essential to the individually-differentiated approach in football training.

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Modern practical gender-specific training systems in taekwondo

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Master of Sports of Russia **E.A. Simakova**¹

Dr. Hab., Professor **V.A. Chistyakov**²

N.P. Sharnin²

I.A. Grigoriev²

¹"Dolphin" Sports School, St. Petersburg

²National State University of Physical Culture, Sports and Health, St. Petersburg

Corresponding author: piskun@imop.ru

Abstract

Objective of the study was to analyze progress and promises of the modern gender-specific training systems in taekwondo.

Methods and structure of the study. We run a questionnaire survey of instructing athletes and coaches (n=20) from the St. Petersburg municipal and national teams, including 13 top-class coaches with 15-plus years long practical coaching experiences and 7 national/ municipal team members actively competing in the regional, national and international tournaments. The respondents were requested to check one of a few response options to profile practical applications of different theoretical materials in the popular training system, with every response scored on the relevant scale.

Results and conclusions. Currently, the Russian women's and men's national teams are trained together in the training camps. The survey data and analyses showed the need for special gender-specific training systems. The respondents underlined the need for the special gender-sensitive training service elements, with a special priority, among other things, to the natural differences in the tactical progress securing elements in the men's and women's taekwondo training system.

Keywords: taekwondo, Russian national team, questionnaire survey, analysis, training system, gender.

Background. Modern competitive taekwondo, one of the popular martial arts, prioritizes not only the technical and tactical aspects, but also a sport-specific philosophy with the relevant ethical pillars every taekwondo competitor is expected to develop and respect [1-6]. Presently modern competitive taekwondo makes a special emphasis on the athletic progress domain in fact although the training systems are traditionally designed on an integral basis. Still the technical and tactical training aspects tend to dominate in the training system – often at sacrifice of the physical, psychological and intellectual progress securing aspects [1, 2, 8].

Objective of the study was to analyze progress and promises of the modern gender-specific training systems in taekwondo.

Methods and structure of the study. We run a questionnaire survey of instructing athletes and coaches (n=20) from the St. Petersburg municipal and national teams, including 13 top-class coaches with 15-plus years long practical coaching experiences and 7 national/ municipal team members actively competing in the regional, national and international tournaments. The respondents were requested to check one of a few response options to profile practical applications of different theoretical materials in the popular training system, with every response scored on the relevant scale [1, 2, 8].

Results and discussion. Presently, the Russian women's and men's national teams' training systems give a special priority to field camp training cycles, with every specific training elements trained by the

Table 1. Questionnaire survey data on attitudes to the gender-specific training system, %

Training systems	No	Very seldom	Sometimes	Yes
Separate gender trainings	58,30	8,30	16,60	16,60
Separate trainings	66,60	8,30	8,30	16,60
Gender-specific rules of competitions	83,30	-	-	16,60
Technical differences	75	-	-	25
Tactical differences	16,60	-	16,60	66,60

team on the whole, although every athlete is free to control the training workload and intensity on an individual progress sensitive basis. Of special interest in our questionnaire survey were the athletes' attitudes to the gender-specific and unspecific trainings in the St. Petersburg sport clubs: see Table 1 hereunder.

The survey data showed the sample recommending the men/ and women' training systems being different, particularly in the tactical training aspects, rules of competitions etc. Modern taekwondo is classified into the following classes: "tul" (formal complexes), "sparring", "self-defense", "power breaking of objects" and "special techniques" [7], with every class training being rather lengthy and multisided. It is important that the tactical training differences are associated with differences in the psychological conditioning, physical and physiological progress aspects. However similar the technical training elements may be, their practical application in the competitive technical toolkits may widely differ in numbers and preferences

The gender differences mentioned in the rules of the competition relate mostly to the "special techniques" scoring standards, with a special priority to a few qualities including strength, explosive strength, speed-strength qualities, and with special relevant ranks within the "special techniques" class. Thus none of the 5 strikes in the "special techniques" class is scored on a gender-unspecific basis, with the gender difference making up at least 10 cm.

Many female athletes opt for one or a few competitive classes, with most of them competing in both the individual and team events. The women's training system in every class are significantly different from the men's ones, with every training system individualized for the technical actions mastering/ excellence cycles and intensities, with a natural sensitivity to the women's biorhythms as recommended by multiple theoretical and practical training manuals and research findings.

It should be noted that the modern combat sports have been increasingly popular in the women's sport communities for the last few years, with a special interest in taekwondo for the physical progress, health and self-confidence building reasons. This interest

has urged the sport community giving a special attention to different women's taekwondo training system improvement aspects, with a special focus on the training system individualization/ customization issues to meet the women's mental, physical and physiological progress needs. The training system shall be designed customizable in the integral training aspects, with a special focus rather on the tactical and psychological training aspects than the purely technical ones.

We believe that the women's taekwondo training system may be improved on the following provisions: (1) Due theoretical and practical basis for the women's taekwondo training system design; (2) Special practical training tools for competitive progress; and (3) Detailed design recommendations for the women's taekwondo training system for every class of the modern competitive taekwondo.

Conclusion. The survey data and analyses showed the need for special gender-specific training systems. The respondents underlined the need for the special gender-sensitive training service elements, with a special priority, among other things, to the natural differences in the tactical progress securing elements in the men's and women's taekwondo training system.

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Movement smoothness rating in musculoskeletal system rehabilitation service for athletes and choreography school students

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PhD **O.S. Vasiliev**¹Dr. Biol., Professor **S.P. Levushkin**^{1, 2}Dr. Med., Professor **I.I. Gaidamaka**³**A.A. Stolyarov**³¹Russian State University of Physical Education, Sport, Youth and Tourism (SCOLIPE), Moscow²Institute of Developmental Physiology of the Russian Academy of Education, Moscow, Russia³Stavropol State Medical University of the Ministry of Health of Russia, Stavropol

Corresponding author: nauka@skfmba.ru

Abstract

Objective of the study was to develop kinematic criteria for assessing local loading on the athletes' locomotor system to further plan rehabilitation activities.

Methods and structure of the study. The study involved the young athletes and dance school students with lower limb injuries and in need of rehabilitation. The study was carried out using the optoelectronic 3D motion capture system "Qualisys". Subsequent data analysis was carried out using a specially designed mathematical model in the statistical computing language R (R programming language) in the RStudio environment.

Results and conclusions. A mathematical model was developed to evaluate the smoothness of the movement trajectory of individual links of the locomotor system, which makes it possible to assess the dynamics and adequacy of local physical load during rehabilitation activities. The kinematic criteria were developed to rate local loading during the rehabilitation of athletes.

The developed concept and mathematical model aimed to analyze the smoothness of the movement trajectory formed the basis of a new perspective tool that enables to rate local loading on the athletes' locomotor system while planning rehabilitation activities.

Keywords: rehabilitation service, movement trajectory smoothness, movement harmony, pain syndrome, pain rating scale, injury, musculoskeletal system, athletes, physical workload.

Background. Special efficient post-musculoskeletal system-injury rehabilitation service is in a special priority in the modern athletic rehabilitation systems, with a key role played by the target physical practices. One of the most challenging and still underexplored issues of such rehabilitation systems is how the physical workload on the target musculoskeletal system segment shall be tested and controlled when the movements are still restricted to a degree and the relevant soft tissues (muscles, tendons, ligaments) may suffer from an excessive physical workload.

Objective of the study was to offer movement smoothness rating tests and analyses for the physical workload control in the musculoskeletal system rehabilitation service.

Methods and structure of the study. The study was run in 2015 through 2019 at the Research Sports and Sports Medicine Institute of Russian State University of Physical Education, Sport, Youth and Tourism (SCOLIPE). We sampled for the study the 12-16 (12.5 on average) year old academic gymnasts and choreography school students (n=46, including 27 girls and 19 boys) diagnosed with musculoskeletal system (mostly lower limb) injuries with immobility and functionality disorders need of a rehabilitation service. To develop the kinematic test criteria for the physical workload control, we used an optoelectronic 3D movement capturing Qualisys test system that produces a digital skeleton image for analysis using a set of skin-fixed reflective markers. The test data were analyzed with application of a special mathematical model us-

ing the mathematical stat R-language. The Qualisys tests included the following two stages:

1. Movement profiling tests and analyses for the target musculoskeletal system segment, with the subjects executing standard motions in circle, ellipse, Lemniscata Bernoulli, etc.; followed by the actual movement profile analyzed for the movement trajectory smoothness and pain syndrome levels versus the relevant standards on the visual analog pain rating scale. The injured limbs were examined next day after the test to diagnose overstresses if any.

2. Movement smoothness analysis for the subject musculoskeletal system segment used a set of well known movement standards for the choreographic trainings including Demi-plié, Grandplié, Battement-développé, etc.

Every injured limb test was run, when possible, by the other healthy limb, with the injured limb tests limited by at most 1 point on the pain rating scale. Upon completion of every test, the actual movement smoothness and trajectory was rated versus the movement trajectory smoothness standard and pain syndrome rate on the pain rating scale.

Results and discussion. Healthy movements may be rated by certain grace and plasticity (smoothness) tests [5], with the movement harmony known to grow with the nervous system progress and physical trainings to reach certain individual adaptation ranges and stay within them under varying conditions [1]. In kinematic terms, movement harmony may be defined as the movement smoothness based quality regardless of the movement amplitude and duration. Natural healthy movements are perceived, in the kinematic terms, as smooth with the right trajectories [5, 1] – in contrast to the unhealthy intermittent/ unsmooth movements typical of an injured musculoskeletal system segment. In neurophysiologic terms, smooth movements may be interpreted as the physical efforts minimizing ones, i.e. jerk minimizing in the biocybernetics language (\ddot{r}) for the whole movement trajectory [5, 2, 3].

Further studies found the logarithmic dimensionless jerk logs (J_N) having high sensitivity and low intra-group variability and, hence, beneficial for a wide range of the movement smoothness tests [5, 4]. Based on this assumption, we designed the local musculoskeletal system functionality and physical workload control mathematical model for the musculoskeletal system rehabilitation systems geared to minimize the logarithmic dimensionless jerk as follows:

$$\log(J_N) = \log\left(\frac{(t_2-t_1)^3}{v_{mean}^2}\right) \int_{t_1}^{t_2} t^2 (\ddot{x}(t)^2 + \ddot{y}(t)^2) dt \rightarrow \min,$$

where v_{mean} means the average movement speed in section. The function was used to rate the movement harmony in the tests.

Thus we found the reciprocating trajectory in “Beak” test to significantly increase the pain syndrome on the pain rating scale from 3 points in the “Lemniscate” test to 4 points in the “Beak” test. Note that the smooth movement standards were also different for the reason that the movement pattern of every movement is different and implies certain natural discontinuities. Given in Table hereunder are the musculoskeletal system test data with the injury rates, pain syndrome on the pain rating scale, rehabilitation progress rates and movement smoothness rates on a 10-point scale. Note that the rehabilitation progress rates were provisionally classified by the rehabilitation progress periods into the startup, middle, and final ones.

It should be noted that only 5 subjects (11% of the sample) were tested with full rehabilitation by the Grand-plié test in the startup rehabilitation period; and 19 subjects (43%) in the middle rehabilitation period. Furthermore, only 36 subjects (82%) were fully smooth in the Demi-plié test in the middle and 41 subjects (93%) in the final rehabilitation period. It should be emphasized that the Grand-plié effectively tests the lower limb functionality albeit its physical workload may be excessive for some lower limb injuries. Therefore, the Grand-plié test rates may not be rec-

Table 1. Injury rate (diagnoses), pain syndrome on the pain rating scale, rehabilitation progress rate and movement smoothness rate: Grand-plié test

Injury rates/ correlations (r)	Movement smoothness rates, pain syndrome on the pain rating scale	Rehab progress rate versus movement smoothness standard
Stretched ankle joint muscles/ tendons	-0.85	0.96
Apophysitis of the pelvic bones	-0.74	0.62
Osteochondropathy of the tibial tuberosity (Osgood-Schlatter)	-0.76	0.84
Osteochondropathy of the calcaneus tubercle	-0.72	0.68

ommended as universal rehabilitation rating criteria for the whole injury range.

Conclusion. Multiple foreign studies have acknowledged that the movement smoothness test rates and analyses provide a good insight into an individual motor functionality, with the movement smoothness test rates known to widely vary with neuromotor disorders/ injuries. However, the research community is still in need of special musculoskeletal system injury and rehabilitation service specific movement smoothness tests and analyses. We believe that the idea to rate the movement smoothness for the professional sport motor skills profiling and rehabilitation service progress rating purposes, as offered and analyzed herein, may be rather beneficial for the sport science.

Disclaimer

We could find neither direct nor indirect conflicts of interest in the published materials.

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Skeletal muscle relaxation to improve athletes' physical working capacity

UDC 612.063+796.071.2



PhD, Associate Professor **S.P. Zavitaev**¹
 Dr. Biol., Professor **Yu.P. Denisenko**²
 PhD, Associate Professor **E.S. Naboichenko**¹
K.A. Velikanov¹

¹Ural Federal University, Yekaterinburg

²Naberezhnye Chelny State Pedagogical University, Naberezhnye Chelny

Corresponding author: vsht.chel@mail.ru

Abstract

Objective of the study was to determine the effects of skeletal muscle relaxation on athletes' physical fitness levels.

Methods and structure of the study. The research method applied for the study purposes was computer polymyography developed by Yu.V. Vysochin. The experiment involved the football and hockey players of the children and youth sports schools of Naberezhnye Chelny, Yekaterinburg, and Chelyabinsk. The battery of tests included: 15 m run from standing start (15 cm), 15 m run with flying start (15 cm), 30 m run from standing start (30 cm), standing triple jump (3 cm), and 5x70 m shuttle run.

All the participants of the experiment were divided into two groups depending on the muscle relaxation rate. Group 1 included the athletes with the high muscle relaxation rate and Group 2 - with the low muscle relaxation rate.

Results and conclusions. The athletes with the high muscle relaxation rate (Group 1), who could tolerate heavy physical loads, were able to endure the tense preparatory period and entered the competitive season in excellent shape. For the athletes with the low muscle relaxation rate (Group 2), the same physical load turned out to be excessive, which was shown in the progressive deterioration of the professionally important athletic qualities.

Consequently, the application of an integrated relaxation training system makes it possible to achieve the best end results simultaneously in terms of all efficiency and adaptation criteria: high levels of energy cost efficiency, speed of the recovery processes, physical and psycho-emotional stress tolerance, physical development and technical skills, as well as the preservation of the health and long sports career of athletes.

Keywords: adaptation, relaxation characteristics, athletes, functional state, sports result.

Background. Modern sports are characterized by a steady increase in the volume and intensity of training and competitive loads. This necessitates the search for and introduction into practice of more effective organizational forms, tools and methods of the educational and training process aimed to improve the physical working capacity of athletes [3, 6-8].

Thus, many studies revealed a positive effect of special muscular relaxation exercises on the central nervous system, visceral organs and system performance, formation of rational blood circulation types, coordination of movements, speed, endurance, technical skill, improvement of special working capacity

and sports results in a wide range of sports activities [1, 2, 5-7]. Of particular importance, in our view, are studies proving the crucial role of the arbitrary relaxation rate of the skeletal muscles in the mechanisms of immediate and long-term adaptation of the body of athletes to extreme conditions or factors [6, 7].

Objective of the study was to determine the effects of skeletal muscle relaxation on athletes' physical fitness levels.

Methods and structure of the study. The computer polymyography method was used to study the mechanisms of regulation and coordination of arbitrary movements, control of the contraction and relax-

ation characteristics of the skeletal muscles, functional state of the central nervous and neuromuscular systems, developed by Yu.V. Vysochin [2]. This method is based on the synchronous graphic recording of the bioelectrical activity of the electromyogram, strength (dynamogram), transverse muscle tone (tonogram) of different muscle groups during the arbitrary tension and relaxation in the isometric mode.

The experiment involved the football and hockey players of the children and youth sports schools of Naberezhnye Chelny, Yekaterinburg, and Chelyabinsk.

The battery of tests included: 15 m run from standing start (15 cm), 15 m run with flying start (15 cm), 30 m run from standing start (30 cm), standing triple jump (3 cm), and 5x70 m shuttle run.

The polymyographic study was conducted once and the tests - thrice at the preparatory stage of the educational and training process.

Given the leading role of the muscle relaxation rate in the dynamics of sports results and levels of sports qualification, all subjects were split into two groups according to the arbitrary relaxation rate. Group 1 included the athletes with the high muscle relaxation rate, and Group 2 - with the low muscle relaxation rate. Even though the athletes were grouped based on one parameter only, significant intergroup differences were observed in a number of other parameters.

Results and discussion. The athletes from Group 1 ($p < 0.001$) surpassed those from Group 2 not only by the arbitrary relaxation rate, but also by the speed of development and intensity of inhibitory processes, balance between the nervous processes, general functional state of the central nervous system, general functional state of the muscles, classification index of the type of adaptation, integral indicator of the central nervous and neuromuscular systems functionality, overall efficiency of the bodily systems, forecast of sports success, as well as the capacity of work on the cycle ergometer. The injury rate characterizing the

likelihood of injuries and musculoskeletal diseases was significantly lower in Group 1.

Similar patterns were observed in each of the three educational tests, as well as in the average results of all three tests (see Table 1).

The athletes with the high muscle relaxation rate (Group 1) considerably surpassed those athletes with the low muscle relaxation rate (Group 2) in all tests, except for the 15 m run from the standing start (1st test) and 15 m run with flying start (2nd test). The most significant differences between the groups were found in the 3rd test and in terms of the average result in all three tests. This indicates that the arbitrary muscle relaxation rate has a significant impact on the speed abilities of athletes, as measured by the results of the 15 m and 30 m run tests, on their speed endurance, as measured by the 5x70 m shuttle run test, and on their speed-strength qualities, as measured by the standing triple jump test.

Of particular attention is the dynamics of changes in the test results and their deviations (in percentage) from the average group data (see Figure 1).

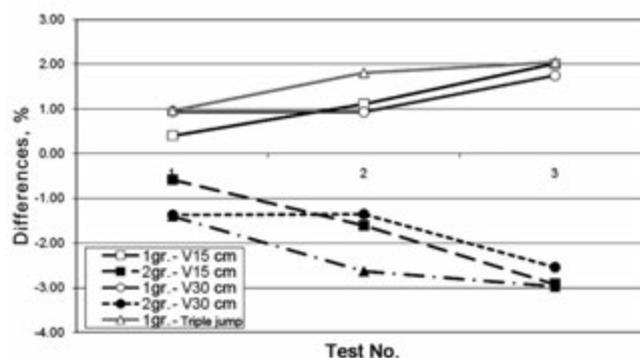


Figure 1. Dynamics of changes in test results at the preparatory stage of the annual educational and training cycle

As the figure illustrates, in Group 1 (high muscle relaxation rate), a progressive improvement was observed in all tests results, which indicated rather high

Table 1. Dynamics of changes in test results at the preparatory training stage of athletes with high (Group 1) and low (Group 2) muscle relaxation rate

Tests	Group 1 (16)		Group 2 (11)		Significance of differences		
	M	$\pm m$	M	$\pm m$	%	t	P
Average result in three tests							
V15 cm	6.65	0.029	6.46	0.042	2.94	3.72	0.001
V15 cm	8.92	0.039	8.64	0.079	3.22	3.15	0.01
V30 cm	7.62	0.028	7.40	0.038	3.03	4.71	0.001
V5*70 m	5.52	0.008	5.37	0.023	2.84	6.18	0.001
Triple jump cm	7.96	0.044	7.65	0.063	4.06	4.04	0.001

efficiency of the training process. At the same time, the Group 2 (low muscle relaxation rate) subjects demonstrated an equally progressive deterioration in all test results, which, on the contrary, testified to the low efficiency of the training process. But this was the same team, working on the same plans and performing the same training loads.

We assume that this was due to the specific characteristics of physical fitness and functional state of the athletes from these groups and, above all, the levels of development of the muscle relaxation rate rather than due to the organization of the training process itself.

Conclusion. The athletes with the high muscle relaxation rate (Group 1), who could tolerate heavy physical loads, were able to endure the tense preparatory period and entered the competitive season in the excellent shape. For the athletes with the low muscle relaxation rate (Group 2), the same physical load turned out to be excessive, which was shown in the progressive deterioration of the professionally important athletic qualities. It is safe to assume that the entire competitive period will be more intense and less successful for Group 2 athletes.

Consequently, an integrated relaxation training system applied makes it possible to achieve the best end results simultaneously in terms of all efficiency and adaptation criteria: high levels of energy cost efficiency, speed of the recovery processes, physical and psycho-emotional stress tolerance, physical development and technical skills, as well as to preserve health and long sports career of athletes.

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Muscle strength in different phases of menstrual cycle in context of theoretical analysis

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Dr. Biol. **A.K. Leal Cortes**¹**A. K. Ferreira**¹**P.S. Alves**¹Dr. Biol. **E. E. Martin Dantas**²PhD A. **K. Gomes**³Dr. Hab., Associate Professor **T.G. Fomichenko**⁴¹University center of Santo Agostinho, Teresina, Brazil²Federal University of the state of Rio de Janeiro, Rio de Janeiro, Brazil³Brazil Academy of sports coaches of the Brazilian Olympic Committee, Londrina, Brazil⁴Federal Scientific Center for Physical Culture and Sports, Moscow, Russia

Corresponding author: fomitchenko@yandex.ru

Abstract

Objective of the study was to theoretically analyze the women's muscle strength and physical working capacity variations with the menstrual cycle phases.

Methods and structure of the study. The study was designed to analyze and classify findings of practical studies with concern to the muscle strength variations with the menstrual cycle phases (15,842 sources in total for 2005 through 2018) available in the electronic databases.

Results and conclusions. As found by the studies, a woman's muscle strength averages 63.5% of a man's one, with the isometric muscle strength of a woman's upper body and lower limbs averaging 55.8% and 71.9% of a man's one, respectively. It was also found by a few studies that the lower-limb muscle strength of the contraceptive-using women appear to be menstrual-cycle-phase dependent, with a special fall in the follicular phase. Analyses of the study reports on the subject have found no systemic significant variations of the women's muscle strength with the menstrual cycle phases – as verified, among other things, by the conflicting findings of the studies focused on specific menstrual cycle phases assumed to be critical. The problem is further complicated by the differences in the muscle strength test methods. At the same time, the researchers generally recognize the importance of the strength training systems being reasonably customized to the menstrual cycle phases for the muscle mass building purposes. Note that we also used for our analyses findings of the studies commissioned by the Federal Scientific Center of the National Physical Culture and Sports Research Institute.

Keywords: muscle strength, menstrual cycle, physical working capacity, strength training.

Background. For the last few decades, national statistics have reported the growing popularity of physical fitness systems for muscle strength building, physical well-being, health improvement, body shaping (aesthetic) and competitive progress purposes [1]. Hard physical trainings, on the other hand, are known to provoke disorders in homeostasis, with special risks for the women's health due to the natural hormonal variations with the menstrual cycle phases. The sports science, however, still leaves underexplored the issues of the women's physical working capacity variations with the menstrual cycle phases [3, 7].

Objective of the study was to theoretically analyze the women's muscle strength and physical

working capacity variations with the menstrual cycle phases.

Methods and structure of the study. The study was designed to analyze and classify findings of practical studies with concern to the muscle strength variations with the menstrual cycle phases (15,842 sources in total for 2005 through 2018) available in the electronic databases.

Results and discussion. We found the practical studies giving priority to the single maximal-strength tests (54%), maximal-strength tests with 10-repetitions (23%) and lower-limb strength variation tests. Of special interest for our study was the fact that the researchers still disagree on the top- and lowest-phys-

ical-working-capacity menstrual cycle phases: see Table 1 hereunder.

As found by the studies, a woman's muscle strength averages 63.5% of a man's one, with the isometric muscle strength of a woman's upper body and lower limbs averaging 55.8% and 71.9% of a man's one, respectively [6, 15]. The studies differ on the question if the trainings-specific hormonal fluctuations affect physical working capacity; although report no significant fluctuations in the maximal muscle strength with the menstrual cycle phases [8, 10].

It was also found by a few studies that the lower-limb muscle strength of the contraceptive-using women appear to be menstrual-cycle-phase dependent,

with a special fall in the follicular phase [1, 2]. One study [15] argues that the wavelike training system control sensitive to the menstrual cycle phases may be rather beneficial for the lower and upper limb strength building and fat mass reduction programs, with the lean body mass reported to grow for an 8-week training cycle. The muscle strength versus menstrual cycle profiling studies found the average and top muscle strength growing in the postmenstrual phase although insignificant differences in the carpal strength were found in the contraceptives using versus non-using women [5].

In the postmenstrual phase, with the growth of estrogen and norepinephrine, the physical working ca-

Table 1. Key studies of the muscle strength variations with menstrual cycle phases

Source	Study type	Sample
Simão et al. (2007) [4]	Descriptive crosscut	21-32-year-old women (n=19) weighing in 49-72.8kg, 153-175cm tall, with normal 28-31-day menstrual cycle, and with the 3-year-plus strength training records
Bezerra (2015) [5]	Descriptive	26.2 ± 3.5 year-old women (n=4) weighing in 57±1.6kg, with 1-year-minus strength training records
Costa et al. (2013) [3]	Descriptive	20.6±0.70-year-old women (n=9) weighing in 59.6±6.85kg, 1.59±0.062cm tall, with normal 28-31-day menstrual cycle
Loureiro et al. (2011) [6]	Descriptive crosscut	27±7-year-old women (n=9) weighing in 58.2±5kg, 161±4.7cm tall, with normal 28-31-day menstrual cycle, and the strength training records of at least 2 years and 8 months
Lopes et al. (2013) [2]	Descriptive	22±1-year-old women (n=20), weighing in 56±5kg, 162±1cm tall, with the 2.2±0.5-year average strength training record
Celestino et al. (2012) [7]	Descriptive longitudinal, application and qualitative	18-30-year-old women (n=8), with 6-month-plus strength training records and normal 25-32-day menstrual cycle
Dias et al. (2005) [1]	Descriptive longitudinal	20-25-year-old women (n=8), 153-169cm tall, with normal 28-31-day menstrual cycle and 6-month-plus strength training records
Kuboetal. (2009) [8]	Descriptive experimental	22.5 ± 0.9-year-old women (n=8) with normal 28-31-day menstrual cycle classified into menstrual (low estradiol and progesterone), ovulatory (high estradiol, low progesterone), and luteal (high progesterone) phases
Lima et al. (2012) [9]	Descriptive	18-25-year-old women (n=25) with normal menstrual cycle for the last 6 months
Oliveira (2015) [10]	Descriptive longitudinal study with a special sample	20-40-year-old women (n=14) with the 3-month-plus strength training experiences in regular Physical Education classes only
Pallavi, SoUza, Shivaprakash (2017) [11]	Prospective	18-24-year-old women (n=100) with normal 26-32-day menstrual cycle (28 on average) and 6-month-plus strength training records
Pedregal et al. (2017) [12]	Descriptive explorative crosscut and qualitative	18-38-year-old women (n=10) non-using contraceptives, with normal menstrual cycle, with the 6-month-plus strength training records
Ramos et al. (2018) [13]	Experimental qualitative and quantitative	18-39-year-old women (n=15) using oral/ injection contraceptives, with the 6-month-plus strength training records
Rezende et al. (2009) [14]	Descriptive crosscut	18-30-year-old women (n=5) with normal menstrual cycle and the 6-month-plus strength training records

capacity rates were tested to grow as reported by the study [3]. The lower-limb muscle strength appears to vary with the menstrual cycle phases in physically active women non-using contraceptives, with the muscle strength peaking in the luteal phase [14, 15]. Other studies found the menstrual cycle phases having insignificant effect on the lower- and upper-limb muscle strength in the strength training women; and on the strength building by single-/ multi-joint exercises for the large/ small muscles and/ or specific body segments [10, 12].

Conclusion. Our analyses of the study reports on the subject have found no systemic significant variations of the women's muscle strength with the menstrual cycle phases – as verified, among other things, by the conflicting findings of the studies focused on specific menstrual cycle phases assumed to be critical. The problem is further complicated by the differences in the muscle strength test methods. At the same time, the researchers generally recognize the importance of the strength training systems being reasonably customized to the menstrual cycle phases for the muscle mass building purposes. Note that we also used for our analyses findings of the studies commissioned by the Federal Scientific Center of the National Physical Culture and Sports Research Institute.

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Wingate tests in elite sports: comparative analysis

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PhD, Associate Professor **K.R. Mekhdieva**¹PhD, Professor **A.V. Zakharova**¹**M.A. Vadelshchikova**¹Postgraduate student **V.E. Timokhina**¹¹Ural Federal University named after the first President of Russia B.N. Yeltsin, Yekaterinburg

Corresponding author: kamilia_m@mail.ru

Abstract

Objective of the study was to analyze and compare the Wingate Test rates in elite athletes of different specializations.

Methods and structure of the study. Sampled for the study were the 17-35 year-old elite athletes ($n=129$) of different specializations: football ($n=29$), futsal ($n=32$), cross-country skiing ($n=27$), mixed martial arts ($n=29$), track and field sports ($n=3$), speed skating ($n=3$), judo ($n=6$). The study was conducted according to the standard Wingate test protocol. The subjects ran Monark Ergonomic 894E Peak Bike. Their maximal alactate power and average power rates were determined.

Results of the study and conclusions. The study revealed statistically significant differences between the maximal alactate power rates in the world-class and Russian mixed martial arts fighters (11.36 ± 1.39 W/kg and 12.22 ± 0.89 W/kg, $p < 0.05$), in the futsal players of different age subgroups (14.13 ± 1.32 W/kg and 14.82 ± 1.1 W/kg, $p < 0.05$). In the subgroups of the skiers of different qualification levels, no statistically significant differences were found (12.98 ± 1.61 W/kg and 13.18 ± 0.59 W/kg, $p > 0.05$). The highest maximal alactate power and speed-strength endurance rates were observed in the speed skaters, futsal and football players (from 14 W/kg to 17.45 W/kg). The average power rates were virtually the same in the athletes of all specializations.

Keywords: Wingate test, sport elite, lactate threshold test, speed-strength endurance, qualities.

Background. Wingate test is widely used in the modern athletic training systems since it provides fairly objective speed-strength test rates indicative of the actual individual anaerobic power critical for success in many sports. Despite the fact that the speed-strength qualities may be rated by many test systems [3, 4] the Wingate test is ranked among the most popular and accessible ones [1].

Objective of the study was to rate and analyze the Wingate test data of the national sport elite on a discipline-specific basis.

Methods and structure of the study. The study was run at the Functionality and Integrated Athletic Progress Test Laboratory of the Ural Federal University. We sampled the 17-35-year-old elite athletes ($n=129$) competing in football, futsal, mixed martial arts, cross-

country skiing, track and field sports, speed skating and judo. The sport subsamples were split on a skills-specific (WCMS, MS, CMS) and competitive-success-specific basis (national and international titles).

Thus the mixed martial arts competitors were split up into the European and World Championship medalists ($n=13$, aged 25.23 ± 4.56 years, 178.61 ± 4.48 cm tall and weighing in 78.53 ± 9.98 kg on average) and Russian Championship medalists ($n=16$, aged 24.5 ± 2.96 years, 178.75 ± 5.88 cm tall and weighing in 78.75 ± 8.21 kg on average). It should be mentioned that most of the world-class fighters are ranked high in other combat sports including sambo, wrestling, kickboxing, hand-to-hand fighting, grappling, boxing, etc. The cross-country skiers were split up into the World Class Masters of Sports, medalists of in-

ternational competitions ($n=7$, aged 31 ± 2.58 years, 180.85 ± 3.57 cm tall and weighing in 79 ± 1.82 kg on average) and Masters of Sports and Candidate Masters of Sports, Russian Championship medalists ($n = 20$, aged 19.15 ± 4.84 years, 176.65 ± 4.93 cm tall and weighing in 69.6 ± 6.58 kg on average).

The futsal players were split up into age groups of 21-minus ($n=16$, aged 19.18 ± 0.98 years, 178.56 ± 4.77 cm tall and weighing in 70.87 ± 7.71 kg on average) and 21-plus-year-olds ($n=16$, aged 28.06 ± 5.60 years, 179.68 ± 6.22 cm tall and weighing in 73.93 ± 6.97 kg on average). Note that the above age groups were actually skills-specific as the junior group was dominated by the Russian Championship medalists, whilst the senior group included the Super League and European/ World Championship medalists. The football sample ($n=29$, aged 20.24 ± 1.27 years, 181.65 ± 6.07 cm tall and weighing in 73.79 ± 5.49 kg on average) was composed of the Professional Football League players.

The speed skating subsample ($n=3$, aged 20.66 ± 6.35 years, 180 ± 2 cm tall and weighing in 75.33 ± 10.01 kg on average); track and field subsample ($n = 3$, aged 25 , 66 ± 2.30 years, 174 ± 10.39 cm tall and weighing in 59 ± 5.29 kg on average) specialized in

the long-distance and highland races; and the judo subsample ($n=6$, aged 20.5 ± 1.51 years, 175 ± 6.92 cm tall and weighing in 81.5 ± 9.48 kg on average) were all Masters of Sport and Russian Championship medalists. A Reference Group was made of the Institute of Physical Culture students including the Sverdlovsk Oblast sport team members and unsporting students ($n=53$, aged 23.19 ± 4.8 years, 177.65 ± 19.43 cm tall and weighing in 77.76 ± 11.05 kg on average).

Every subject gave an informed written consent for the study and individual test data processing and publication. Wingate test was run using a vertical cycle ergometer Monark Ergomedic 894E Peak Bike (made by Monark, Sweden) with a standard test protocol [2]: 5-minute muscle warm-up (staircase run, on-spot run, etc.) plus 1-minute cycling warm-up followed by a 30-second top acceleration test with a preset weights rated at 7.5% of the individual body mass – to produce the lactate threshold test rate (W/ kg) and average power (W/ kg).

Results and discussion. Given in Table hereunder are the Wingate test data with the lactate threshold test and average power rates for the sampled sport groups.

Table 1. Wingate test data with the lactate threshold test and average power rates for the sampled sport groups ($M \pm SD$, min-max)

Sport	Sub-grouping criteria	Lactate threshold test, W/ kg	AP, W/ kg
Speed skating	MS, WCMS	$15,26 \pm 0,47$ (14,75-15,34)	$9,92 \pm 0,78$ (9,42 -10,82)
Futsal	18-21 year olds	$14,13 \pm 1,32$ (12,8 -17,46)	$9,11 \pm 0,7$ (7,82-10,08)
	21+ year olds	$14,82 \pm 1,1$ (13,23-16,58)	$9,28 \pm 0,72$ (7,77-10,41)
Football	18-21 year olds	$14,64 \pm 1,1$ (13,45-17,13)	$9,62 \pm 0,53$ (9,26-10,45)
Judo	MS, WCMS	$13,69 \pm 0,36$ (13,23-14,29)	$8,66 \pm 0,22$ (8,31-14,29)
Mixed martial arts	National medalists	$11,36 \pm 1,39$ (9,9-13,05)	$8,14 \pm 0,61$ (6,86-9,14)
	International medalists	$12,22 \pm 0,89$ (10,25-13,69)	$8,29 \pm 0,32$ (7-8,96)
Cross country skiing	CMS, MS	$12,98 \pm 1,61$ (10,32-16,17)	$8,87 \pm 0,7$ (7,52-10,27)
	WCMS	$13,18 \pm 0,59$ (12,59-14,27)	$8,88 \pm 0,52$ (8,39-9,67)
Track and field sports	MS, WCMS	$12,68 \pm 1,9$ (11,08-14,79)	$9,31 \pm 0,86$ (8,78-10,3)
RG, sporting students		$12,02 \pm 1,29$ (8,21-14,49)	$8,21 \pm 0,64$ (6,64-10,46)

The intra-group (discipline-specific) comparisons of the lactate threshold test and average power test data found significant differences between the Russian Championships and European and World Championship medalists ($p < 0.05$); and between the futsal age groups ($p < 0.05$). The cross-country skiing groups, however, showed insignificant skill-specific differences ($p > 0.05$). Moreover, the average power differences were found insignificant for the sports groups on the whole ($p > 0.05$).

The lactate threshold test and average power rates were expectedly high for the speed skating groups; and the lactate threshold test rates were also high for the cross-country WCMS, whilst the younger and less skilled skiers were tested with the lower lactate threshold test rates (under 16 W/ kg). It should be noted that the relatively high speed-strength qualities may not always guarantee success in modern cross-country ski races. Thus the long-distance ski racers were tested with the relatively low lactate threshold test and high speed-strength endurance test rates (with average power = 9.31).

The RG test data and analysis give the reasons for the following findings: (1) lactate threshold test rates under 10 W/ kg are unusual for the sporting individuals (even amateurs); and (2) untrained people may be tested high on the lactate threshold test scale and low on the speed-strength endurance scale.

The correlation analysis found significant correlations of the lactate threshold test and average power test rates for the world-class mixed martial arts competitors ($r = 0.89$, $p < 0.01$); 21-minus-year-old futsal players ($r = 0.498$, $p < 0.05$); their 21+ peers ($r = 0.69$, $p < 0.01$); WCMS skiers ($r = 0.814$, $p < 0.01$); CMS/MS skiers ($r = 0.805$, $p < 0.05$); and for the sporting RG subgroup ($r = 0.547$, $p < 0.01$). No correlations

were found for the football group ($r = 0.346$, $p > 0.05$); and for the Russian-level mixed martial arts group ($r = 0.319$, $p > 0.05$).

Conclusion. The study found the highest speed-strength endurance test rates in the speed skating, football, judo and world-class cross-country skiing subsamples – versus the relatively low speed-strength endurance rates in the mixed martial arts subsample.

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Chinese national women's volleyball team: evolution of training theory and practice

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Dr. Sc. Phil., Professor **Yang Zhi**²Dr. Hab., Professor **V.P. Guba**¹**Huang Yun**³¹Russian State University of Physical Education, Sports, Youth and Tourism (SCOLIPE), Moscow²Henan University, Kaifeng, China³Zhengzhou SIAS University, Zhengzhou, China

Corresponding author: 249289253@qq.com

Abstract

Objective of the study was to determine the peculiarities of the technical-tactical training of the Chinese national women's volleyball team.

Results of the study and conclusions. As practice shows, in the Chinese national women's volleyball team training process special attention is paid to technical stability while high requirements are set to the quality of each match played during the competition. Team competitiveness is increased by means of targeted trainings aimed to improve the female athletes' psychological preparedness for competitions. The load intensity during such trainings approaches or even exceeds the competitive load intensity so that to meet the needs of world competitions. Such high-intensity trainings combine two dimensions: one - physiological load intensity, two - psychological load intensity. Heavy workloads require that the quality of technical and tactical practices are rationalized. The members of the Chinese national women's volleyball team give much attention to the precompetitive trainings and scoring, as well as to the rehabilitation activities after trainings and competitions. Innovative methods and tactics are an important way to achieve excellent sports results. In line with the world volleyball development trends, the Chinese national women's volleyball team is actively involved in technical-tactical research and innovative projects.

Therefore, theoretical and practical innovations in athletic training are an important reason why the Chinese national women's volleyball team has long been among the world's strongest teams and has achieved significant results in world competitions. The main advantage of the Chinese women's volleyball team training system is the unique technical and tactical style of playing, strict observance of the principle of competitive needs, training in compliance with the actual requirements, innovation based on the volleyball development trends and evolution of its main characteristics.

Keywords: volleyball, theoretical and practical support service, athletic training system, competitive performance.

Background By 2020, the Chinese women's national volleyball team has won 10 titles of the top-ranking international championships (including 3 Olympic titles) plus 11 medals of the other major events. These outstanding competitive accomplishments are believed to be due to the modern effective training system with the growing application of innovative training models and tools and new training service design and management ideas.

Volleyball in China has been on the growth since 1905 and made a great progress for this more than 100-year period. Since the 1980s, the Chinese national women's volleyball team has been increasingly

dominant in many global tournaments where it was challenged mostly by the USSR national team [2]. Nowadays the teams' technical and tactical toolkit is highly aggressive and efficient with the well harmonized attacks and defenses. The national volleyball progress history for the last century shows that the competitive successes have been mostly due to the new unexpected technical and tactical elements and special techniques spearheading progresses of the players and teamwork on the whole [1, 3].

Objective of the study was to analyze the technical and tactical progress aspects of the Chinese national women's volleyball team training system.

Results and discussion. Since a new scoring system was introduced with every error bringing a point to the rival team, the requirements to the individual technical skills and their stability were stepped up. The Chinese national women's volleyball team training system analysis shows the coaches and experts tend to give a growing priority to the technical performance stability and quality in every rally and every match. With the fast progress of the Chinese national women's volleyball team in every attack and defense element, the national sport community has been persistently looking for the technical and tactical skills excellence tools, models and methods. In pursuing this policy, the Chinese national women's volleyball team has made a special emphasis on the serving and attacking skills quality and stability in trainings, with the serves designed to facilitate the blocking and defensive actions. As a result, the Chinese national women's volleyball team serves at the 2018 World Volleyball Championships were notably more stable than those of the other leading teams and, hence, heavily complicated the opponents' attacks and facilitated the Chinese national women's volleyball team's defense technical and tactical actions.

Furthermore, the Chinese national women's volleyball team has prioritized joint training with the men's teams and individual players for the skills excelling purposes, and these trainings have effectively contributed to its competitive progress [6, 8]. The Chinese national women's volleyball team trainings are often assisted by a few top-professional sparring male players that closely mimic the game styles of the leading foreign opponents to help the female players develop the counter technical and tactical skill sets for competitions and be able to efficiently control the game and exert pressure as required for success. Prior to the Rio Olympics, the Chinese national women's volleyball team coaches Chen Zhonghe and Li Tong gave a special priority in the trainings to the team leaders' (Yuan Zhi, Shi Hayrong and others) technical and tactical excellence elements, and these trainings heavily contributed to their teams' competitive success in the event.

It should be mentioned that the competitive technical and tactical skills and the competitive performances on the whole may be highly influenced by the actual timeframes of the World Series events, their locations, venue, refereeing service quality, spectators, climatic conditions, transportation service, accommodation, diets and many other factors of influence. The coaches and athletes need to timely understand, analyze and respond these objective factors of influence on the competitive performance by special target training tools to make the athletes mentally and physically fit for potential hardships in the upcoming matches, with such precompetitive conditioning sessions being rath-

er traditional for the Chinese national women's volleyball team for the last decade. On the Chinese national women's volleyball team way to success in the top-ranking global events, coach Yuan Weimin has often modeled a wide variety of potential match situations in the targeted training sessions. The team, for example, has been trained for 2 hours straight after transportation, with the training timeframes and workloads simulating the actual expected matches.

Note that many World Series events are always run around the midday time which is the traditional lunch-time for the Chinese athletes. No wonder that the athletes may be far from their individual best physical and mental fitness standards at that time. Knowing that, the team management runs a series of special scheduled trainings to help the athletes meet the physical and mental problems, get fit for any match time and effectively adjust to whatever situation when necessary [4, 10]. Such special unpredictable trainings make the athletes highly fit for a wide range of unexpected problems and stressors that may come up in matches. They develop an effective adaptability to get always fit for response to any problem, plus highly immunity to any influence from outside. When Lan Ping coached the Chinese national women's volleyball team, she used special precompetitive conditioning trainings to effectively model the upcoming match times and conditions on the stadiums and indoors. These trainings effectively helped the athletes develop specific stress tolerances for the upcoming matches, with a firm concentration on own technical and tactical skills and missions – to be able to effectively mobilize their competitive resources for success.

With the permanent improvements in the theoretical and practical support service quality, the team has given a growing priority to the rehabilitation methods, models and tools – knowing that the competitive and training workloads need to be well harmonized with the rehabilitation service for competitive progress [5, 9]. As things now stand, the Chinese national women's volleyball team trainings take more than 6 hours per day 6 days a week – that makes up 36 hours a week in total. The team trains particularly hard for the “Three Major Tournaments” (Olympic Games, World Championships and the World Cup) with a special priority to the individual physical fitness management aspects and competitive stress tolerance. The team often runs high-intensity trainings closely simulating the actual competitions to make the athletes fit for the top-ranking events. These high-intensity trainings make a special emphasis on the following two aspects: (1) physical fitness for success; and (2) mental conditioning for the competitive stressors. The trainings are also designed to excel the technical and tactical skills by special practices, with a special focus to the counteractions to the opponents' technical and tactical ac-

tions and match situations, for the athletes to be highly fit for the potential mental and physical stressors and able to respond by the most efficient technical and tactical skills. Such aggressive confrontation mimicking training methods with the performance scoring, wins and losses has proved highly efficient for the individual mental conditioning and teamwork improvement purposes making the athletes highly fit for the mental and physical pressures in matches on their way to success.

Furthermore, the Chinese national women's volleyball team has lately given a special priority to the precompetitive target trainings with the performance scoring followed by highly effective rehabilitation sessions after every match and tournament. When athletes are seriously injured and unfit for further high-intensity training, they enjoy special therapeutic and rehabilitation services to facilitate their recovery as required by the team health policies and practices. With the modern volleyball sport being increasingly commercialized and professionalized, the national athletes on the whole and national team members in particular feel more and more responsible for the club/ team performance and, hence, train hard to keep up their competitive fitness throughout the whole calendar year, with the innovative technical and tactical training methods and models being particularly appreciated for their growing contributions to the competitive successes [7]. This is the reason why the Chinese national women's volleyball team management, coaches and athletes are always prepared to test the new technical and tactical research findings and innovative technical and tactical training tools.

Conclusion. Modern theoretical and practical support service is ranked increasingly high among the priority training components that pave the way for the Chinese national women's volleyball team to the competitive successes in the top-ranking world competitions. The key advantages of the Chinese national women's volleyball team training system include the unique technical and tactical skill sets and special game styles developed by the team; persistent progress with a special focus on the individual skills,

teamwork and competitive spirit; high customization of the training system for success in modern volleyball; and efficient innovative training models and tools geared to respond to the volleyball progress trends and the actual evolution of the game with time in every element.

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Theoretical and practical support service for sports elite: foreign experience

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PhD **A.V. Zubkova**¹Dr. Hab. **A.G. Abalyan**¹PhD **T.V. Dolmatova**¹Dr. Hab. **T.G. Fomichenko**¹Dr. Hab., Professor **M.P. Shestakov**¹¹Federal Scientific Center for Physical Culture and Sports, Moscow

Corresponding author: fomitchenko@yandex.ru

Abstract

Objective of the study was to run a comparative analysis of the theoretical and practical support service to foreign sports elites.

Methods and structure of the study. We run for the purposes of the study an analysis of the data on the subject available from the relevant science-metrics databases and websites of the relevant French and Canadian governmental and non-governmental sports organizations.

Results of the study and conclusions. The study showed that the methodological support in Canada and France is organized by many specialists and scientists working with athletes in stationary sports training centers. The sports centers have a hierarchical structure that enables them to work not only with the main national teams but also with the promising athletes of the youth and reserve teams. Particular attention should be paid to the following difference in the organization of the methodological support.

In France, the sports prospects' training service is largely sponsored by the relevant sports federations – in contrast to Canada where their training service is sponsored by the local governments. Unlike the existing Russian standards that require every sport discipline being served by a dedicated research team, Canada and France make a special emphasis on the key medals-promising sports based on the great local historical traditions and experiences plus the well-developed service systems of the relevant sports federations that ensure high inflows of the enthusiastic young human resource to these popular sports.

The study data and analyses have clearly demonstrated the growing role played by the modern theoretical and practical support service for the national sports elites having good chances for the World Championship, European Championship and Olympic titles.

Keywords: *theoretical and practical support service, sports elite, sports institutions, multisport centers.*

Background. The theoretical and practical support service is in top priority in the modern sports elite training systems and institutions – as verified by the practical progress experiences of the leading sports nations. The key international competitors of Russia have lately demonstrated a growing interest in comparative analyses of the national progress in the theoretical and practical support service for the sports elite. We sampled France and Canada for the purposes of the study since both nations have been highly successful in the recent Olympics. Thus France was ranked in the top-10 on the Summer Olympics

and 2014/ 2018 Winter Olympics unofficial scoreboards; and Canada was ranked in the top-3 on the three latest Winter Olympic unofficial scoreboards; and in the top-20 of the 2016 Summer Olympics in Rio de Janeiro.

Objective of the study was to run a comparative analysis of the theoretical and practical support service to foreign sports elites.

Methods and structure of the study. We run for the purposes of the study an analysis of the data on the subject available from the relevant science-metrics databases and websites of the relevant French

and Canadian governmental and non-governmental sports organizations.

Results and discussion.

Sports Centers and Institutions of Canada

The Athletic Institutions and Centers of Canada [7] have been established by the Sports Canada, Canada Olympic Committee (COC), Coaches Association of Canada (CAC), and the relevant provincial governments. The Canadian Olympic and Paralympic Sports Institutions (COPSI) network may be described as the system of multisport centers recognized by Sports Canada and Win the Pedestal foundation and sponsored by the relevant national and provincial partners.

The network includes four sports institutions of Canada based in Calgary, Montreal, Ontario and British Columbia, and three Canadian multisport centers in Manitoba, Saskatchewan and Atlantic Canada. In addition to the practical service at the sports institutions and centers, the key research teams advance their projects in the modern athletic training theory, sports progress facilitating technologies and the short- and long-term training system designs with contributions from the modern sports elite training and excellence methods, models and technologies.

The above Canadian sports institutions and centers report to serve about 1,300 national elite athletes competing in 81 sports, with every sports institution / center naturally specialized in a few sport disciplines due to mostly local geographical and cultural specifics. Despite the service specialization, every of the seven sports institutions is highly active in

virtually every sport as required by the flows of local resource and specific needs of the local sport elites. Moreover, many sports institutions and multisport centers within the COPSI network actively collaborate with both their national sports federations and provincial sports organizations, particularly in the junior prospects' training service aspects. As demonstrated by some research data, athletes and coaches normally fix, report and apply not more than 30% of the training and competitive progress related data; and the sports institution experts take special efforts to mine and analyze the remaining 70% of the data using a wide range of modern research tools. Given in Table 1 hereunder is the financial flow analysis for the governmental assignments (\$16 million per year) for the national sports institutions and multisport centers via the Sports Canada and Win the Pedestal foundation [1].

Sports centers and institutions of France

The French Sports Ministry controls the French Institute of Sport (INSEP) responsible for the sports elite training service and training of trainers, plus studies in the sports theory [9]. The two key divisions of the INSEP are the Sport, Expertise and Performance Lab (SEP) and the Institute of Biomedical and Epidemiological Research in Sport (IRMES) that provides special theoretical and practical support service including the biomedical support service to the national sport elite competing in the Olympic and Paralympic sports teams [10]. The INSEP actively advances research in the sport theory, with the research projects implemented in close cooperation with the French national sports federations, often at

Table 1. Governmental financing of the sports institutions and multisport centers via the Sports Canada and Win the Pedestal foundation in 2016 through 2019, \$

Beneficiaries	2015-2016	2016-2017	2017-2018	2018-2019
Canada Sports Center (CSC), Atlantic Canada	558,941	645,846	647,050	647,890
Manitoba CSC	404,250	374,010	347,800	326,785
Saskatchewan CSC	297,420	298,420	311,920	302,301
Canada Sports Institute (CSI), Calgary	4,112,600	3,812,317	3,396,696	3,081,374
Ontario CSI	2,258,890	2,487,849	2,820,135	3,107,665
British Columbia CSI	4,143,876	3,896,660	3,491,996	3,764,893
National Sports Institute, Quebec	3,298,149	2,936,062	2,829,109	2,950,436
Total	15,074,126	14,451,164	13,844,706	14,181,344

Table 2. Governmental finance for the FFE's sports elite training service as of 2017, Euro thousand [5]

Disbursements	Budget	Ministry of Sports share, %	National Federation's share, %	Other, %
Research projects	20	65	35	–
Obligatory health service to the sports elite	18	100	–	–

requests for research in specific sports domains from the relevant sports coaches [8]. In addition to the INSEP, such research projects are run by the French Riding Institute, National Institute of Sailing and Water Sports, National Institute of Alpine Sports and the National Sports Museum.

French Fencing Federation (FFE)

It is the National Technical Directorate (DTN) on the whole and its Sports Elite Service Department in particular that are responsible for the theoretical and practical support service to the national teams [63]. The sports elite training systems are tested and implemented by the National Teams Training Center at the INSEP, and its six affiliated sport reserve training centers [4]. There is also a scientific research department in the French Fencing Federation.

French Judo Federation (FFJ) There are four national judo training centers in the country known as the “Pole France Releve” based in Bordeaux, Marseille, Orleans and Strasbourg [6].

French Ski Federation [2] The National Technical Director manages the National Technical Advisory Service (CTS) that employs around 80 technical experts contracted by the French Sports Ministry.

Therefore, the modern theoretical and practical support service for the sports elite in Canada and France is provided by a large pool of theoreticians, coaches and training experts at the stationary sports centers designed on a hierarchical basis to effectively serve the active sports elite, potential qualifiers for the national teams and promising junior prospects. We would mention the following national differences in the theoretical and practical support service.

In France, the sports prospects’ training service is largely sponsored by the relevant sports federations – in contrast to Canada where their training service is sponsored by the local governments. Unlike the existing Russian standards that require every sport discipline being served by a dedicated research team, Canada and France make a special emphasis on the key medals-promising sports based on the great local historical traditions and experiences plus the well-developed service systems

of the relevant sports federations that ensure high inflows of the enthusiastic young human resource to these popular sports.

Conclusion. The study data and analyses have clearly demonstrated the growing role played by the modern theoretical and practical support service for the national sports elites having good chances for the World Championship, European Championship and Olympic titles.

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Data analysis systems for sailing sports reserve training service

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Dr.Hab., Professor **S.E. Bakulev**¹Dr.Hab., Professor **S.M. Ashkinazi**¹PhD, Associate Professor **V.S. Kulikov**¹Dr.Hab., Professor **V.V. Ryabchikov**¹Dr.Hab., Professor **V.A. Tajmazov**¹¹Lesgaft National State University of Physical Education, Sport and Health, St. Petersburg

Corresponding author: sergei_ashkinazi@mail.ru

Abstract

Objective of the study was to analyze benefits of the new experimental Fast Skipper Data Analysis Systems for application in the national sailing sports reserve training systems.

Methods and structure of the study. We run the Fast Skipper Data Analysis Systems piloting study under the "Theoretically grounded sailing sports reserve technical and tactical skills and mental training systems excellence models" Research Project under implementation by the Lesgaft National State University of Physical Education, Sport and Health (St. Petersburg) on a special contract with the Ministry of Sports of the Russian Federation. We installed the Fast Skipper Data Analysis Systems on a few yachts to support the sailing sports reserve technical and tactical skills excellence trainings; and analyzed the data produced and processed by the system to rate the practical technical and tactical skills of the yachtsmen.

Results conclusions. Based on findings of the Fast Skipper Data Analysis Systems piloting study, we found the system beneficial for the sailing sports reserve technical and tactical skills excellence trainings as its sensors and software generate extensive and accurate data flows and analyses to help the coaches effectively customize/ individualize the technical and tactical skills training systems using the informative digital data profiles so as to prevent and eliminate the technical and tactical errors made by every crew member.

Keywords: sailing sport, yachting, data analysis systems, sports reserve, yachtsmen, technical and tactical skills.

Background. Modern data analysis systems with their data management capacities are ranked among the top priorities in the sports science. One of their key benefits is that the objective test data flows and analysis provide a sound basis for the training system being efficiently customized and management for success.

Presently the modern data analysis systems are increasingly popular in the sailing sport for the technical and tactical skills excellence and yachting technology resource mobilizing purposes [1]. The sailing sports data analysis systems are being actively developed by the leading foreign companies including B&G (UK), Garmin (US) and Raymarine (UK), with their benefits tested and proved in major international competitions (America's Cup, Volvo Ocean Race, TP52 MedCup, etc.). The sailing sports data analysis systems produce a wide variety

of the yacht control parameters including course, roll, trim (bow/ stern tilt of the yacht), coordinates, ground speed, water speed, boom-sheet/ mainsheet/ forestay tension force, steering angle, sailors' heart rates, etc.

It should be mentioned that the sailing sports data analysis systems applications in the training systems may be rather costly, with the costs dominated by the software and system procurement and operation and maintenance services. The situation is further complicated by the import substitution policy pursued by the Government of the Russian Federation in response to multiple sanctions with the violations of the global trade covenants [3]. Domestic information technologies remain among the most critical challenges for these policies as has been repeatedly mentioned by President of the Russian Federation V.V. Putin [4].

It is also important that one of the key national progress goals for the period up to 2024 is “to ensure modern digital technologies being extensively implemented in the national economy and social sector” [4]. The draft Physical Education and Sports Progress Strategy of the Russian Federation for the period up to 2030 underlines the growing need for high-quality IT/ data analysis systems in the national Physical Education and Sports sector [2]. This is the reason why the national sailing sports community takes special efforts to implement the domestic data analysis systems in the sailing sports elite/ reserve training systems. Recently a research team from Peter the Great Polytechnics University and IT Academy (St. Petersburg) developed and offered an experimental Fast Skipper Data Analysis System for the national sailing sport community.

Objective of the study was to analyze benefits of the new experimental Fast Skipper Data Analysis Systems for application in the national sailing sports reserve training systems.

Methods and structure of the study. We run the Fast Skipper Data Analysis Systems piloting study under the “Theoretically grounded sailing sports reserve technical and tactical skills and mental training systems excellence models” Research Project under implementation by the Lesgaft National State University of Physical Education, Sport and Health (St. Petersburg) on a special contract with the Ministry of Sports of the Russian Federation. We installed the Fast Skipper Data Analysis Systems on a few yachts to support the sailing sports reserve technical and tactical skills excellence trainings; and analyzed the data produced and processed by the system to rate the practical technical and tactical skills of the yachtsmen.

Results and discussion. Every vessel was equipped with a tablet with the Fast Skipper Android-based data analysis systems that produces a variety of sailing sports reserve technical and tactical skills rating data and analyses to fast rate practical performance of every crew member and make necessary adjustments to the training system on an individual basis. Technically, the Fast Skipper Data Analysis System is powerful enough to generate an extensive data flow to rate every technical and tactical action of the crew. Special attention in the data analyses was given to the technical and tactical responses to at least the following inputs: yacht speed, turn angle, action time, true wind angle on the yacht, relative (apparent) wind speed and relative wind angle.

The Fast Skipper Data Analysis Systems data flows and analyses made it possible to rate the following: yacht speed on the course, turn control accuracy, control efficiency in every distance segment, etc.; with the sailing sports reserve coaches provided with detailed data and analyses to rate the following sailing sports reserve technical and tactical skills: turn on the signs; yacht control under varying winds; tactical skills on the

distance; sails control skills; speed-retaining contact zone passing skills, etc. We also found that the Fast Skipper Data Analysis System was rather helpful in detecting the speed-loss segments and times and turn control inaccuracies. It is not unusual for an experienced coach to visually detect the blunders, although the data analysis system objectively fixes every disorder/ failure in the digital logs for further analyses.

The Fast Skipper Data Analysis System testing experiment found the system having the following advantages as compared with a few foreign data analysis systems (e.g. the Italy-made Sail Data system):

- It is faster in the key data reading and analyzing aspects due to the more precise sensors and more advanced software toolkit;
- Its wind control station was found highly reliable and better fit for the top-difficulty weather conditions;
- The system uses a few wireless sensors in the key points of the vessel to read the top mechanical stresses; and
- The system generates high-frequency data flow to control the yacht position in whatever specific time point.

Conclusion. Based on findings of the Fast Skipper Data Analysis Systems piloting study, we found the system beneficial for the sailing sports reserve technical and tactical skills excellence trainings as its sensors and software generate extensive and accurate data flows and analyses to help the coaches effectively customize/ individualize the technical and tactical skills training systems using the informative digital data profiles so as to prevent and eliminate the technical and tactical errors made by every crew member.

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Corporate sports services in human resource management strategies

UDC 796:658

PhD **N.V. Popova**¹Dr. Hab., Associate Professor **A.V. Ponomarev**¹PhD **E.G. Shurmanov**¹¹Ural Federal University named after the first President of Russia B.N. Yeltsin, Yekaterinburg

Corresponding author: n.v.popova@urfu.ru

Abstract

Objective of the study was to analyze benefits of the modern corporate sports service projects within the corporate human resource management strategies.

Methods and structure of the study. The article presents the results of the document analysis, comparative data analysis, and secondary processing of the empirical data in terms of implementation of corporate social programs at 6 industrial enterprises of the Urals.

Results and conclusions. The corporate sports promotion initiatives within the modern corporate human resource management strategies offer excellent tools for team building, corporate culture formation, disease and bad habits prevention and health improvement purposes, with great benefits both for the industrial human resource and local communities on the whole. These benefits have been found particularly high for the youth corporate sports service projects. The numbers and progress of the corporate sports service interests and shareholders largely depend on the corporate resources and policies including financial resources, professional physical education and sport service personnel and sports managers. Special support for the corporate sports service initiatives may be provided by the PR department and HR department management, trade unions, corporate progress managers and dedicated and responsible corporate sports managers.

Keywords: *sports management, corporate human resource management strategies, corporate sports service, youth.*

Background. The ongoing socio-economic reforms in Russia with revisions in the corporate HR management and labor remuneration strategies are associated with innovations in the corporate sports service design and management policies. It should be mentioned that the present situation in this area is contradictory to a degree. On the one hand, companies understand the growing demand for modern physical education and sport services from the personnel and their families, with a special priority to the traditional and popular sports appreciated both for their health benefits and team spirit and mutual support climate they cultivate. And on the other hand, the traditional corporate physical education and sport services need to give way to the modern cor-

porate sports service models to facilitate the health improvement initiatives and competitive progress in the popular team/ individual sports and to encourage the natural sporting motivations and health cultures in companies.

Objective of the study was to analyze benefits of the modern corporate sports service projects within the corporate human resource management strategies.

Methods and structure of the study. We analyzed, for the purposes of the study, the corporate human resource management strategies with their corporate sports service components of the Ural Locomotives Ltd.; Sinarsky Pipe Production JSC; Ural Electromechanical Federal Plant; Uralvagonzavod

[Ural Railway Carriage] JSC; Kachkanar Mining and Ore-dressing EVRAS JSC; and the Russian Railways JSC [2, 6] – based on the questionnaire surveys of the industrial personnel in these 6 companies. We sampled 370 young people including corporate subsamples of 25, 51, 28, 61, 100 and 105 people from every above company, respectively. The sample was 46% male and 54% female with 31% and 69% being 18-24 and 25-30 years old, respectively. By the education levels, the sample was grouped into the basic general (9-class) education (2%), primary vocational (school plus lyceum) - 1%; general secondary (11-class) education (31%); secondary vocational education (17%); and higher education (49%). By the service experiences, the sample was grouped into the under-1-year (15%), 1-5 years (43%), 6-10 years (33%) and 10-plus years (9%) groups. And positions-wise the sample included 31%, 4%, 58% and 7% of the workmen, office staff members, specialists and managers, respectively. The questionnaire survey was geared to find and analyze the people's attitudes to the corporate human resource management strategies and their corporate sports service / physical education and sports / healthy-lifestyle-encouragement issues and the general satisfaction with the corporate sports service systems and individual physical education and sports progress.

Results and discussion. The questionnaire survey data showed every of the 6 sampled companies running the health-group-specific corporate sports service projects including the "HR Health", "Youth Health", "Women's Health", "Personnel and Family Health", "Healthy Lifestyle Cultivation", "Bad Habits Prevention", "Social Service" and other projects. Cost estimates of such HR health projects are normally fixed in the collective service contracts [2-6]. It should be mentioned, however, that our audit of the collective service contract of the Sinarsky Pipe Production JSC found the "Sporting Projects" and services with the relevant budgeting requirements handed over to the company's trade union. It is beneficial that the existing corporate sports service projects are sensitive to the needs of the age- and service-specific groups and their families. Thus the Russian Railways OJSC run 2,100 popular sports groups serving 41,200 railway workers and their family members. In 2019, Uralvagonzavod Ltd. held 19 mass physical education and sports events with 19,568 competitors in total.

The corporate sports service services are reportedly the most popular [4, p. 240]. They are particularly appreciated for their specific missions geared to: improve the corporate image with its sporting culture and HR sensitivity aspects; lure young professionals to the company; facilitate the teamwork and team building efforts; develop comfortable emotional climate in the companies; keep up and promote the corporate tradi-

tions, cultures and values; help the individual socialization agendas; help the personnel effectively rehabilitate in every physical and mental aspect after hard workdays; prevent diseases; promote healthy lifestyle in the teams, etc.

We assumed in our study that the corporate sports service / physical education and sport service management means the corporate intellectual, financial, input flow, material and human resource management system on the whole with its physical education and sport service design and management domain in particular. Modern corporate sports service shall ideally "improve the HR relationships with the relevant benefits for the labor efficiency; meet every physical education and sports progress need of every staff member; encourage creative contributions of every staff member to the corporate mission and goals for joint success; and effectively use the local national traditions, historical accomplishments, progress needs and culture for success of the modern HR management system" [1, p. 60]. Special responsibility for the corporate sports / physical education and sports service is vested with the dedicated corporate sports service manager i.e. the corporate physical education and sport system manager; corporate Physical Education and Sports Council head; the local (workshop, department, youth) Physical Education and Sports Trainers' Council heads; and the relevant managers of the physical education and sport infrastructure holding (renter) entities. Thus the Sinarsky Pipe Production JSC supports, for more than 80 years, its staff physical education and sports group headed by a dedicated physical education and sport manager, with a Trainers' Council composed of the lower-level physical education and sports trainers serving in every large workshop/ department. The physical education and sport service manager supervises and supports activities of the Sinara Football Club, children's football and ice hockey teams, team sports, children's boxing, rifle shooting and tourist groups, plus the Sinara Walrus Club [5, p. 26].

The companies plan their corporate sports service on a yearly, quarterly and monthly basis. Most popular in the 2019 Sports Festivals, for example, were the track and field relays with the winners awarded by "Mashinostroitel' newspaper; the Vagonskaya Snezhinka cross-country skiing event; the Uralvagonzavod Volleyball Cup and Championship; and futsal winter/ summer championships. No wonder that the 2020 COVID-19 pandemic undermined the corporate sports service in the sampled companies. The Sinarsky Pipe Production JSC, e.g., had to cancel the traditional Winter Sports Festival and reschedule the Summer Sports Festival for July including football, track and field, basketball, volleyball, running and other events. It was in October that the last sports events

(swimming and billiards tournaments) were hosted by the company.

The sampled companies have established good partnerships with the sports sponsors including some leading corporations, industrial interests and trade unions. One of the typical examples of such productive sponsorship is the traditional support from the International Pipe Company (TMK) for the annual basketball and football tournaments under the auspices of the Horizons International Corporate Forum.

The questionnaire survey data and analysis showed the lower corporate sports service satisfaction levels in a few companies still lagging behind in this domain [6, p. 73]. Thus 60% of the sample reported the highest satisfaction with the corporate sports service / physical education and sports / health services. The corporate/ factory/ workshop corporate sports service satisfaction indices were the following: 0.80 for the Ural Locomotives OJSC; 0.84 for the Sinarsky Pipe Production JSC; 0.69 for the Ural Federal Electromechanical Plant; and 0.61 for Uralvagonzavod Ltd. Findings of our study gave us good grounds to come up with recommendations on how the corporate sports service may be improved by every company, with a special priority to the corporate sports management standards, particularly in the youth corporate human resource management domain.

Conclusion. The corporate sports promotion initiatives within the modern corporate human resource management strategies offer excellent tools for team building, corporate culture formation, disease and bad habits prevention and health improvement purposes, with great benefits both for the industrial human resource and local communities on the whole. These benefits have been found particularly high for the youth corporate sports service projects. The numbers and progress of the corporate sports service interests and shareholders largely depend on the corporate resources and policies including financial resources, professional physical education and sport service personnel and sports managers. Special sup-

port for the corporate sports service initiatives may be provided by the PR department and HR department management, trade unions, corporate progress managers and dedicated and responsible corporate sports managers.

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2018 FIFA World cup: host versus non-host city students' opinion survey

UDC 316.346.32-053.6 + 796.038



V.A. Dikhov¹

PhD, Associate Professor **D.Yu. Narhov**¹

PhD, Associate Professor **D.V. Shkurin**¹

PhD, Associate Professor **A.M. Burkova**¹

PhD, Associate Professor **N.B. Serova**¹

¹Ural Federal University, Yekaterinburg

Corresponding author: dikhviktoria@mail.ru

Abstract

Objective of the study was to survey students from the host and non-host cities (host city, non-host city) and analyze their opinions on the expected benefits and losses from the 2018 FIFA World Cup.

Methods and structure of the study. The “Young people’s attitudes to the 2018 FIFA World Cup” Opinion Survey Project was run in the period of November 1 to December 17, 2017 on by the Russian Society of Sociologists Presidium Decision of October 12, 2017. The Russian Society of Sociologists came up with an online opinion survey form to analyze the people’s attitudes to the 2018 FIFA World Cup that offered 29 questions grouped into socio-demographic (10 questions) and football-specific (8 questions) ones. The study involved a total of 6,498 students from 70 universities (5046 responded every question in the opinion survey form) including students from 9 of 11 host cities. The 59.2% female and 40.8% male sample was dominated (82.3%) by the 18-21 year-olds and rated representative.

Results of the study and conclusions. The host cities were significantly upgraded in the run-up to the FIFA World Cup in terms of infrastructure, stadium construction, and socio-cultural aspects. According to the survey results, a general feeling of apprehension and anxiety was observed. The respondents from the host cities were found to have higher rates, which was due to their personal interest and involvement in the process. The young people from the host cities were characterized by a greater cluster difference: a smaller percentage was interested in football (compared to the representatives from other cities), but most of them were interested in all top-level football tournaments. The respondents from the host cities demonstrated had little interest in the local games and local-level tournaments. Such results could be stemmed from the fact that the host cities offered a diverse cultural program for leisure activities, so only major football events beat the competition.

Keywords: 2018 FIFA World Cup, students’ opinion survey, fan community, host city.

Background. The 2018 FIFA World Cup is ranked a sports event number one in our country for the last four years. Foreign fans reportedly appreciated the sports facilities and excellent organization and management services for the global event and hospitality of the Russian fans and people. The leading sport experts believe that the foreign visitors to the championship were dominated by the so called scarfers i.e. the relatively wealthy fans wearing their club signage and colors and driven mostly by emotions generated by the football event [1].

Objective of the study was to survey students from the host and non-host cities (host city, non-host

city) and analyze their opinions on the expected benefits and losses from the 2018 FIFA World Cup.

Methods and structure of the study. The “Young people’s attitudes to the 2018 FIFA World Cup” Opinion Survey Project was run in the period of November 1 to December 17, 2017 on by the Russian Society of Sociologists Presidium Decision of October 12, 2017 [2]. The Project was coordinated by the Physical Culture and Sports Research Committee of the Russian Society of Sociologists headed by S.I. Rosenko, Doctor of Sociology, Professor and Dean of the Department of Social Studies and Humanities of Lesgaft National State University of Physical Education,

Sport and Health (St. Petersburg). The Opinion Survey Project tools and software were developed by D.V. Shkurin, Sociology PhD and Associate Professor.

The Russian Society of Sociologists came up with an online opinion survey form to analyze the people's attitudes to the 2018 FIFA World Cup that offered 29 questions grouped into socio-demographic (10 questions) and football-specific (8 questions) ones. We sampled for the survey 6498 students from 70 universities (5046 responded every question in the opinion survey form) including students from 9 of 11 host cities. The 59.2% female and 40.8% male sample was dominated (82.3%) by the 18-21 year-olds and rated representative.

Results and discussion. Host cities (Volgograd, Yekaterinburg, Kazan, Kaliningrad, Moscow, Nizhny Novgorod, Samara, St. Petersburg and Saransk) accounted for 69% of the student sample; with the host city students found twice more active in the poll than their non-host city peers. This group activity may be due to the fact that 7 of 9 host cities are populated by millions and ranked among the key national education centers.

Table 1. Grouped interests in professional football, %

Are you interested in professional football?	Host cities	Non-host cities
No	60	57
Interested only in some international matches including FIFA events	23	19
Interested in the Football League and UEFA matches	18	13
Interested in the Russian Football Championship matches	17	16
Interested in some foreign football leagues, continental football and some foreign football clubs	11	11
Interested in progress of the local football, local leagues and championships	7	10

Given in Table 1 hereunder are the students' interests in professional football – that were found generally low: the sport was reportedly of special interest only for two of five respondents. Note that we surveyed interests in the professional rather than amateur football. Furthermore, the survey found some clustering in the host city group, with a smaller share interested in football versus the non-host city group, albeit most of the sample reported interest in the top-ranking football events including national championships, World/

European Championships, UEFA Cups, etc. One more significant difference is the lower host city group interest in the local football matches and tournaments – that may be due to the fact that the large cities offer a much wider variety of cultural events and leisure-time entertainments, and only the top-ranking sports events are perceived as deserving a special interest in these cities.

We actually found the host city group attending football stadiums more often, with 35% of the group reporting visits to stadium one or more times – versus 28% of the non-host city group: see Table 2. It should be mentioned, though, that one of five non-host city students also reported attending a stadium a few times.

Table 2. Football stadium attendance rates, %

How often have you attended formal football matches on stadiums?	Host cities	Non-host cities
Never	65	72
A few times in my life	25	21
Once a year or more often	8	6
Once a month or more often	2	2

The above data were found correlated with the reported affiliations with the football fan communities: see Table 3. The intergroup group difference in this domain was found insignificant, although the host city group seemed less likely to identify themselves as fans and more uncertain on the point. This marginal indifference may be again explained by the more intense lifestyles and a wider variety of the leisure-time activities and entertainment in the large cities. Experts believe [1] that young people normally identify themselves as football fans when they attend matches on a regular basis and keep track of the football events. Therefore, ranked with the football fan community in the host city group was 10-12% versus 8-10% in the non-host city group.

Table 3. Reported affiliations with the football fan community, %

Do you belong to the football fan community?	Host cities	Non-host cities
Yes	15	16
No	71	72
Uncertain	14	12

Prior to the 2018 FIFA World Cup, the national residents were opposite in their opinions on the event: one group emphasized the importance of the large-scale sporting event for the national image, infrastructure and economy, and the skeptical group believed that the event was rather stressful in the financial, social and emotional terms for the nation.

Table 4. Attitudes to the upcoming 2018 FIFA World Cup in Russia, %

What is your attitude to the upcoming 2018 FIFA World Cup in Russia?	Host cities	Non-host cities
Very welcoming (PP)	25	29
Rather welcoming than not (P)	29	25
Neutral (n)	24	30
Rather negative (N)	13	7
Very negative (NN)	6	5
Uncertain (S)	3	4
Welcoming rate ¹	0,54	0,66

¹ Calculation formula: $K = (2*PP + P + 0*n - N - 2*NN) / 100$

After the 2018 FIFA World Cup, the VTSIOM analysts were surprised to find most of the young population happy with the unexpectedly pleasant and festive atmosphere of the event. Our survey was run prior to the 2018 FIFA World Cup, and that is why the pre-event expectations of students were of special interest in this context: see Tables 4, 5. Note that the host city group was notably concerned and expressed anxiety and even fears prior to the global event, with the host city group welcoming rate tested 8% lower than in the non-host city group.

Therefore, the survey found virtually no intergroup difference in opinions on the gains and losses from the upcoming event, with almost half of the sample expecting benefits and only one of nine expecting losses for the country from the event.

Table 5. Expected benefits and losses from the 2018 FIFA World Cup in Russia, %

Do you expect gains or losses from the 2018 FIFA World Cup?	Host cities	Non-host cities
Mostly gains	49	49
Mostly losses	12	12
No gain, no loss	21	20
Uncertain	18	19

Conclusion. The opinion survey found the host city students more prepared for the global sports event in sociological terms and less prepared in psychological terms as verified by the expressed concerns, anxiety and even fears of expected negative changes in the habitual lifestyles. The post-event surveys, however, found the event unexpectedly entertaining and pleasant for the residents and very well organized and managed.

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Benefits of global sports events for local sustainable development

UDC 330.356, 796.062.4

PhD **A.O. Lantsev**¹PhD **E.G. Shurmanov**¹Dr. Hab., Associate Professor **A.V. Ponomarev**¹PhD **L.L. Tolvaishis**¹¹Ural Federal University, Institute of Physical Culture, Sports and Youth Policy, Yekaterinburg

Corresponding author: a.o.lantsev@urfu.ru

Abstract

Objective of the study was to analyze actual benefits of the 2018 FIFA World Cup for sustainable development of the host Russian cities and their appeal for the national youth.

Methods and structure of the study. We widely used as a basis for the study database of the Federal Agency for Tourism of the Russian Federation and analytical reports of the FIFA and Russian Football Union complemented by own research at the Ural Federal University's Youth Service Department. We supported the study database by a questionnaire survey of the Yekaterinburg young population in February through April 2020 to analyze the local attitudes to the 2018 FIFA World Cup and its heritage plus views on the global sports events and its hosting service on the whole. We sampled for the survey the 14-30-year-old locals (n=119) including the school/ college/ university students, young employed people including those from the governmental system and business communities.

Results of the study and conclusions. Our study and analyses showed that the 2018 FIFA World Cup was certainly beneficial for the global promotion of the host regions and cities. We believe that the success was largely due to the sustainable development strategy for the Host Region offered jointly by FIFA and Russia-2018 Host Committee. It facilitated the host infrastructure development projects and global promotion of the host cities. New hospitable environments were created in the key locations which have been appealing enough for both the gifted, sporting and creative local youth and for the educated human resource from outside to facilitate the local sustainable development initiatives.

Keywords: *global sports events, sustainable development, FIFA World Cup.*

Background. Global sports events including the Olympic Games, European and World Football Cups and others attract millions of fans the world over and form new progress options for and images of the host cities and locations [7, 8, 10]. They are always expected to give a big boost for sustainable economic and social development of the host areas. There is still a question if the global sports events really meet expectations of the local communities and effectively promote the host cities? And it is always questionable if the host countries are really capable of taking full benefits of the global sports events – as demonstrated by multiple discussions since the FIFA nominated South Africa and Brazil to host the World Cups and even hot-

ter discussions since Russia was elected to host the 2018 FIFA World Cup.

Objective of the study was to analyze actual benefits of the 2018 FIFA World Cup for sustainable development of the host Russian cities and their appeal for the national youth.

Methods and structure of the study. We widely used as a basis for the study database of the Federal Agency for Tourism of the Russian Federation and analytical reports of the FIFA and Russian Football Union complemented by own research at the Ural Federal University's Youth Service Department [1, 2, 4, 5]. We supported the study database by a questionnaire survey of the Yekaterinburg young population in February

through April 2020 to analyze the local attitudes to the 2018 FIFA World Cup and its heritage plus views on the global sports events and its hosting service on the whole. We sampled for the survey the 14-30-year-old locals (n=119) including the school/ college/ university students, young employed people including those from the governmental system and business communities.

We used for the study the global sports events benefits rating model offered by the German Society for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit) [6]. The sample model rates the benefits of global sports events on the following scales: 1) political and communicative; 2) economic; 3) infrastructural; 4) social; and 5) environmental. In was in February 2020 that we formed a focus group (n=11) to design the study metrics and group the sample by key expectations prior to the 2018 FIFA World Cup.

Results and discussion. The FIFA and Russia-2018 Host Committee came up, on the eve of the 2018 FIFA World Cup, with a Sustainable Development Strategy for the Host Region with the following three domains: (1) facilitate the local social progress and human resource training and growth; (2) encourage environmental protection in the area; and (3) give a boost to the local economic growth. A special goal of the sustainable development strategy was to prevent or mitigate the potential negative impacts of the global

sports events on the local communities, economy and environment and ensure its benefits being realized in full [4].

It should be mentioned that the 2018 FIFA World Cup in Russia has become the most costly FIFA World Cup for its history, with only the officially reported costs estimated at RUR 679 billion [3]. Some Western experts argue that these excessive costs are explainable, among other things, by the sports infrastructure development projects beneficial for a few vested interests in the political and business elites [9].

On the other hand, the event was rated the most financially successful FIFA World Cup for its history. As formally reported by FIFA, its income totaled USD 5.357 billion [5]. Total inputs of the event into the host regional economies were estimated at 2% to 20% of the local GDPs [2]. We believe that the regions reporting the higher and steadily growing GRP are more promising for the sustainable development initiatives and more appealing for the national young educated human resource. As reported by the Federal Agency for Tourism, preparatory works for the 2018 FIFA World Cup gave a powerful boost for the local infrastructure and service development projects [1].

In the global sports events heritage rating domain, positive official (governmental and hosts') reports not always agree with the local people's opinions on some points. Our questionnaire survey found every respondent being well aware of the 2018 FIFA World Cup

Table 1. Key ranked benefits of the 2018 FIFA World Cup reported by the sample

Rank	Benefits	Beneficiary sector	Share
1	New sports fields, training gyms and outdoor sports facilities available for the local youth later on, for sustainable progress	Local infrastructure	71,1%
2	Host city/ region promotion	Political and communicative	60,5%
3	New highways and the related infrastructure	Local infrastructure	57,9%
4	New landscaped and well-served sites/ areas	Local infrastructure	52,6%
5	Good experience for the host cities	Political and communicative	44,7%

Table 2. Positive expectations prior to the 2018 FIFA World Cup versus its actual perceived benefits

Expectations, share, %	Benefits	Actual benefits, share, %
Social domain		
42,1	Associated cultural services	26,3%
15,8	Associated education services	2,6%
Economic domain		
26,3	New appealing jobs	15,8%
26,3	Expanded range of goods and services	7,9%
Environmental domain		
15,8	Environmental awareness/ advocacy projects	2,6%
13,2	Waste reduction	0%

in Yekaterinburg, and 96.1% reported keeping track of the matches on the stadiums, on TV, mass media/ Internet. Given in Table 1 are the key ranked benefits of the 2018 FIFA World Cup reported by the sample.

A vast majority of the sample ranked high the infrastructural projects in the city and progress in the political and communicative domain. The young people, however, were found to prioritize rather the social, economic and environmental benefits of the global event: see Table 2.

Conclusion. Our study and analyses showed that the 2018 FIFA World Cup was certainly beneficial for the global promotion of the host regions and cities. We believe that the success was largely due to the sustainable development strategy for the Host Region offered jointly by FIFA and Russia-2018 Host Committee. It facilitated the host infrastructure development projects and global promotion of the host cities. New hospitable environments were created in the key locations which have been appealing enough for both the gifted, sporting and creative local youth and for the educated human resource from outside to facilitate the local sustainable development initiatives.

Ratings of the actual 2018 FIFA World Cup benefits and heritage by the sample may facilitate preparations for the upcoming 2023 World Student Summer Games in Yekaterinburg. Based on the study data, we developed the following recommendations for the World Student Summer Games hosts:

(1) Our study showed that the local youth expects mostly infrastructural changes from the global event. The World Student Summer Games concept requires 9 new sports facilities being constructed plus 26 rehabilitated and adapted for the event; whilst the General Plan of the World Student Summer Games Village provides for every sports facility being efficiently used later on for sustainable development goals;

(2) The International University Sports Federation (FISU) was urged to pay more attention to promotion of the Yekaterinburg and Sverdlovsk host regions in the relevant marketing, communication and PR projects under development, and we hope that the Federation will respect these recommendations; and

(3) Based on a few prior studies including this one, the authorities decided to establish a Cultural Events Organizing Department reporting to the 2023 World Student Summer Games Directorate, and include a range of artistic nominations in the World Student Summer Games program (vocal and instrumental performances, dances, public arts etc.). We would recommend the Directorate to consider benefits of a public awareness and World Student Summer Games service personnel training program in Yekaterinburg, and make due provisions for some of the events being covered online for a wider audience.

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Competitive success and personality progress factors in sambo: coaching service quality aspects

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Dr. Sc. Hist. **E.A. Kalinina**¹
PhD **L.M. Kieleväinen**¹

¹Petrozavodsk State Pedagogical University, Petrozavodsk

Corresponding author: kalinka46@yandex.ru

Abstract

Objective of the study was to rate, by a questionnaire survey, and analyze the coaching service quality aspects (education mastery, theoretical and practical knowledge and experience, skills and personality qualities) for the athlete's personality progress and competitive success, with sambo taken for the case study.

Methods and structure of the study. We analyzed, for the purposes of the study, memories and bibliographic sources; and run a questionnaire survey and interviews of the active sambo coaches serving at children's sports schools in the Republic of Karelia, active competitors and retired athletes still serving in the national physical education and sports sector.

Results and conclusions. The authors' conclusions were based on the theoretical analysis and generalization of the archival and documentary sources, as well as the questionnaire survey and interviews with the sambo coaches and their trainees. The formula of success of the Karelian sambo wrestlers was derived. The ways the coach and his trainees could work together to achieve high sports results were defined. The authors state that the role of the coach (educator) in shaping the personality of a sports school trainee will always depend on his professional skills and personal qualities. The best coach will be someone who can shape and motivate his trainees to achieve the set goal, who can urge for action and its execution through the targeted pedagogical impact.

Keywords: *sports, sambo, coach, educator, skills building.*

Background. Modern Russian sport communities take special efforts to protect, revive and develop a variety of ethnic wrestling sports, with sambo formally ranked among the priority national combat sports subject to special promotion and development policies [8, 9]. Progress in sambo, as in many other individual sports disciplines, is known to heavily depend on the coach's knowledge, skills, experience and personality qualities that may encourage or hamper individual competitive successes [5]. Some coaches' opinion poll report the trainees being discouraged by disbeliefs in own abilities, low willpower, loss of interest in sports for different reasons, vague progress opportunities, laziness, slowness and many other factors. [7]. Sensitive and determined coaching service with high

professionalism and personal role models is viewed by many as an indispensable basis for good competitive progress in active sports and healthy lifestyle upon retirement from them.

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children's sports schools in the Republic of Karelia, active competitors and retired athletes still serving in the national physical education and sports sector.

Results and discussion. The Karelian sambo school was founded by Ilya Romanovich Shegelman, Technical Science Doctor, Professor of Petrozavodsk State University (PSU), Honored Trainer of Russia and Kazakhstan Republic. In 1969, he initiated a small sambo group at PSU being upgraded to a fully-fledged sambo school for the local students, with its experience fast promoted and rolled out in other regions. The first municipal sambo tournament was organized in 1969 by I.R. Shegelman, V. Fomin and N. Mamchur. In 1975 the sambo community organized the first Republic of Karelia sambo championship; and in 1976 established the Karelian Sambo Federation that was reformed to the Karelian Sambo and Judo Federation in 1999 (formally accredited for Sambo only) – and still headed by I.R. Shegelman, Senior Coach of the Republic of Karelia. This outstanding talent has trained many World, European and Russian sambo champions and above 200 champions of the Republic of Karelia in sambo, judo, hand-to-hand fights, mixed martial arts, plus an enthusiastic martial arts coaching team [2-4].

One of the key goals of modern sambo is the athlete's personality progress in every life and health control aspect, high creativity in thinking, self-exploration and assertion agenda etc. Theoretical and practical training service shall help the personality progress and competitive success – largely dependent on the coach's service quality and progress management ability geared to encourage both physical progress and sports-specific skills, qualities and experience, i.e. the individual sporting fitness, culture and spirit on the whole [6]. Every successful athlete or team is always backed by a coach whose merits and contributions cannot be overestimated. Highly successful coaches capable of training world champions are always unique.

Our analysis of the survey data and memoirs found a few most precious qualities mentioned by the trainers and trainees. First of all, it is a *profound knowledgebase* the practical experience is built on, with a special role often played by the knowledgebase scope that should cover every related knowledge field as well. I.R. Shegelman emphasized the importance of persistent self-education: "I have always worked hard to keep track of new developments in sports pedagogy and psychology, have read lots of reference literature in sports medicine, biomechanics, children's sports service etc. My key goal is to teach the trainees how to think efficiently ... I have always told my trainees: your mission is good education first and foremost" [1].

Interpersonal relationship is reported as one more important factor for the coaching service success. A coach shall be always open for dialogue with a trainee

to perfectly know his strengths and weaknesses, actual needs, individual traits and responses to workloads – to timely and efficiently manage the training system. However bright the coach's personality may be, it should never dominate the trainee's personality otherwise the latter is suppressed by the coach's authority. A good coach is still and always indisputably authoritative in the trainee community as reported by the respondents.

Perfect goal setting is ranked high among the success factors. We found the initial goals of the beginner trainees. One of them reported that he 'wanted to protect himself and his loved ones' in the difficult 1990ies, and that is why opted for the 'weaponless self-defense' as sambo is abbreviated in Russian. One more sambo master wanted 'to become stronger, assert himself in the peer community and protect himself' [1]. With age these primary goals were reported to naturally change as the athletes focused on the competitive wins at the top level, to qualify for Masters of Sports, World Class Masters of Sports, join the national team and win the World Championships. Our survey showed the success always favoring the coaches who strived for perfection. Thus I.R. Shegelman emphasized in his interview: "I have always told my trainees that they should come on top and, when they opt for coaching careers, they should train champions".

Coach's intuition was also ranked among the trainees' success factors. A good coach always perfectly knows the trainee's strengths, weaknesses, needs and traits, and manages his progress by a perfect instinct or "inner vision" that shows the way to success. Intuition is also needed to single out a gifted athlete. For example, I.R. Shegelman immediately recognized the gifts and great resources of young Maxim Antipov from the Karelian village of Pindushi who soon won the Russian and World Champion titles in combat sambo.

What personality qualities are critical for a sambo coach? Responses of the athletes referred to their own coaches' personality qualities that inspired and governed them on the way to success. Above all, the athletes mentioned the role model provided by the coach, with his dedication, hard working, last for new knowledge, sincere love and respect to children. Modern sambo is a highly intellectual sport, and its ambassadors often go beyond the stereotyped popular concepts of athletic personalities. The respondents emphasized that "a coach should inspire the trainee by his belief that he is no worse than the others who compete at the top level, and the trainee needs to only work hard, develop healthy aggression and must-win mindset to win sooner or later" [1]. The trainee should become a sort of fanatic governed by some sports ideal or mission for fast competitive progress. This feel is either inborn or not and rather difficult for cultiva-

tion, and this is the reason why the coaches that may recognize the individual resource in a child, train him and make the national, World and European Champion are so seldom and precious.

Conclusion. The case study of the Karelian sambo school progress has found that many of its leaders have been successful in a few life domains other than sports – in law enforcement system, education, governmental agencies, where they were highly appreciated as determined professionals. The success of the Karelian sambo wrestlers has been largely due to the personality and professional qualities of its coaches with their comprehensive knowledgebase, skills and experiences, appreciation of sambo as a national heritage, perfect interpersonal coach-athlete relationships and succession in every aspect, preservation and promotion of the unique national culture and identity on the global sports arenas. Persistent progress in the theoretical and practical knowledge, perfect goal setting, highest responsibility, intuition, authority and good interpersonal communication climate were ranked among the key success factors of the Karelian sambo school by the sampled coaches and athletes. Success of the school has been proved by the actual competitive progress histories of its leaders.

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Women's Paralympic athletics: self-control profiling study

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PhD, Associate Professor **S.M. Galysheva**¹
 Postgraduate **E.D. Tretyakova**¹
 PhD, Associate Professor **L.N. Rogaleva**¹
 PhD, Associate Professor **L.A. Boyarskaya**¹
 PhD, Associate Professor **A.V. Shikhov**¹
¹Urals Federal University, Yekaterinburg

Corresponding author: sve20851157@yandex.ru

Abstract

Objective of the study was to profile and rank self-control in women's Paralympian athletics.

Methods and structure of the study. We sampled for the study the 21 to 25-year-old female Paralympians (n=8) competing in track and field events with musculoskeletal system disabilities and having varying sports qualifications and competitive experiences. Their self-control was rated by a questionnaire survey by E.F. Bazhin, E.A. Golyunkina and A.M. Etkind [5]. The questionnaire survey assumes the individual self-control ratable by a general internality index that factors in the success internality, failure internality, family internality, professional internality, interpersonal internality and health internality.

Results and discussion. The study data and analyses showed the female Paralympians' self-control dominated by the internal ones, with the success internalities tested the highest in the sample and growing with the competitive progress. The sample was tested lowest on the health internality scale – that may be interpreted as indicative of health being not a key self-control factor for the sample. We also found the adaptive sports facilitating the interpersonal and family internalities i.e. encouraging the positive and proactive behavioral strategies in women with disabilities.

Keywords: Paralympic sports, female Paralympic athletes, internality test rates.

Background. Adaptive physical education and Paralympic sports are still relatively new for the Russian communities of disabled people although getting increasingly popular for their inspirational effects, stimulated progress in physical conditions, focuses on proactive behavioral models with healthy goals and hard work for success – to facilitate the socializing and personality progress agendas of the disabled trainees [1, 4].

The adaptive sports community, however, still leaves practically underexplored the personal resource mobilization issues of the women's adaptive/ Paralympic sports leaders who demonstrate high athletic fortitude and success in competitions. Since the self-control rates are generally considered a fair measure of a personality progress with the individual responsibility, activity and own life

control aspects [3], they may be applied for the female Paralympic athletes' personality resource profiling purposes.

Objective of the study was to profile and rank self-control in women's Paralympic athletics.

Methods and structure of the study. We sampled for the study the 21 to 25-year-old female Paralympic athletes (n=8) competing in track and field events with musculoskeletal system disabilities and having varying sports qualifications and competitive experiences. Their self-control was rated by a questionnaire survey by E.F. Bazhin, E.A. Golyunkina and A.M. Etkind [5]. The questionnaire survey assumes the individual self-control ratable by a general internality index that factors in the success internality, failure internality, family internality, professional internality, interpersonal internality and health internality.

Results and discussion. Self-control of the sample was tested to vary in a wide range on the test scales. We provisionally grouped the sample into two groups with relatively close test rates: Group 1 with the moderate to high (7-plus points) general internality test rates and Group 2 with sub-moderate to low (5-minus points) general internality test rates: see Figure 1 hereunder.

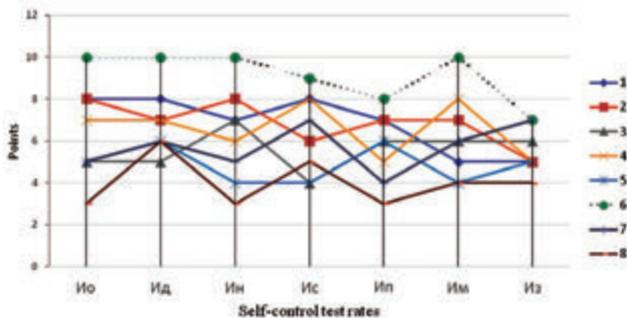


Figure 1. Self-control test rates of the sample of Paralympic athletes

General internality Success internality Failure internality Family internality Professional internality Interpersonal internality Health internality

Having analyzed the internality test rates versus the competitive experience, we found Group 1 dominated by the individuals with the high competitive accomplishments and 5-plus-year experience; and Group 2 including mostly the athletes with the 2-3-year experience and still relatively unsuccessful. Furthermore, Group 1 was found to believe that their progresses were due mostly to their own efforts that can change their lives. This finding is rather important in our opinion, considering that the group success internality was rated moderate-to-high, i.e. the sports careers help the athletes set healthy goals and reinforce their beliefs in own resources, missions and successes in sports and lives; and in case of failure they are not inclined to blame others, but instead accept their own errors – as indicated by the failure control internality test rates

Knowing that the Paralympians are diagnosed with either congenital or acquired disabilities (e.g. cerebral palsy, amputee), we had a special interest in their health internality test rates – that were found moderate to low in fact. No wonder, that the disabled people's health self-rates are lower than in relatively healthy samples, although the Paralympians were still found well motivated for own physical condition control; moreover, they were tested motivated for physical progress despite the inevitable relapses and falls in

their physical progress paths. On the whole, therefore, we found the Paralympian sample well aware of their diseases and physical conditions on the one hand and still believing that their health issues may not seriously hamper their physical progress agendas on the other hand. That is why they are determined in their goals and missions and never ranking health issues among the key barriers for success in sports and personality progress agendas.

Two more important life domains in the questionnaire survey were rated by the interpersonal internality and professional internality tests – that were generally found relatively high in the more successful group and lower in the less successful one. It can be assumed that sports not only increase the confidence of athletes in personal progress, but help them in their socializing agendas by facilitating progress in their communicative qualities, social activity and, hence, their professional progress. As was found by I.S. Koksharova and Y.V. Kirillova, communication and mutual support in competitions play a great role for the disabled peoples' progress in family relationships, everyday lives and even their employment initiatives [2].

Conclusion. The study data and analyses found the female Paralympians' self-control dominated by the internal ones, with the success internalities tested the highest in the sample. Despite the wide variations in the self-control test profiles, we found the self-control generally higher in the group more successful in the adaptive sports.

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State of regulatory mechanisms and body component composition of female students trained under sportization programs

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Dr. Biol., Associate Professor **A.A. Govorukhina**¹**K.A. Mushtai**¹**S.V. Kolomiets**¹Dr. Med., Associate Professor **O.A. Malkov**¹¹Surgut State Pedagogical University, Surgut

Corresponding author: kris4450@mail.ru

Abstract

Objective of the study was to assess the state of the regulatory mechanisms and body composition indicators of the female students trained under the sportization programs.

Methods and structure of the study. The article presents the results of study of the autonomic regulation mechanisms and body component composition of 118 female students of non-sports faculties of the Surgut State Pedagogical University, who were trained under the selected sportization programs during the year: body conditioning course with the elements of track and field athletics, volleyball, and artistic gymnastics. The subjects' heart rate variability was studied using the "VNS-Spectrum" hardware and software complex. The body component composition was studied using the "Tanita BC-730" analyzer. The statistical data processing was made using the STATISTICA 10.0 software package.

Results and conclusions. It was found that trainings under one of the sportization programs during the year affected the subjects' body composition and vegetative regulation indices. In the group of female students who had chosen the body conditioning course with the elements of track and field athletics, there was observed an increase in the spectrum power of the high frequency component of the heart rate variability, a decrease in the body fat percentage, and a reduction of the biological age. In the female students engaged in volleyball, the total spectrum power increased at the cost of increased spectrum power of the low- and very low frequency components, a decrease in the indices of centralization and activation of subcortical centers. Those involved in the artistic gymnastics did not have any significant changes in the heart rate variability indices, but were found to a reduction of the body fat mass. It was found that trainings under the sportization programs during the year had different effects on the parameters of the autonomic nervous system.

Keywords: *students, heart rate variability, body component composition, sportization.*

Background. The importance of formation and maintenance of students' health, especially in the regions with harsh climatic and geographical conditions, is beyond doubt, as the body has to adapt to both aggregate natural factors and mental and other types of loads [3]. In this view, it is quite a challenge to choose the most rational ways to organize the students' physical activity. Sportization is one of the ways [6], which is based on the independent choice of the type of physical load. The body's functional resource management during the adaptation to sports-specific muscular

activity is carried out through the central and autonomous nervous, endocrine and humoral mechanisms, with their derivatives being the frequency ranges of heart rate variability [1]. However, vegetative dysregulation can be considered as an early sign of disadaptation to physical loads [2, 5, 7]. There is mixed evidence in the literature on the relationship between the heart rate variability rates and individual body component composition [4].

Objective of the study was to assess the state of the regulatory mechanisms and body composition

indicators of the female students trained under the sportization programs.

Methods and structure of the study. Sampled for the study were 118 female students of non-sports faculties of Surgut State Pedagogical University. During the 2nd year of study, the female students were trained under the standard physical education program, and the sportization programs were introduced in the 3rd year only. As a result of sportization of physical education, all the female students were divided into 3 groups depending on the selected training course: Group 1 – body conditioning with the elements of track and field athletics (n=40); Group 2 – volleyball (n=40), Group 3 – artistic gymnastics (n=38). Each female student gave a written informed consent for the study. At the time of the study, all the girls were in good health and had no complaints about their health for the previous two weeks.

The subjects' heart rate variability was studied using the "VNS-Spectrum" hardware and software complex [8]. The following indices were analyzed: standard deviation of Normal-Normal (SDNN), root mean square of standard deviation (RMSSD), spectrum total power (TP), power of very low frequency waves (VLF), power of low frequency waves (LF), power of high frequency waves (HF), index of centralization (IC), index of activation of the subcortical centers (IASC). The fat body mass and biological age were determined using the "Tanita BC-730" analyzer.

Results and discussion. The dynamics of changes in the heart rate variability rates in the female students trained under various sports programs during the year are shown in Table 1. The median values of SDNN, reflecting the cumulative effect of the vegetative regulation before the introduction of the sportization programs, were found to be within the normal limits (40-80 ms) in Group 3 (artistic gymnastics) only. In the other two groups, this indicator exceeded the standard values and declined significantly after one

year of body conditioning and volleyball practices.

In other study groups, this indicator slightly exceeded the normal level in the 2nd-year female students, which indicated the relative predominance of the parasympathetic regulation unit. In the 3rd year of study, SDNN in the girls engaged in volleyball decreased statistically significantly (p=0.000), which may indicate a decrease in the autonomous regulation circuit activity and activation of the higher levels of regulation.

The analysis of RMSSD in all the study groups showed that this indicator exceeded the normal level (20-50 ms), thus testifying to a high level of activity of the autonomous regulation circuit. At the same time, the influence of the parasympathetic nervous system increased in the 3rd year of study as compared to the previous year (p=0.003). In other study groups, there were minor changes in RMSSD.

The female students engaged in volleyball were found to have a significant increase in the spectrum total power (p=0.019) due to an increase in the power of low (p=0.000) and very low frequency (p=0.015) waves, which indicated an improvement in the adaptive capacity of the cardiovascular system and stress tolerance (Table 2) after one year of training under the selected sportization program. The girls engaged in body conditioning practices demonstrated a statistically significant increase in high frequency values (p=0.043), which testified to a shift in the vegetative balance towards the predominance of the parasympathetic unit and increased vagal effects.

The analysis of index of centralization and index of activation of subcortical centers during the year revealed statistically significant changes (p=0.039 and p=0.000, respectively) only in the group of girls engaged in volleyball, which indicated minimization of the effects of the central regulation circuit on the heart rate and a decrease in the subcortical center activity.

Table 1. Indicators of temporary analysis of female students depending on type of physical load, Md (Q1-Q3)

Indicators	Group 1 (body conditioning), n=40		Group 2 (volleyball), n=40		Group 3 (body building), n=38		Significance of differences
	2nd year of study	3rd year of study	2nd year of study	3rd year of study	2nd year of study	3rd year of study	
SDNN, ms	86 (57-327)	72 (55-338)	101.7 (60.7-363)	62.9 (38-75)	69 (54-330)	86 (54-362)	p ₁ =0.554 p ₂ =0.000 p ₃ =0,234
RMSSD, ms	56 (32-96)	77 (56-494)	70 (53-107)	69 (41-98)	79 (42-353)	89 (56-524)	p ₁ =0.003 p ₂ =0.788 p ₃ =0,102

Note. Hereinafter: p₁ – the significance of differences between the body conditioning groups before and after the introduction of the sportization program; p₂ – the significance of differences between the volleyball groups before and after the introduction of the sportization program; p₃ – the significance of differences between the body building groups before and after the introduction of the sportization program.

Table 2. Spectral indices of heart rate variability in female students depending on type of physical load, Md (Q1-Q3)

Indicators	Body conditioning with elements of track and field athletics, n=40 (1)		Volleyball, n=40 (2)		Body building, n=38 (3)		Significance of differences
	2nd year of study	3rd year of study	2nd year of study	3rd year of study	2nd year of study	3rd year of study	
TP, ms	5516 (3544-8655)	4726 (3782-7361)	6099 (2835-7669)	8003 (4526-9110)	6698 (3322-8655)	6523 (2736-8655)	$p_1=0.196$ $p_2=0.019$ $p_3=0.472$
VLF, ms ²	1459 (820-1751)	1611 (792-2443)	1548 (1127-2204)	1768 (1108-2302)	1488 (856-2099)	1434 (856-1672)	$p_1=0.206$ $p_2=0.015$ $p_3=0.175$
LF, ms ²	1374 (1096-2717)	1893 (982-4028)	1022 (781-2134)	2132 (1249-3542)	1615 (1081-3380)	1304 (985-3328)	$p_1=0.736$ $p_2=0.000$ $p_3=0.303$
HF, ms ²	1959 (1152-4014)	3001 (2100-4500)	3088 (1246-4134)	3239 (1199-5820)	2715 (930-3893)	1590 (1019-3088)	$p_1=0.043$ $p_2=0.181$ $p_3=0.170$
IC, c.u.	1.3 (0.9-2.6)	1.1 (0.7-1.8)	1.2 (0.7-3.1)	1.1 (0.5-1.9)	1.5 (1.0-3.3)	1.8 (1.1-2.6)	$p_1=0.419$ $p_2=0.039$ $p_3=0.994$
IASC, c.u.	1.3 (0.8-2.6)	1.4 (0.6-3.2)	1.4 (0.9-3.7)	0.5 (0.4-1.9)	1.0 (0.7-3.0)	1.3 (0.8-2.3)	$p_1=0.527$ $p_2=0.000$ $p_3=0.901$

Table 3. Individual body component composition indices in female students depending on type of physical load, Md (Q₁-Q₃)

Indicators	Body conditioning with elements of track and field athletics, n=40 (1)		Volleyball, n=40 (2)		Body building, n=38 (3)		Significance of differences
	2nd year of study	3rd year of study	2nd year of study	3rd year of study	2nd year of study	3rd year of study	
Body fat mass, %	25,3 (20.1-0.8)	22,5 (16.6-26.5)	24.3 (19.8-30.7)	29.9 (21.9-32)	25.0 (20.7-30.7)	21.5 (16.8-24.8)	$p_1=0.033$ $p_2=0.149$ $p_3=0.003$
Biological age, years	17 (12-28)	16 (12-19)	16 (12-26)	16 (12-19)	16 (12-26)	13 (12-21)	$p_1=0.021$ $p_2=0.057$ $p_3=0.185$

The dynamics of changes in the body component composition that correlated with the heart rate variability rates in the female students trained under different sportization programs during the year is presented in Table 3.

It was found that the body fat mass in the female students engaged in body conditioning and body building decreased during the year ($p=0.033$ and $p=0.003$, respectively). In addition, there was a decrease in the biological age of the girls engaged in body conditioning ($p=0.021$).

We found a correlation between the heart rate variability and body component composition parameters of the female students with different sports speciali-

zations. For example, before the introduction of the sportization program, in the female students trained under the body conditioning program with the elements of track and field athletics, the total power, VLF, and LF rates had a low positive correlation with the biological age (0.3-0.5). In the female students of Group 3, the biological age correlated with the total power, LF, and index of activation of subcortical centers rates (0.3-0.5), while the body fat percentage correlated with SDNN and RMSSD (0.3-0.5). In Group 2, the correlation relationships were detected only after the introduction of the sportization program: RMSSD and HF negatively correlated with the body fat mass (-0.3 - 0.5), while index of centralization - positively (0.321).

Conclusion. The introduction of the sportization program in the form of body conditioning with the elements of track and field athletics was accompanied by an increase in the activity of the parasympathetic regulation unit, a decrease in the body fat mass, and a decrease in the biological age. The volleyball practices during the year helped increase the adaptive capacity of the female students, reducing the activity of the parasympathetic nervous system, which before the introduction of the sportization program was somewhat above normal. Regular body building practices during the year contributed to the reduction of body fat percentage without causing any significant changes in the parameters of heart rate variability.

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Precompetitive strength training of women in early adulthood participating in bikini fitness competitions

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Associate Professor **T.M. Lebedikhina**¹
 PhD, Associate Professor **I.V. Yerkomayshvili**¹
 Senior teacher **V.A. Filippova**¹
¹Ural Federal University, Yekaterinburg

Corresponding author: t.m.lebedikhina@urfu.ru

Abstract

Objective of the study was to substantiate and develop a method of precompetitive strength training of bikini fitness competitors in their early adulthood.

Methods and structure of the study. The experiment was conducted for 7 months on the basis of the fitness club "Powerhouse Gym", Yekaterinburg, and involved the 20-35 year-old females, who were split into 2 groups: Experimental and Control ones, 8 women each. The homogeneity of the selected groups was defined based on the subjects' physical development and physical fitness rates. The authors determined the morphofunctional and psychological characteristics of the male and female bodies and concluded on the need for planning the training loads for women practicing bikini fitness in view of their biological characteristics. The essence of the developed methodology was that the training program for the female athletes of both groups was designed so that to correspond to the precompetitive training mesocycle: hypertrophy, strength training, "ripping". However, for the Experimental group females, additional adjustments to the training process were made during the strength building and hypertrophy periods in view of the ovarian menstrual cycle phases and dietary habits.

Results and conclusions. The analysis of the strength tests results and questionnaire survey findings proved the effectiveness of the developed precompetitive strength building method for women in the early adulthood.

Keywords: bikini fitness, strength training, training planning, precompetitive period, ovarian-menstrual cycle, diet.

Background. Presently, there has been a huge increase in gym attendance as the latest trend and tendency. Herewith, the number of women willing to participate in bikini fitness competitions is increasing from year to year. Women's Bikini-Fitness as a physique-exhibition event for women was introduced by the International Federation of Bodybuilding and Fitness (IFBB) in 2011. Among the factors determining the fitness level for bikini-fitness competitions are: athlete's body constitution; level of development of the muscular system of the body; small amount of subcutaneous fat. Equally important, a bikini fitness competition is a modeling contest. What is essential for the judges are the posture, gracefulness of the female participants, their ability to show themselves on the stage, overall

coordination of movements, character, and personal qualities. This sport does not encourage large muscles, muscle separation, noticeable veins or vessels. The figure should be as feminine as possible. The above requirements for the evaluation of the physical fitness of the female participants necessitate the use of effective strength training means and methods during the training process.

Training cycles are currently planned upon the recommendations drawn from men's bodybuilding, which often results in health issues in female athletes. The effectiveness of the entire training process for women is determined by the development of a scientifically grounded strength building system in view of specific characteristics of the female body.

Objective of the study was to substantiate and develop a precompetitive strength building method for bikini fitness competitors in their early adulthood.

Methods and structure of the study. The experiment was conducted for 7 months on the basis of the fitness club "Powerhouse Gym", Yekaterinburg, and involved the 20-35 year-old females, who were split into 2 groups: Experimental (EG) and Control (CG) ones, 8 women each. The homogeneity of the selected groups was defined based on the subjects' physical development and physical fitness rates. The statistical data processing revealed no statistically significant differences between the CG and EG during the.

The peculiarities of women's strength training are associated with the specific features of organization and functioning of their body. Woman's body differs from man's in the total sizes, and above all - in the ratio of its parts and their level of development. Woman's limbs are relatively shorter, while the torso is longer than those of men. Their bone density is smaller. Women have a relatively small (6%) muscle mass and larger fat mass, their shoulders are narrower, and their pelvis is wider. The upper body is less developed and the lower body is more massive. With relatively strong leg and abdominal muscles, women have weak arm muscles and rotator cuff, which makes it difficult to perform strength exercises with own weight with both arms. The heart volume is less by 100-200 ml, the heart mass is less by 50 g, vital capacity – by 1.7 l. The physical working capacity of women is 20-40% lower than that of men. Adaptation to physical loads is accompanied by high functional tension and slow recovery [2, 4].

During the strength training it is not practical for women to use exercises with a high degree of arching (which may lead to metrectopia) and with maximum weights in a standing position (which may cause impaired posture and spinal cord injuries). It is more appropriate to exercise in a seating or prone position, which primarily strengthens to the core and abdominal muscles. Straining exercises and depth jump on a fixed support should be minimized [1, 3].

The total amount of strength exercises and exercises with maximum and close-to-maximum weights in women's workouts should be 20 to 30% smaller than that for men. The dynamics of the increment in the volume and intensity of strength loads should be smoother than that for men, and the rest intervals between sets and series should be longer.

During their strength trainings, women should be extra careful in between the first periods and the establishment of a normal ovarian-menstrual cycle. In the pre-menstrual phase of the ovarian-menstrual cycle, the overall load should be significantly reduced and straining exercises, exercises with close-to-max-

imum and maximum weights, and jumping exercises should be avoided.

If feeling unwell or in case of ovarian-menstrual cycle issues or severe premenstrual syndrome, the overall load should be significantly reduced and straining and whole-body vibration exercises should be avoided [3, 4].

In practice, there are two approaches to planning women's workouts. Some coaches do not actually follow the ovarian-menstrual cycle phases and thus do not plan physical loads in advance, but only reduce the volume and intensity of loads for 2-3 days. Other coaches plan in advance taking into account the ovarian-menstrual cycle phases. This approach is more appropriate and promising, as the distribution of training load according to the structure of the ovarian-menstrual cycle creates certain prerequisites for performing the basic training work in the optimal state of the body [1, 3, 4].

The bikini-fitness competitions are held twice a year: in April and October. The International Federation of Bodybuilding and Fitness (IFBB) posts the calendar of events online. The training macrocycles for the female athletes were developed based on this document. Normally the bikini-fitness macrocycle consists of three mesocycles: hypertrophy, strength training, "ripping".

The training programs for the EG females were additionally adjusted at the strength training and hypertrophy stages based on their biological cycles.

In the first two days of the menstrual phase, the training load was reduced to 30-40% of the one-time maximum (hereinafter, OTM), and from the third to the fifth day of the phase, the workload was increased to 50-70% of OTM. In this phase, preference was given to the upper body, excluding abdominal exercises. In the post-menstrual phase, the training load was increased to 70-90% of OTM. In the ovulatory phase, the workload was decreased to 50-70% of OTM. If the leg day fell on this phase, only strength exercises with own weight were used during the training session. In the post-ovulatory phase, the workload was increased to 70-90% of OTM. In the premenstrual phase, the training load was reduced to 60-70% of OTM.

Results and discussion. An educational experiment was carried out to test the effectiveness of the developed strength training method for women. At the beginning of the experiment, the subjects' physical development and physical fitness levels were determined using a set of tests. The comparative analysis of the data obtained showed no statistically significant difference between EG and CG ($p \geq 0.5$) prior to the experiment in all indicators.

After the experiment, the strength levels increased in both groups, but the EG rates were higher than the CG ones. Significant changes ($p \leq 0.5$) were observed

Table 1. *Biological cycles in women during educational experiment*

EG						
Athlete/months	November	December	January	February	March	April
H.M.	+	+	+	+	+	+
K.M.	+	+	+	+	!	!
K.E.	+	+	+	+	+	+
F.Y.	+	+	+	+	+	+
D.O.	+	+	+	+	+	+
A.A.	+	+	+	+	+	+
Sh.O.	+	+	+	+	+	!
Z.L.	+	+	+	+	+	+
CG						
Athlete/months	November	December	January	February	March	April
K.T.	+	+	+	!	!	!
KM.	+	+	!	!	-	-
A.N.	+	+	+	+	!	!
O.N.	+	+	!	!	!	!
S.O.	+	+	+	+	+	+
L.A.	+	+	!	!	-	-
P.E.	+	+	!	!	!	!
M.A.	+	+	+	!	!	!

in the following tests: bench press; deep barbell squats; push-ups; feet anchored sit-ups. At the same time, there were no significant changes ($p \geq 0.5$) in the results of the pedagogical control test "leg raises to a 90-degree angle".

At the end of the educational experiment, the EG and CG females were subjected to a questionnaire survey to assess the regularity of their biological cycles, as well as their state of health before the competitions. Having processed the survey results, the information on the biological cycles of the females of each group was compiled into a table.

As seen from Table 1, only 25% of the EG females had a late period (delay of menstruation). These delays occurred in the final months of training for the competitions. This may be due to the tightening of dietary restrictions, as well as stresses that the female athletes may experience prior to the competitions. In the CG, 25% of women reported missed periods (suppressed menstruation) in the last months of pre-competitive training, while 62% of women had a late period.

The questionnaire survey data showed that 3 out of 8 women in the EG mentioned permanent fatigue, feeling unwell, sleep disorder, emotional imbalance, increased irritability, loss of interest in training and competitions, lack of self-confidence. In the CG, these symptoms were observed in 7 in 8 women.

Conclusion. In the EG, the rate of increase in the pedagogical control test results was higher than that in the CG. There were statistically significant changes ($p \leq 0.5$) in the following tests: bench press; deep barbell squats; push-ups; feet anchored sit-ups. At the same time, no significant changes ($p \geq 0.5$) were observed in the results of the pedagogical control test "leg raises to a 90-degree angle". The results of the post-experiment questionnaire survey proved the effectiveness of the developed training method and showed that amenorrhea and anovulation were typical of 87% of the CG females and 25% of the EG ones. Also, the CG females often reported fatigue, feeling unwell, sleep disorder, emotional imbalance, increased irritability, loss of interest in training and competitions, and lack of self-confidence.

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Physical activity level and sedentary lifestyle of children and young people aged 7-18 as social problem of the 21st century

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PhD, Associate Professor **J. Herbert**¹PhD, Associate Professor **K. Garwol**²PhD, Associate Professor **L. Zareba**³¹Institute of Physical Culture Sciences, College of Medical Sciences at Rzeszów University, Rzeszów, Poland²Institute of Sociological Sciences, College of Social Sciences, University of Rzeszów, Rzeszów, Poland³Institute of Computer Science, College of Natural Sciences at Rzeszów University, Rzeszów, Poland

Corresponding author: jherbert@ur.edu.pl

Abstract

Physical activity is the basis for maintaining physical and mental health of children and young people. This is also a crucial social problem which, together with the development of digital technologies consuming young people's time, is becoming more visible. Moderate-to-Vigorous Physical Activity (MVPA) lasting 60 minutes a day is of key importance with respect to health of the majority of children and young people. Monitoring physical activity by means of an accelerometer becomes a reliable and correct method for estimating physical activity. The aim of this study was to determine the level of physical activity of children and young people based on the MVPA index, number of steps and sedentary time. 108 pupils and students took part in the study. The ActiGraph WGT3X-BT accelerometer was used. The average MVPA value is 56.7 minutes (minimum: 19 – maximum: 133.6). The average number of steps is 8347 (minimum: 2630 – maximum: 19132). Basic physical activity calculated by means of simple indicators in representative samples of children and young people should be the basis for conducting health analysis.

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

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

According to the World Health Organisation (WHO) documentation, with regard to children and young people aged 5-17, it is recommended to take up at least 60 minutes of daily Moderate-to-Vigorous Physical Activity (MVPA) for the purpose of meeting basic development and health needs [12, 13, 29].

Taking all levels of physical activity intensity into consideration, MVPA has been best studied and, on the basis of these studies, MVPA is considered to be essential for health promotion and disease prevention

[19]. The analyses conducted suggest that 4/5 of the world's population of young people does not reach the MVPA [10] level recommended by WHO. The reason is that many children spend most of their time in a sitting position [8] and that this time has been longer for the past 10 years [21].

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

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

action should be taken in order to make children and young people more active in this respect.

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

The study subjects were instructed to wear the accelerometer for seven subsequent days, 24 hours a day. They were also informed that they must not use the accelerometers for spraying or water-related activities, as it must not come into contact with moisture.

The ActiGraph data was analysed using Actilife 6.0 software (ActiGraph LLC, Pensacola, FL, USA). In addition, values of weight and height were measured and the Body Mass Index (BMI) was calculated by squaring the body size (kg / m^2) BMI (kg/m^2).

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

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

In table no 2, the sedentary index indicating the time spent in lying, sitting or standing position - without body activity - was presented, which was 1167.4 minutes per day on average (minimum: 951.3 – maximum: 1335.1). From the aforementioned result obtained, about 8 hours of sleep ($1167-480=687$ minutes) should be subtracted, which means that the sample group spent only 273 minutes on average during a day on being active (walking, running, doing exercises). It should be mentioned that this index is increasingly being analysed in various studies on the whole world. In Aggio and research collaborators study [2], sedentary time of children and young people (group aged

Table 1. BMI divided into four age groups Source: Based on author's own research.

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

Source: Based on author's own research.

Table 2. Sedentary index divided into four age groups

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

Source: Based on author's own research.

Table 3. Total MVPA index divided into four age groups

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

Source: Based on author's own research.

Table 4. Number of steps divided into four age groups

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

Source: Based on author's own research.

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

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

In relation to children and young people, Moderate-to-Vigorous Physical Activity (MVPA) has a positive impact on their physical and mental health in the short

and long term [7, 13], so the analyses carried out are especially important for analysing physical inactivity.

In table 4, the number of steps were indicated. The average value in this table is 8347 steps (minimum: 2630 – maximum: 19132). The analysis carried out by Vincent and Pangrazi [28] was one of the first studies assessing a large group of pupils aged 6-12 (N = 711). As a basis for physical activity, the authors suggested at least 11 000 steps for girls and 12 000 steps for boys. On the other hand, Tudor-Locke and research collaborators [27], suggested at least 12 000 steps for children aged 6-11 for girls and 15 000 steps for boys and for young people aged 12-19: 10 000– 11700 steps / day [26]. By comparison, the studies conducted by Tudor - Locke [25] indicated that children and young people made 9000 steps on average.

Conclusions. For many generations, there have been changes in the course of the population's somatic development and these changes have been steadily speeding up. They are called 'secular trends'. One of their signs is the acceleration of biological development and adolescence period. These changes are primarily related to the constantly improving social and economic situation and the enhancement of the population's standard of living. These factors are, among others: change of dietary habits, an improvement in environmental conditions, an increase in the level of education and better quality of health care. Monitoring of the physical activity of children and young people is the main indicator of health sustainability. Basic physical activity calculated by means of simple indicators in representative samples of children and young

people should be the basis for health analysis. The relationship between physical activity and a sedentary lifestyle seems to be insufficiently researched, which is particularly unfavourable, among others, due to the significant increase in the number of young people with obesity. The analysis of the number of steps provides an objective assessment of the current state of physical activity of children and young people and is the basis for promoting daily physical activity among young people.

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Integrative development approach for university physical education service

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Dr. Hab., Professor **A.Y. Nain**¹

Dr. Hab., Professor **L.A. Lipskaya**¹

Dr. Hab., Professor **O.L. Karpova**¹

Dr. Hab., Professor **A.A. Nain**¹

¹Ural State University of Physical Culture, Chelyabins

Corresponding author: anain@yandex.ru

Abstract

Objective of the study was to develop an integrative-development-approach-based multilevel training concept for physical education university students.

Methods and structure of the study. We tested the integrative-development-approach-based multilevel training model at Ural State University of Physical Culture in 2015 through 2020, and analyzed the benefits of the multilevel training system as complementary to the physical education service. We used for the study purposes a combination of theoretical analyses and syntheses of the research data; valid general/ physical education curricula and work programs; and empirical surveys, observations and progress testing experiment.

Results and conclusions. The training concept of multi-level training of sports university students based on the implementation of the provisions and principles of the complementary competency-building and culturological paradigms, which guide future workers in the field of physical education and sports to promote physical and social activities among children and young people, a healthy and culture-congruent way of life in their indivisible unity. The combination of the mentioned conceptual ideas is possible and can be effective through a clearly innovative integrative development approach. The continuity of the socio-humanitarian training of students includes not only the continuity of the educational process but also a certain correlation in the formation of universal and professional competences at various levels of training, with due regard to the professional orientation of the social and philosophical disciplines, which is reflected in the work programs and evaluation tools.

The integrative development approach consolidates and unites contents of the socio-humanitarian education concept to effectively train students for creative professional service, build up versatile self-development skills and resources and facilitate the individual self-realization agenda. When a consolidated educational environment is created, continuity of the socio-humanitarian disciplinary module makes it possible to effectively build up and expand competences formed at the prior stages to advance the comprehensive training in social studies and humanities with progress in the prior basic competences and form new advanced competences.

Keywords: *integrative development approach, socio-humanitarian disciplines, interdisciplinary model, multilevel training, culturing and competency-building paradigm, universal and professional competences, physical education.*

Background. The ongoing transition to the new Federal State High Education Standards requires new advanced educational concepts and technologies being developed and implemented to facilitate the socio-humanitarian and professional training service provided by the physical education universities. It should be mentioned that the physical education system reforms need to be advanced with a spe-

cial priority to the socio-humanitarian disciplines so as to integrate the competencies developed at every education stage (bachelor, master, postgraduate). We believe that one of the promising vectors for the reforms is the new interdisciplinary and integrative socio-humanitarian education prioritizing concept within the culturing and competency-building paradigm. Such integrative approach urges the teachers

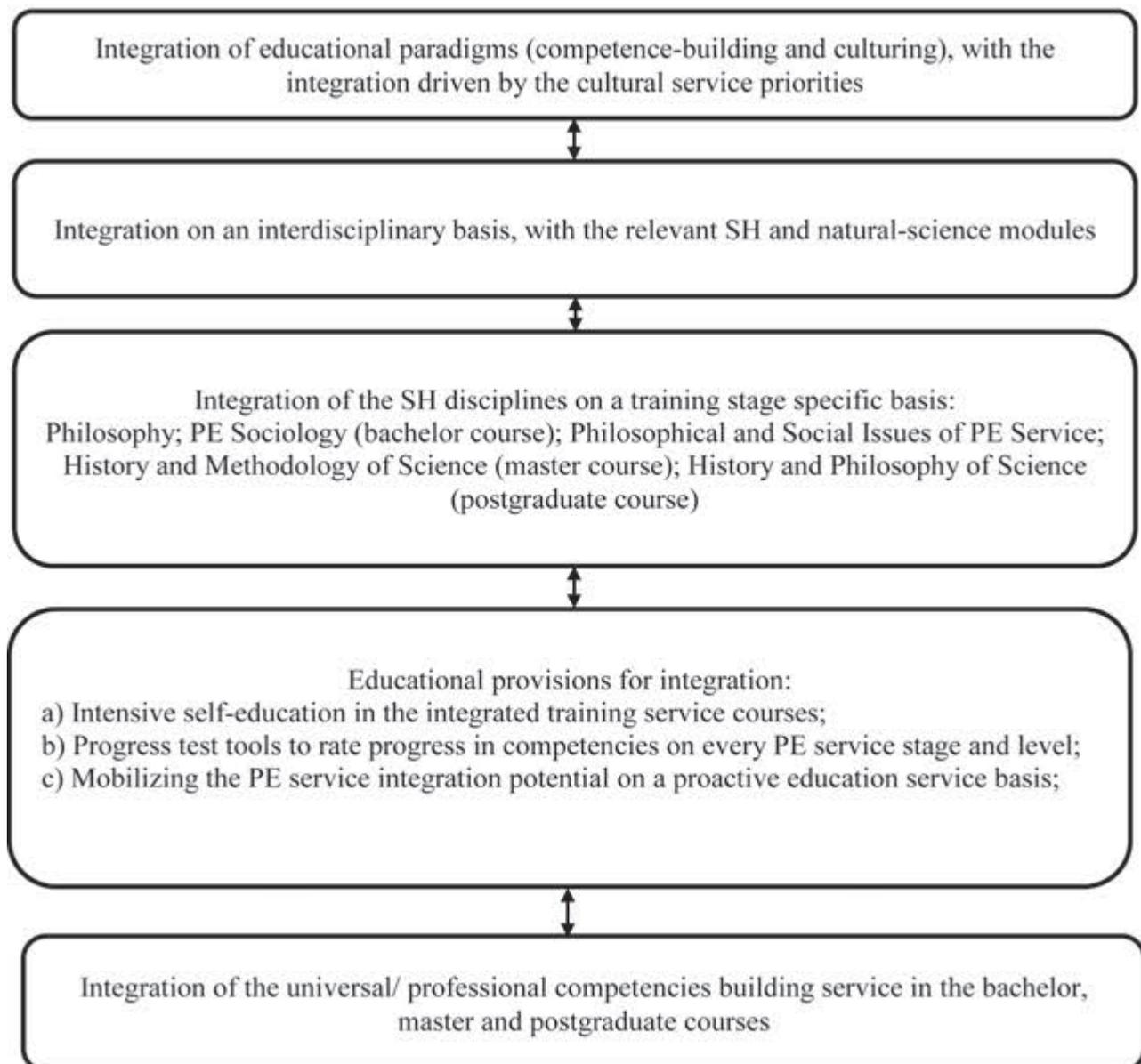
to prudently combine the cognitive, practical, motivational and values-driven elements with due emphasis on the interdisciplinary links, continuity and succession in the knowledge in social studies and humanities. This harmonized set of the education concepts and ideas may be implemented based on an integrative development approach.

Objective of the study was to offer an integrative-development-approach-based multilevel training concept for physical education university students.

Methods and structure of the study. We tested the integrative-development-approach-based multilevel training model at Ural State University of Physical Culture in 2015 through 2020, and analyzed the

benefits of the multilevel training system as complementary to the physical education service. We used for the study purposes a combination of theoretical analyses and syntheses of the research data; valid general/ physical education curricula and work programs; and empirical surveys, observations and progress testing experiment.

Results and discussion. Complementary cultural and competency-building paradigms are implied in the modern physical education design models geared to facilitate individual integral biosocial-cultural development in the physical, spiritual, intellectual and ethical domains. Studies by V.K. Balsevich and L.I. Lubysheva demonstrated that the biological aspects of human development may not



IDA-based multilevel training concept for a PE university

be isolated from the individual social responsibilities, roles and relations [2] and, therefore, the growing role of the science dimension of social studies and humanities in education cannot be underestimated by the educational sector on the whole and its physical educational system in particular.

The socio-humanitarian disciplines shall secure due continuity and harmonized progress trajectory for the physical education university curricula with a special attention to the professional progress in every discipline – as has been underlined by many authors [1-5]. It should be noted that the socio-humanitarian training service continuity refers not only the training content as such but also to specific connections in the universal and key professional competencies building process. We pursued this approach when designing the work programs and progress test tool-kits [1, 3].

We feel that the best solution is offered by a modular training system with the interdisciplinary connections reinforced in every level of the socio-humanitarian training and its inter-level training elements. A module may be defined herein as the education service component/ unit (cluster of socio-humanitarian disciplines in our case) geared to secure certain level of competences as required by the core curriculum. Such modular training technology makes it possible to build up in a master course the prior bachelor competencies followed by a postgraduate course, with the relevant continued and comprehensive socio-philosophical worldview forming and development elements.

The integrative training module developed by the Pedagogy Department offers learning materials classified by semesters, academic years and progress stages. This training approach was proved effective for the focused training in a few different and relative disciplines united by some specific contents and goals: see Figure hereunder.

Given in the above Figure are the basics of the integrative-development-approach-based multilevel training concept for a physical education university, with its every element, as verified by the model testing experiment, found beneficial for the bachelor, master and postgraduate courses. The Reference Group was tested somewhat lower on the test scales since its training was free of the integrative-development-approach-driven physical education service elements. Generally, the education community recognizes the need for a modern education approach forming a basis for individual self-development skills of special demand on the fast-changing employment markets.

The integrative development approach may be recommended as a promising approach. As provided by L.A. Shipilina, the integrative development ap-

proach is the specific cognitive and practical activity format that prioritizes integrative ideas in the training system [5, p. 20]. The approach was named to identify its content and key mission. Integration generally fits in with the modern social progress trends in the student personality formation domain, with a fully-fledged personality expected to be highly fit for the professional service and self-education and progress – as specified in the educational provisions for integration. Individual creativity shall be mobilized to efficiently harmonize the purely educational, psychological and professional progress domains, with the integration also reflecting specifics of every discipline with its integrative contents and meanings.

Thus the integrative socio-philosophical module includes the following interrelated disciplines: Philosophy, Physical Education Sociology (bachelor course), Philosophical and Social Issues of Physical Education Service, History and Methodology of Science (master course), and History and Philosophy of Science (postgraduate course). The module implies the philosophical, methodological and theoretical/research materials being classified by the difficulty levels in the leveled physical education and sport service customizable to the future professional responsibilities.

To ensure the socio-humanitarian disciplines in the new curricula and work programs being consistent, we developed their level-specific contents and competence tests with account of their dialectical complication with courses and education service stages, and their interaction logics. Thus the bachelor course includes the Physical Education Sociology discipline that covers the social role, responsibilities and problems of modern physical education. The master course analyzes the social, gender-specific, socializing, conflicts-setting and other sociological aspects of modern physical education service under Philosophical and Social Problems of Physical Education discipline. This master course discipline also furthers progress in the moral/ ethical qualities and worldviews basically formed by the bachelor Philosophy discipline. Continuity of the education service goals is particularly obvious in the master and postgraduate training stages. Thus the master course History and Methodology of Science is effectively continued and expanded by the postgraduate History and Philosophy of Science discipline at a higher philosophical and methodological level [4, p. 111].

Conclusion. The integrative development approach consolidates and unites contents of the socio-humanitarian education concept to effectively train students for creative professional service, build up versatile self-development skills and resources and facilitate the individual self-realization agenda. When a consolidated educational environment is

created, continuity of the socio-humanitarian disciplinary module makes it possible to effectively build up and expand competences formed at the prior stages to advance the comprehensive training in social studies and humanities with progress in the prior basic competences and form new advanced competences.

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