T&PPC

№ 8 August 2021

Theory & Practice of Physical Culture

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

Key issues of the modern sports science for discussion

Methodological principles of building a modern system of training physical education personnel

Currently, the idea of continuing education is becoming particularly relevant in the training of professional personnel.

The branch of physical culture and sports covers sports organizations of various structures, whose tasks change in connection with the demands of public life. In this regard, it is important to build a multi-component system of personnel training, which could be developed on a strictly constructed methodological basis, allowing the use of diversification of tasks, functions, structure and content of professional training. Learning throughout your life, gaining new knowledge and remaining competitive for many years – this is the task facing specialists in the field of physical culture and sports.

Personnel training should be based on methodological principles that allow to fully build both the system of basic and additional education.

The implementation of this principle is shown in the first article "Prospects", prepared by a group of authors from St. Petersburg under the guidance of associate professor M. Yu.Schennikova. As part of the monitoring, the authors analyzed the key indicators of the development of physical culture and sports, which determine the personnel need at the regional level. The study revealed:

• stabilization of the ratio of the number of athletes per coach, due to the approved standards for the occupancy of training groups and the number of training sessions in the federal standards of sports training and federal state requirements for the implementation of additional pre-professional programs in the field of physical culture and sports;

• a significant lag in the growth rate of personnel support from the increase in the number of people who are systematically engaged in the fields of physical culture and mass sports at the place of work, at sports facilities, in other physical culture and sports organizations.

Statistical monitoring is designed to generate regularly updated information on the trends in the development of the labor market of the industry and related processes, on the effectiveness of the use of the personnel potential of the sphere of physical culture and sports at the level of regions and subjects of the Russian Federation, on the need and sufficiency of personnel support for the implementation of the development strategy of the industry.

Thus, the proposed principles of the system of continuous professional development reflect the ideas of professional training of specialists in the field of physical culture and sports, determine the ways of transforming scientific and innovative complexes of the system of continuous professional education.

A highly professional human resource is the key to the effective development of the physical culture and sports industry and the formation of a healthy lifestyle of the country's population.

We invite scientists to publish articles that are aimed at finding new ways to develop the human resource of the physical culture and sports industry in accordance with the needs of society.

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

Theory and Practice of Physical Culture

8'2021

Monthly Scientific-theoretical Journal, founded in 2013

ISSN 2409-4234

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Theory and Practice of Physical Culture

Contents

Covid-19 related training service restrictions: effects on competitive technical scores in elite women's freestyle wrestling

UDC 796.015

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Abstract

Objective of the study was to analyze effects of the COVID-19 related training service restrictions on the competitive technical scores in the women's freestyle wrestling elite.

Methods and structure of the study. We collected the input data for analysis from the refereeing protocols and video captures of the Russian Freestyle Wrestling Championship (RFWC) that was rescheduled from May to September 2020 as a result of the pandemic. The RFWC-2020 records reported 152 competitors and 179 bouts in all weight classes. The input data was used to compute the competitive technical scores as recommended by the leading experts to produce: total/scoring technical and tactical actions; competitive technical and tactical actions scoring ratios; technical and tactical actions averages per bout and minute; technical and tactical actions success rates; attack-to-attack intervals; average bout time, etc. We analyzed the women's freestyle wrestling elite's competitive performance data for the RFWC-2020 versus the pre-pandemic RFWC-2018 to rate the regress in the competitive performance due to the COVID-19 related training service restrictions.

Results and conclusion. The ongoing COVID-19 pandemic has heavily restricted social contacts and physical activity the world over and forced the sporting communities to limit and adapt the training systems as required by the lockdown and self-isolation regulations. As a result, the special training service has been heavily limited at detriment to the competitive performance in many sports including the national elite women's freestyle wrestling sport. Our study has found, however, that the forced limitations of the training service have had their 'silver lining' in some aspects. On the positive side, we would mention growth in the numbers of qualifiers for the national women's freestyle wrestling championship due to rehabilitation of chronic injuries; and higher competitive motivations, with the athletes clearly eager to compete after the long forced break. On the negative side, we found a significant drop in many competitive performance indicators with the inevitable sags in the competitive activity and scoring actions. The study data and analyses are recommended for consideration by the elite freestyle wrestling and coaches in their training for the upcoming World Wrestling Championship and Olympic Games in Tokyo.

Keywords: *female wrestler, competitive performance, pandemic, competitive technical scores, analysis, Championship, results, activity.*

Background. The ongoing COVID-19 pandemic has negatively transformed lifestyles the world over with multiple implications for the commercial, social, physical and other activities including popular sports on the whole and elite professional sports in particular. It has been no more possible for the last year for the freestyle wrestler to train two-three times a day in special well-equipped gyms as before, and the athletes have had to train in congested unequipped spaces or outdoors in their efforts to keep up the habitual workouts and fitness whilst having no access to special equipped training service. These training restrictions have fully applied to every professional wrestling discipline that requires special training gyms and special focused workouts including sparring bouts. The pandemic-related training restrictions, therefore, have ef-

fectively reduced the special training workloads with the associating inevitable regress in many aspects of the competitive performance.

Objective of the study was to analyze effects of the COVID-19 related training service restrictions on the competitive technical scores in the women's freestyle wrestling elite.

Methods and structure of the study. We collected the input data for analysis from the refereeing protocols and video captures of the Russian Freestyle Wrestling Championship (RFWC) that was rescheduled from May to September 2020 as a result of the pandemic. The RFWC-2020 records reported 152 competitors and 179 bouts in all weight classes. The input data was used to compute the competitive technical scores as recommended by the leading experts (N.Y. Nerobeev, 2014; A.A. Karelin, A.B. Tajmazov et al. 2016; R.N. Apoyko, B.I. Tarakanov, 2015; H. Th nnemann, 2019) to produce: total/ scoring technical and tactical actions; competitive technical and tactical actions scoring ratios; technical and tactical actions averages per bout and minute; technical and tactical actions success rates; attack-to-attack intervals; average bout time, etc. We analyzed the women's freestyle wrestling elite's competitive performance data for the RFWC-2020 versus the pre-pandemic RFWC-2018 (as reported by B.I. Tarakanov, R.N. Apoyko, S.I. Petrov, N.V. Vorobyova, 2020) to rate the regress in the competitive performance due to the COVID-19 related training service restrictions.

Results and discussion. Given in Table 1 hereunder is the women's freestyle wrestling elite's competitive performance data for the RFWC-2020 versus the pre-pandemic RFWC-2018.

A comparative analysis of the above data showed significant competitive performance differences of the events, with the RFWC-2020 showing growth versus RFWC-2018 in numbers of competitors and bouts (plus 22.6%) – that may be interpreted as indicative of the freestyle wrestling elite rehabilitation from chronic injuries with the associating improvements in the competitive fitness for the pandemic-related long break in competitions. The bout statistics, however, showed a high growth of wins by points (plus 51.7%) with reduction of the wins for technical superiority (minus 10%). We should also mention some growths in the total technical and tactical actions and scoring points (by 5.2% and 2.2%, respectively) and significant variations of these rates by periods – that may mean that the scoring technical and tactical actions are now distributed more even in bouts albeit the overall scoring activity of the women's freestyle wrestling elite still keeps significantly higher in the first period. The technical and tactical actions scoring points has also sig-

Table 1. *Women's freestyle wrestling elite's competitive performance competitive performance data of the RFWC-2020 versus the pre-pandemic RFWC-2018*

Competitive performance	RFWC-2018		RFWC-2020		Difference	
	n	%	n	%	n	%
Freestyle wrestling competitors	124	100	152	100	28	22,6
Wins by:	146	100	179	100	33	22,6
– Points	60	41,1	91	50,8	31	51,7
– Technical superiority	55	37,7	50	27,9	-5	10
– Fall (pin)	27	18,5	31	17,3	4	14,8
– Default	4	2,7	7	3,9	3	75,0
Total technical and tactical actions including:	688	100	724	100	36	5,2
– Period 1	440	64,0	446	61,6	6	3,9
– Period 2	248	36,0	278	38,4	30	6,7
Scoring points by:	1375	100	1405	100	30	2,2
– Period 1	891	64,8	870	61,9	-21	4,7
– Period 2	484	35,2	535	38,1	51	8,2
Technical and tactical actions scored by: 1 point	129	18,8	180	24,9	51	39,5
– 2 points	496	72,1	476	65,7	-20	4,2
– 4 points	63	9,2	67	9,3	4	6,3
– 5 points	0	0	1	0,1	1	0

Table 2. *Women's freestyle wrestling elite's competitive performance data of the RFWC-2020 versus the pre-pandemic RFWC-2018*

Competitive performance data	RFWC-2018	RFWC-2020	Difference	
	M±m	M±m	t	p
Average technical and tactical actions per bout	4,60±0,20	4,09±0,15	2,04	0,05
Average technical and tactical actions per minute	1,15±0,08	0,94±0,06	2,10	0,05
Average score per bout	9,19±0,31	7,96±0,29	2,93	0,01
Average score per minute	2,30±0,17	1,84±0,14	2,09	0,05
Technical and tactical actions success rate, points	2,00±0,03	1,95±0,04	1,00	
Attack-to-attack interval, s	54,1±3,9	64,9±4,7	1,77	
Average bout time, min, s	4.06±11	4.25±12	1,17	

nificantly changed due to the significant growth in the low-scoring 1-point actions (plus 39.5%) and a drop in the 2-point actions (minus 4.2%), whilst the 4-point actions stayed virtually the same. Given in Table 2 hereunder is the further detailed analysis of the competitive performance data indicative of the technical and tactical actions activity and success.

The above data analysis demonstrates the pandemic-related transformations in the women's freestyle wrestling competitive performance due to the special training service limitations. We found the highest significant reductions in the average technical and tactical actions per bout (by 0.51; p 0.05) and per minute (by 0.21; p 0.05); and in the average scores bout (by 1.23 points; p 0.01) and per minute (by 0.46 points; p 0.05); with the associating growth of the attack-to-attack interval (by 10.8 s); drop in the technical and tactical actions scores (by 0.05 points) and, as a result, an unsurprising growth in the average bout time (by 19 s). Having summarized the above data and analyses, we every reason for concerns with the competitive performance sags in the women's freestyle wrestling elite due to the long pandemic-related restrictions on the special training service in well-equipped gyms.

Conclusion. The ongoing COVID-19 pandemic has heavily restricted social contacts and physical activity the world over and forced the sporting communities to limit and adapt the training systems as required by the lockdown and self-isolation regulations. As a result, the special training service has been heavily limited at detriment to the competitive performance in many sports including the national elite women's freestyle wrestling sport. Our study has found, however, that the forced limitations of the training service have had their 'silver lining' in some aspects. On the positive side, we would mention growth in the numbers of qualifiers for the national women's freestyle wrestling championship due to rehabilitation of chronic injuries; and higher competitive motivations, with the athletes clearly eager to compete after the long forced break. On the negative side, we found a significant drop in many competitive performance indicators with the inevitable sags in the competitive activity and scoring actions. The study data and analyses are recommended for consideration by the elite freestyle wrestling and coaches in their preparations for the upcoming World Wrestling Championship and Olympic Games in Tokyo.

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Psychophysiological tests to facilitate competitive progress in elite mixed martial arts

UDC 796.082

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Abstract

Objective of the study was to analyze benefits of the psychophysiological qualities tests and analysis for competitive progress in modern mixed martial arts.

Methods and structure of the study. We sampled the mixed martial arts elite and provisionally split it up into the fast-, mid- and slow-success groups (M1, M2 and M3, respectively) for the psychophysiological qualities tests with the polar groups matching method and group competitive progress analysis. We used the following psychophysiological qualities tests: simple and complex sensorimotor response tests; static and dynamic movement coordination tests; critical flash discrimination frequency test; response to moving object test; and stress tolerance, activity, communication skills and feel of rhythm tests – using KPFK-99 Psychomat Test System. We also tested the attention control by proofreading test and Gorelov test; and rated the static-kinetic balancing skills by the Yarotsky test.

Results and conclusion. The study data and analysis found the set of psychophysiological qualities tests being beneficial for profiling competitive progress in modern mixed martial arts. The tests found the psychophysiological qualities of the mixed martial arts elite being by far higher in many aspects than in unsporting groups and many sports groups. This finding was verified by the sensorimotor response, movement coordination, critical flash discrimination frequency, response to moving object and other tests, with a special role played by the tests of the attention controls under high-intensity physical stress and tests of the ability to fast adjust the high-intensity motor actions requiring fast thinking, with complex and partially aerial/ unsupported movement sequences. Of special benefit was the full set of Luscher tests for the elite mixed martial arts competitors qualified Honored Masters of Sports and World Class Masters of Sports – whose test rates were significantly higher than in the Masters of Sports and Candidate Masters of Sports groups.

Keywords: *mixed martial arts, psychophysiological tests, psychophysiological qualities, polar groups matching method.*

Background. Modern mixed martial arts fights require high stress tolerance, excellent mental control and certain physiological qualities for the mixed martial artist to be able to alternatively excite and inhibit the motor centers when necessary for success. The competitive stressors also activate functions of the sympathetic/ parasympathetic nervous system for the situation-specific performance control. Responses to the same competitive stressors are rather individual being dictated by the customary behavioral control patterns [1, 4, 6-10]. That is the reason why the mixed martial arts sport community gives a special priority to the sport-specific psychophysiological qualities and their training tools knowing that they provide a basis for success of the competitive techniques and tactics.

Objective of the study was to analyze benefits of the psychophysiological qualities' tests and analysis for competitive progress in modern mixed martial arts.

Methods and structure of the study. We sampled the mixed martial arts elite and provisionally split it up into the fast-, mid- and slow-success groups (M1, M2 and M3, respectively) for the psychophysiological qualities tests with the polar groups matching method and group competitive progress analysis. We used the following psychophysiological qualities tests: simple and complex sensorimotor response tests; static and dynamic movement coordination tests; critical flash discrimination frequency test; response to moving object test; and stress tolerance, activity, communication skills and feel of rhythm tests – using KPFK-99 Psychomat Test System [2]. We also tested the attention control by proofreading test [5] and Gorelov test [2]; and rated the static-kinetic balancing skills by the Yarotsky test [5].

Results and discussion. The complex sensorimotor response test found significant intergroup differences (M1 - 279.2±8.1; M3 - 311.0±6.9, $p < 0.05$) – that were tested 99% significant for the average complex motor response time (M1 - 113.9±6.5; M3 - 143.7±4.1, $p < 0.01$). On the average latent complex sensorimotor response time scale, we found significant ($p < 0.05$) differences between the fast- and slow-success groups (M1 - 279.2±8.1; M3 - 311.0±6.9, $p < 0.05$); and on the mean complex sensorimotor response time scale the difference was significant within the 99% margin (M1 - 113.9±6.5; M3 - 143.7±4.1, $p < 0.01$).

The dynamic coordination test data were indicative of the high importance of this quality for competitive success in mixed martial arts. Thus the fast-success group was significantly better in the test than the slow-success one (M1 - 3045±136.8; M3 - 4943±237.8, $p < 0.001$), and within the 99% margin better than the mid-success group (M1 - 3045±136.8; M2 - 4062±63.5, $p < 0.01$). The M3 group on this test scale was also tested significantly lower than M2 (M2 - 4062±63.5; M3 - 4943±237.8, $p < 0.05$).

On the tapping frequency scale, the fast-success group was also tested significantly higher than the slow-success one (M1 - 3.6±0.3; M3 - 5.0±0.3, $p<0.01$), and higher than the mid-success group (M2 - 3.9±0.2; M3 - 5.2±0.3 $p < 0.05$). The same intergroup difference was found on the average tap time scale (M1 - 135.6±8.9; M3 - 168.9±5.3, $p < 0.05$) and on the integral tapping value scale (M1 - 48.9±2.1; M2 - 37.6±2.7, $p < 0.05$).

We also used the Luscher color test [3] to rate the psychophysiological qualities in the sample. The test data analysis found that on the total anxieties and compensations scale the fast-success group was significantly lower than the slow-success one (M1 - 2.8±0.1; M3 – 3.8±0.3, $p < 0.05$); and on the vegetative index scale the intergroup difference was within the 99% margin (M1 - 0.9±0.06; M3 - 1.3±0.1, $p < 0.01$). For the mid- and slow-success groups, the gap was significant within 95% margin (M2 - 1.0±0.08; M3 - 1.3±0.1, $p < 0.05$).

The feel of rhythm test produced the average intervals in rhythm steps, rhythm step trend, rhythm-step-specific response number, and average response interval in tapping stage rates. The test data were found significant only for the fast- and mid-success groups on the average intervals in rhythm steps scale (M1 - 384.3±16.1; M2 - 423.0±15.0, $p < 0.05$).

We used the Gorelov-1 jumping test to rate the group attention control under high-intensity physical stress. The test data showed this quality being critical for competitive success in mixed martial arts, as verified by the following intergroup differences: M1: 16.1±0.5 versus M3: 19.9±0.2, with the 3.8s gap, $p < 0.001$; and M2: 16.2±0.4 and M3: 19.9±0.2, with the 3.5s gap, $p < 0.01$. The jumping test data was also beneficial for rating the individual ability to fast adjust the high-intensity motor actions in need of fast thinking, with complex and partially aerial/ unsupported movement sequences. The test found a great advantage of the fast- and mid-success groups over the slow-success one: M1 - 33.7±0.6; M3 - 41.8±1.4, $p < 0.01$; and M2 - 35.2±0.3; M3 - 41.8±1.4, $p < 0.01$.

Conclusion. The study data and analyses found the set of psychophysiological qualities tests being beneficial for profiling competitive progress in modern mixed martial arts. The tests found the psychophysiological qualities of the mixed martial arts elite being by far higher in many aspects than in unsporting groups and many sports groups. This finding was verified by the sensorimotor response, movement coordination, critical flash discrimination frequency, response to moving object and other tests, with a special role played by the tests of the attention controls under high-intensity physical stress and tests of the ability to fast adjust the high-intensity motor actions requiring fast thinking, with complex and partially aerial/ unsupported movement sequences.

Of special benefit was the full set of Luscher tests for the elite mixed martial arts competitors qualified Honored Masters of Sports and World Class Masters of Sports – whose test rates were significantly higher than in the Masters of Sports and Candidate Masters of Sports groups.

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Youth sports training service quality determinants analysis

UDC 076

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Abstract

Objective of the study was to analyze and rank the youth sports training service quality determinants.

Methods and structure of the study. We sampled for the first-stage questionnaire survey the 14-18 year-old sports school trainees (n=200), their families (n=70) and coaches (n=12) to find their opinions on and expectations as to the training service quality. The survey data were verified by a content-analysis of the relevant legal and regulatory framework to produce an updated second-stage version of the questionnaire survey form with a special emphasis on the youth sports training service quality. The new questionnaire survey ranked the training service quality factors on a 5-point scale (from 1-point unimportant to the 5-point extremely important elements). The questionnaire survey data and rankings were used to develop a factor model for the training service quality that puts the training service quality factors and elements into a single matrix to facilitate a factorial analysis with the Varimax rotation test.

Results and conclusion. The training service quality elements and combined factors analyzed above are unlikely inclusive enough; and we would recommend further studies to correct, amend and complement the training service quality rating and ranking database and analyses.

The training service quality profiling data and analysis may be recommended as benchmarks for the coaching personality and expertise excellence and junior athletes' sports training service quality improvement initiatives.

Keywords: *coach's image, junior athletes' training service quality determinants.*

Background. Modern sports are increasingly competitive, with the competitive success no more assured by the one-way training intensity stepping tools only. In this context sports communities have to give a growing priority to the sports training service personnel quality on the whole and sport school trainers' service quality in particular [3]. Most of the theoretical and practical studies of the training service quality assume it being directly proved by the trainees' competitive accomplishments and physical/ technical progress within certain timeframes, although this assumption may not always be fair enough [12]. We believe that special studies may be beneficial to analyze the junior sports training service quality determinants.

Objective of the study was to analyze and rank the youth sports training service quality determinants.

Methods and structure of the study. We sampled for the first-stage questionnaire survey the 14-18 year-old sports school trainees (n=200), their families (n=70) and coaches (n=12) to find their opinions on and expectations as to the training service quality. The survey data were verified by a content-analysis of the relevant legal and regulatory framework to produce an updated second-stage version of the questionnaire survey form with a special emphasis on the youth sports training service quality. The new questionnaire survey ranked the training service quality factors on a 5-point scale (from 1-point unimportant to the 5-point

Table 1. *Youth sports training service quality factors ranking statistical/ factorial matrix*

Factor: weight	Factor elements with their specific weights
1: 27.46%	Trainee-dependent training service quality elements – Competitive progress motivations: 0.862 – Training discipline: 0.860 – Training aptitude: 0.822 – Physical and mental health protection/ improvement agenda: 0.820 – Compliance with the Federal Sports Training Standards: 0.806 – Formal medical permissions for competitions: 0.741 – Competitive progress in a wide range of events: 0.687 – Three-year competitive progress: 0.670 – Individual training plan execution: 0.669 – Promotions/ qualifications under the valid Federal Sports Training Standards: 0.658 – Compliance with the sports ethics codes: 0,618 – Yearly trainees' retention data: 0.550 – Progress in physical fitness tests: 0.529 – Success of the short- and long-term training/ competitive goals: 0.513 – Athletic functionality progress: 0.510
2: 21.72%	Coach-dependent training service quality elements – Training and rehab service management system compliance with the Federal Sports Training Standards: 0.782 – Physical and mental health protection/ improvement: 0.738 – Sound training and competitive process scheduling/ control system: 0.628 – Encouraging trainees' sports motivations: 0.562 – Self-control, management and test skills building in trainees: 0.555 – Individual cultural/ motivational service if any: 0.541 – Doping intolerance culture building in trainees: 0,540 – Dieting culture building in trainees: 0.527 – Spiritual/ ethical progress encouraging service aspects: 0.524 – Compliance of the sports ethics codes by trainees: 0.501
3: 15.44%	Training service system design/ management training service quality elements: – Quality material and technical assets/ resources: 0.796 – Good funding of the training service: 0.773 – Good rehabilitation system and methods: 0,658 – Harmonized progress prioritizing training service design: 0,614 – Healthy emotional/ progress facilitation team climate: 0.514
4: 7.61%	Coaching service quality elements: *Coach's professional expertise:* – Coaching motivations for the training service: 0.518 – Determined coaching skills upgrade agenda: 0,504 *Coach's personality credentials:* – Appealing/ progress encouraging personality qualities: -0,773 – Harmonic and friendly coach-trainee relationship: -0.569
72.23 %: total contribution of the four factors into dispersion	

Note: the Table lists the factors with 0.5-plus weights only

extremely important elements). The questionnaire survey data and rankings were used to develop a factor model for the training service quality that puts the training service quality factors and elements into a single matrix to facilitate a factorial analysis with the Varimax rotation test.

Results and discussion. Given in Table 1 hereunder is the training service quality factors ranking matrix with the factor analysis of the training service quality survey data.

As demonstrated by the above Table, the statistical model groups the training service quality elements into four categories/ factors. Factor 1 weighing 27.46% covers the 'Trainee-dependent training service quality elements' including the competitive progress motivations, training discipline, training aptitudes, physical and mental health protection/ improvement agenda, compliance with the Federal Sports Training Standards, competitive progress, promotions/ qualifications under the valid Federal Sports Training Standards etc.

Factor 2 weighing 21.72% groups the 'Coach-dependent training service quality elements' including the training and rehabilitation service management

system compliance with the Federal Sports Training Standards, physical and mental health protection/ improvement service, training/ competitive process scheduling/ control system, encouraging trainees' sports motivations, individual cultural/ motivational service if any, doping intolerance culture building in trainees, dieting culture building, etc.

Factor 3 weighing 15.44% covers the 'training service system design/ management training service quality elements' including the quality material and technical assets/ resources, good funding of the training service, good rehabilitation system and methods, harmonized progress prioritizing training service design; and healthy emotional/ progress facilitation team climate.

And Factor 4 weighing 7.61% refers to the 'Coaching service quality elements' including the c*oach's professional expertise with* the coaching motivations for the training service, and determined coaching skills upgrade agenda; plus the c*oach's personality credentials* with the appealing/ progress encouraging personality qualities; and the harmonious and friendly coach-trainee relationship.

The training service quality elements and combined factors analyzed above are unlikely inclusive enough; and we would recommend further studies to correct, amend and complement the training service quality rating and ranking database and analyses.

Conclusion. The training service quality profiling data and analysis may be recommended as benchmarks for the coaching personality and expertise excellence and junior athletes' sports training service quality improvement initiatives.

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10-17 year-old's 100m freestyle swimming speed, stroke pace and length profiling study

UDC 796.012.412.7

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Abstract

Objective of the study was to analyze the modern swimming speed control profiles in the youth 100m freestyle.

Methods and structure of the study. We rated the swimming speed in every 25m segment; stroke pace by five double stroke tests; and the stroke length by segmental swimming speed divided by the relevant stroke pace. The study was run in September-November 2019 at the Russian State Social University's and Moscow State Medical University's swimming facilities, with the 10-17 year-old swimmers (n= 26) sampled for the tests.

Results and conclusion. We found the 100-meter freestyle swimming speed control patterns fairly individual, with every analyzed age group found swimming faster the first 25 meters (within one-percent significance rate). This startup acceleration appears largely due to the jump start, since the water start was found of insignificant contribution to the segment 1 speed.

The study found wavelike variations and correlations of the segmental speeds, stroke length and stroke pace in the 100m freestyle in every age group. The findings on the age-specific segmental stroking patterns are recommended being taken in account by the junior swimmers' training and competitive systems.

The study found the first 25m segment speed in the 100m freestyle being the fastest in the junior sample, with every age group tested with the stroke pace sags on the distance, particularly in the final 25m segment. The 10-13-year-old group was tested with the stroke length gradually growing and then dropping in the final segment – versus the wavelike stroke length variation in the 14-17-year-old group. On the whole, the junior swimmers' sample was tested with inconsistent segmental speed/ stroke pace/ stroke length variations.

Keywords: *swimming parameters, junior athletes, various distance segments, front crawl.*

Background. The ever-growing competitiveness of the modern swimming sport urges the sport community to look for the training system excellence models and tools [1, 2], with a special priority to the swimming speed control including the stroke pace and stroke length profiled by the distance segments [3, 4]. The sport research community, however, is still in need of special studies to analyze the swimming profiles in the youth 100m freestyle to find the best speed control model.

Objective of the study was to analyze the modern swimming speed control profiles in the youth 100m freestyle.

Methods and structure of the study. We rated the swimming speed in every 25m segment; stroke pace by five double stroke tests; and the stroke length by segmental swimming speed divided by the relevant stroke pace. The study was run in September-November 2019 at the Russian State Social University's and Moscow State Medical University's swimming facilities, with the 10-17 year-old swimmers (n= 26) sampled for the tests.

Results and discussion. We found the 100-meter freestyle swimming speed control patterns fairly individual, with every analyzed age group found

swimming the first 25 meters faster (within one-percent significance rate). This startup acceleration appears largely due to the jump start, since the water start was found of insignificant contribution to the segment 1 speed.

We found the first 25m segment speed of the 10-11 year-olds averaging at 1.44 m/s (t = 17.36s); 12-13 year-olds at 1.63 m/s (t =15.34s); 14-15 year-olds at 1.78 m/s (t = 14.04s), and the 16-17 year-olds at 1.91 m/s (t =13.09s). The second 25m segment speed was found to fall in the 10-11 year-old group to 1.31 m/s (t = 19.08s); 12-13 year-old group to 1.50 m/s (t = 16.67s), 14-15 year-old group to 1.56 m/s (t = 16.03s); and the 16-17 year-old group to 1.64 m/s (t = 15.24s). The third 25m segment (50-75m) speed was tested to significantly change as compared to the second segment, with the 12-13 and 16-17 year-old groups showing insignificant falls versus the 10-11 and 14-15 years old groups that were tested with insignificant growth. The fourth 25m segment (75-100m) speed was tested to significantly fall in every age group, particularly in the 10-11-year-old group (18.8%, $p < 0.01$) followed by the 12-13 year-olds (17.3%, $p < 0.01$), 14-15 year-olds (12.0%, $p < 0.01$) and the 16-17 year-olds (3.8%, $p < 0.05$). It may be concluded that the segmental speed was found age-specific.

Furthermore, we should mention the natural competitive progress in the 100m freestyle with age, as the 10-11 year-olds recorded 77.54s; 12-13 year-olds to 68.52s; 14-15 year-olds 63.22s; and the 16-17 year-olds 59.82s. The stroke pace was also tested to vary on a segment-specific basis, with every age group tested with the stroke pace falls, particularly in the final segment. It should be emphasized that the stroke pace was tested to fall with age, particularly in the first segment. The stroke pace contrast ratio (segment 1 to segment 4 speed ratio) was tested the highest in the 10-11-year-old group (K = 1.18), and lowest in the 16-17-year-old group (K = 1.08 units) – that may be interpreted as indicative of the stroke pace stability growing with age despite the significant drop in segment 4, with the one- and five-percent significant margins (versus segment 1) for the 10-15 and 16-17 year-olds, respectively.

The segmental stroke length analysis found the age variations as well, with the 10-13-year-olds stroke length tested to gradually grow from the start and then fall in segment four; the 14-17-year-olds stroke length showing a wavelike variation; and the 16-17-year-olds stroke length tested highly stable. Therefore, the 10-17 year-old sample was tested with the age- and segment-specific speed/ stroke length / stroke pace variations that need to be taken into account by the training system designers for competitive progress.

The speed variability analysis found the segmental speed control rates being age-specific, with the highest variation range in the 10-11-year-old group (V = 4.2-9.8%) and lowest range in the 16-17 year-old group (V = 3.5-6.4%). The variation was the shortest and highest for segments 1 and 4, respectively, albeit never exceeding 10%, i.e. fairly stable.

The stroke pace variability was the highest (V = 4.8-12.5%) in the 10-11 year-old group – that may be interpreted as indicative of some individuals in the group prioritizing stroke pace and the others stroke length. The 16-17-year-olds were the only group with the low variation range, with the highest and lowest variations typical for the final segment 4 and starting segment 1, respectively – that is the case for every age group in fact.

We analyzed the age-specific stroke length correlations with the distance segments, and found them growing with age. The segment 1 and 4 stroke length were found mostly uncorrelated, and only the 16-17-year-olds were tested with a significant (r = 0.566) correlation of the segmental stroke length. The segmental stroke pace correlations were higher, with eight values found correlated within one-percent significant margin and growing with age. The correlations were the highest for the adjacent segments; and only the 16-17-year-olds were tested with a significant correlation of segment 1 and 4 stroke length rates (r = 0.565).

On the whole, the segmental stroke length and stroke pace were found correlated for the relevant segments: see Table hereunder. Thus the 10-11-year-old group speed in segment 1 was found dominated by stroke pace (r = 0.637); with the stroke length / stroke pace parity achieved in segments 2 and 3 (r = 0.558 and r = 0.540, respectively); followed by stroke length domination in segment 4 (r = 0.638).

The 12-13-year-old group was specific in the stroke test rates, with segments 1 and 3 tested with the stroke length / stroke pace parity, segment 2 dominated by stroke pace, and segment 4 by stroke length. The 14-15-year-old group was tested with significant stroke pace / stroke length correlations with the segmental speed, with segments 1 and 3 dominated by stroke pace, and segments 2 and 4 by stroke length. And the 16-17-year-old group was tested with the stroke length domination in segments 2 and 4, and stroke pace domination in segment 1.

Table 1. *Segmental speed correlations with the stroke length and stroke pace in the junior sample*

Age group stroke parameters	Segments, m			
	0-25	25-50	50-75	75-100
10-11 year-olds				
Stroke pace	637	547	540	478
Stroke length	530	558	572	638
12-13 year-olds				
Stroke pace	610	668	570	430
Stroke length	575	438	565	637
14-15 year-olds				
Stroke pace	672	570	638	520
Stroke length	571	625	530	614
16-17 year-olds				
Stroke pace	638	535	625	564
Stroke length	598	646	610	639

Note: Shaded correlations significant with

p<0.01 p<0.05

On the whole, the study found wavelike variations and correlations of the segmental speeds, stroke length and stroke pace in the 100m freestyle in every age group. The findings on the age-specific segmental stroking patterns are recommended being taken in account by the junior swimmers' training and competitive systems.

Conclusion. The study found the first 25m segment speed in the 100m freestyle being the fastest in the junior sample, with every age group tested with the stroke pace sags on the distance, particularly in the final 25m segment. The 10-13-year-old group was tested with the stroke length gradually growing and then dropping in the final segment – versus the wavelike stroke length variation in the 14-17-year-old group. On the whole, the junior swimmers' sample was tested with inconsistent segmental speed/ stroke pace/ stroke length variations.

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Volleyball setting skills (second contact) trainings with practice targets

UDC 796.925

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Abstract

Objective of the study was to test and analyze the 15-17 year-olds' technical skills in practical ski jumping competitions.

Methods and structure of the study. We sampled the 15-17 year-old ski jumping competitors (n=45) at the 2020 Student Sports Games in Tchaikovsky. The technical skills were captured by Sony HDR-CX650E camcorders fixed horizontally on tripods about 20m from and perpendicular to the jump line and rated at 50 frames per second. The camcorders were placed at the take-off and 6m/ 35m far downhill. The postural control and skiing symmetries was rated in the (1) in-run, (2) take-off and (3) flight phases from behind.

Results and Conclusion. The three phase (in-run, take-off and flight) kinematics was analyzed to rate the individual technical executions on the 102m long K-95 ramp in competitions. The jump techniques were analyzed on a more detailed basis in the leaders group.

The study data and analyses made it possible to rate the technical fitness of the 15-17 year-old ski jumpers for the 2020 Student Sports Games. The leaders group was tested with the postural controls in the in-run and mid-flight phases close to or matching with the technical execution standards. The take-off errors were due to the postural control asymmetries in the in-run and take-off phases in most of the sample, and we recommend the coaches giving a special priority to this technical element excelling aspects in the training systems. We also recommend the junior ski jumping training service quality being improved by regular camcorder tests with the postural control analyses and simulations to develop clear and symmetrical technical execution. Such tests and analyses are indispensable for the individual technical progress control with reference to the modern execution standards.

Keywords: *ski jumping, junior ski jumpers, biomechanics, angle characteristics, aerodynamics.*

Background. Junior ski jumpers are traditionally trained so as to master every technical element and jumping technique on the whole using simulators and practices on hills and snow bumps, with the basic skills mastered on special training tables and then on real competitive ramps and hills. Since the jumping skills schooling takes a long time, the beginner ski jumping technique training practices should be designed with a close reference to the best modern technical execution standards [2], with the more senior trainees' skills and postural controls tested and corrected versus the phase-specific joint angle standards [3, 6] and aerodynamic flight indices [1]. It is very important for the ski jumping schools to design and manage the sports reserve training systems as recommended by the modern well-grounded theory and practice [4].

Objective of the study was to test and analyze the 15-17 year-olds' technical skills in practical ski jumping competitions.

Methods and structure of the study. We sampled the 15-17 year-old ski jumping competitors (n=45) at the 2020 Student Sports Games in Tchaikovsky. The technical skills were captured by Sony HDR-CX650E camcorders fixed horizontally on tripods about 20m

Table 1. *The 15-17 year-olds in-run postural control test data versus the execution standard*

Ski jumping Group		Trunk angle*	Knee joint angle	Shin angle*
Standard		10-15	60-70	50-55
Leading group, n=10	$\dot{X}$	14	73	54
	δ	4,78	2,77	4,30
Main group, n=34	$\dot{X}$	11	77	55
	δ	5,53	3,85	6,10

**Note: angles rated to the ramp center line*

from and perpendicular to the jump line and rated at 50 frames per second. The camcorders were placed at the take-off and 6m/ 35m far downhill. The postural control and skiing symmetry was rated in the (1) in-run, (2) take-off and (3) flight phases from behind.

Results and discussion. The three phase (in-run, take-off and flight) kinematics was analyzed to rate the individual technical executions on the 102m long K-95 ramp in competitions. The jump techniques were analyzed on a more detailed basis in the leaders group (n=10). Given in Table 1 hereunder are the in-run postural control test data of the sample versus the technical execution standards [3, 6].

The in-run phase postural control rates of the sample were found basically compliant with the standards, albeit the video captures shoot from behind found a few postural control asymmetries and ski control errors: see Figure hereunder. It may be pertinent to remind that the key goal of the in-run phase is to speed up as fast as possible and set into an optimal take-off position; with the parallel skiing on the whole track with minimal side friction plus the streamlined posture to minimize the air resistance for faster acceleration.

In most cases, poor 'body centering' in the in-run phase appeared responsible for the further chain of errors (see Figure 1) including failures to control the total center of gravity in the take-off phase; deviations of the take-off jump line from the ramp center line; twists in the skier-ski system in the mid-flight phase etc. Our tests found 18 jumpers successful in skiing right in the middle of both tracks in every attempt; 5 jumpers failing at times doing that; 22 jumpers were tested with frequent skiing errors with the ski contacts with the track sides; and 24 and 21 jumpers were tested with serious and minor (respectively) in-run postural control asymmetries in the trunk and limb positions (see Figure 1a).

The take-off tests and analyses showed that, despite the joint angles being basically within the standard, the average take-off angles in both groups were above 90 - that is indicative of the 'neutral position' of the center of gravity on the edge in most of the sample. Such an execution of the key technical element fails to develop a due torque in the take-off point that facilitates taking the aerodynamically optimal configuration of the skier-ski system, i.e. the technical execution in

(1a) **(1b)** **(1c)** **(1d)**

Figure 1. *Postural control asymmetries and skiing errors in the in-run (1a), take-off (1b), flight start (1c) and mid-flight (1d) phases*

this phase was tested inconsistent with the modern take-off standards. It should be noted that 30 out of 45 competitors were tested with the take-off postural control asymmetries, mostly with errors in the knees positioning and skiing track centering (Figure 1b); and 27 jumpers were tested with the flight startup asymmetries (Figure 1c).

The mid-flight postural control angles were rated 35m far from the table, i.e. in the mid-point of the landing slope of the K-95 ramp. The leading group was tested close to or within the standard at this point. The technical performance may be still improved by mobilizing the postural aerodynamics reserves to reduce the frontal air resistance by 'more active' and ski/ trunk controls so as to minimize the aerodynamic flight indices. The main group was tested with particularly low average aerodynamic flight indices = 0.55 and, hence, requires special mid-flight control improvement trainings.

Furthermore, only 3 and 22 athletes were tested with no or minor flight-control asymmetries, respectively. Most of the sample, including the leaders group, was tested with the limb/ trunk/ skis control asymmetries and/or twists in the skier-ski system, and/or deviations from the ramp center line (Figure 1d); with these errors seriously limiting the aerodynamic quality and aesthetic aspects of the flight phase [5, 6].

The landing phase analysis tested only 6 jumpers with the right Telemark landing (one foot in front) style;15 athletes were unsuccessful in their Telemark execution attempts; 13 jumpers landed with no Telemark whatsoever; and 11 landed in deep squatted (erroneous) positions penalized by the technical score deductions.

On the whole, the competitive scoring points recorded in protocols include the points for aesthetic/ artistic merits and technical execution of the in-run, flight and landing phases. The technical scores averaged 15.4 and 13.7 out of 20 for the leaders and main groups, respectively, that means the medium and low technical execution qualities.

Conclusion. The study data and analyses made it possible to rate the technical fitness of the 15-17 year-old ski jumpers for the 2020 Student Sports Games. The leaders group was tested with the postural controls in the in-run and mid-flight phases close to or matching with the technical execution standards. The take-off errors were due to the postural control asymmetries in the in-run and take-off phases in most of the sample, and we recommend the coaches giving a special priority to this technical element excelling aspects in the training systems. We also recommend the youth ski jumping training service quality being improved by regular camcorder tests with the postural control analyses and simulations to develop clear and symmetrical technical execution. Such tests and analyses are indispensable for the individual technical progress control with reference to the modern execution standards.

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University footballers' game-position-specific physical fitness and physical development tests and analysis

UDC 796.332/015.682

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Abstract

Objective of the study was to test and analyze the physical development/ physical fitness in the university football teams versus the players' game positions.

Methods and structure of the study. We sampled the university football players in Moscow and tested them in March through October 2019 by the standard physical development tests to obtain the body mass, body length, chest size, vital capacity, carpal strength and limb length test rates; and standard physical fitness test toolkit including the 15m sprint (standard/ running start), 30m sprint, 7x50m shuttle sprint, 12-min race, standing high jump, standing long jump, and five-time standing long jump tests.

Results and conclusion. The game-position-specific chest size was expectedly correlated with the vital capacity rates that averaged for wing defenders, forwards, goalkeepers, central defenders, wing defenders and central midfielders. On the whole, the physical fitness test data and analyses made it possible to profile the university football players' physical fitness on a game-position-specific basis.

The game-position-specific physical fitness / physical development test data analyzed given herein are recommended for application by the university football sport communities in their trainings and line-ups for competitions and for the physical fitness / physical development excellence trainings sensitive to the players' game positions.

Keywords: *physical development, physical fitness, test data correlations, football players, university students, game positions.*

Background. Modern football communities give a special priority to the physical development / physical fitness data as a basis for successful technical and tactical performance [1, 3]. Traditional progress concepts with their preference for the physical fitness versatility are increasingly sensitive to the new theoretical recommendations to have the physical fitness being prudently customized to the players' game positions [2, 4, 5]. These provisions, however, are still underdeveloped for the professional football, whilst university football lags far behind in these research aspects.

Objective of the study was to test and analyze the physical development/ physical fitness in the university football teams versus the players' game positions.

Methods and structure of the study. We sampled the university football players in Moscow and tested them in March through October 2019 by the standard physical development tests to obtain body mass, body length, chest size, vital capacity, carpal strength and limb length test rates; and standard physical fitness test toolkit including the 15m sprint (standard/ running start), 30m sprint, 7x50m shuttle sprint, 12-min race, standing high

jump, standing long jump, and five-time standing long jump tests.

Results and discussion. The average body length was as follows: goalkeepers: 182.8±4.9cm, central defenders: 180.5±3.6cm, central midfielders: 177.2+3.4cm; wing midfielders: 176.4±4.8cm, wing defenders: 175.5±3.5cm; and forwards: 174.0±4.7cm. The goalkeepers, central defenders, central midfielders, wing midfielders, wing defenders and forwards body mass was tested to average 76.2±6.9; 72.6±4.8; 69.0±3.4; 68.9±3.6; 67.9±5.3 and 67.2±4.8kg, respectively. The resting chest size was the highest for goalkeepers (92.1±6.3cm), followed by wing defenders, central defenders, central midfielders, forwards and wing midfielders with 91.1±2.9cm, 90.2±3.2cm, 89.9±3.4cm, 89.5±3.3cm and 87.2±3.3cm, respectively. The game-position-specific chest size was expectedly correlated with the vital capacity rates that averaged for wing defenders, forwards, goalkeepers, central defenders, wing defenders and central midfielders 4653±551ml; 4558±415ml; 4450±548ml; 4408±485ml; 4333±492ml and 4220±420ml, respectively.

Leading in the arm size was goalkeepers with 80,7±4,4cm followed by the central defenders, wing defenders, central midfielders, wing midfielders and forwards with 79,5±2,4cm, 78,9±2,4cm, 77,4±2,3cm, 76,3±2,6cm and 75,3±3,1cm, respectively. The lower limbs in distal-proximal segments were rated in the central defenders, goalkeepers, central midfielders, wing midfielders, wing defenders and forwards at 96,9±2,4cm, 95,6±8,1cm, 94,9±3,6cm, 93,6±4,0cm, 93,4±2,8cm and 92,6±3,8cm, respectively. On the carpal strength (right/ left) scales, the sample was ranked as follows: goalkeepers: 49,9±,8 and 47,5±9,2kg; central defenders: 47,4±6,1 and 45,3±6,2kg; central midfielders: 47,4±6,6 and 43,3±5,6kg; wing defenders: 45,8±5,4 and 42,9±9,9kg; wing midfielders: 45,1±5,2 and 41,4±5,8kg; and forwards: 45,0±4,2 and 41,1±5,2kg.

Many experts tend to believe that it is not necessary anymore to develop every physical quality for the top excellence in team sports since the trainings should be rather focused on the game-position-specific needs with the key progress factors to give special priority to the key functions, organs and systems critical for the competitive performance. In this context, we tested the sample by a standard physical fitness test toolkit including the 15m sprint (standard/ running start), 30m sprint, 7x50m shuttle sprint, 12-min race, standing high jump, standing long jump, and five-time standing long jump.

Leading in the standard 15m sprint tests were the forwards and central defenders with 2,75±0,10s and 2,77±0,12s, respectively, versus the rest of the sample that scored 2,78±0,09s to 2,84±0,11s. The last in the test were goalkeepers with 2,88±0,13s. Leading in the running 15m sprint test were the wing midfielders and forwards with 1,82±0,05s and 1,83±0,06s, respectively; followed by central defenders, wing defenders, central midfielders and goalkeepers with 1,85±0,09s; 1,86±0,07s, 1,87±0,07s and 1,88±0,06s.

Leading in the 30m sprint were forwards with 4,24±0,11s followed by wing midfielders, central defenders, wing defenders, central midfielders and goalkeepers with 4,29±0,12s, 4,33±0,17s, 4,35±0,15s, 4,37±0,14s and 4,45±0,16s, respectively. Leading in the 7x50m shuttle sprint test were the wing midfielders with 63.6±1.8s, whilst the other players were tested with 64.0 to 64.4±2.2s.

Leading in the Cooper 12-min race test were the wing midfielders and central midfielders with 3254±157m and 3244±131m, respectively, whilst the others scored 3124±174m to 3160±151m, and with the goalkeepers again being the last with 3035±106m. The goalkeepers, however, leaded in the standing high jump test with 52,4±2,4cm; followed by central defenders, wing midfielders, central midfielders, forwards and wing defenders with 49,2±2,7cm, 48,3±3,0cm, 47,8±2,9cm, 47,6±2,2cm and 46,9±2,4cm, respectively.

The goalkeepers also leaded in the standing long jump test with 264±11cm, followed by central midfielders, central defenders, wing defenders, forwards and wing midfielders: 248±10cm, 247±12cm, 245±10cm, 239±11cm, respectively. Leading in the five-time standing long jump test were goalkeepers with 13,08±0,91m, followed by wing midfielders, central midfielders, central defenders and wing defenders with 13,14±0,82m; 13,12±0,87m, 13,10±0,93m and 12,51±0,88, respectively. On the whole, the physical fitness test data and analyses made it possible to profile the university football players' physical fitness on a game-position-specific basis.

Conclusion. The game-position-specific physical fitness / physical development test data analyzed given herein are recommended for applica-

tion by the university football sport communities in their trainings and line-ups for competitions and for the physical fitness / physical development excellence trainings sensitive to the players' game positions.

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Functional properties of athlete's heart

UDC 796.01:612

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Abstract

Objective of the study was to assess the hemodynamic status and left ventricle function in athletes trained on a regular basis.

Methods and structure of the study. Subject to the study were 22 male athletes (12 first-rank athletes and 10 Candidate Masters of Sport of Russia) aged 18-23 years. All the track-and-field athletes taken under observation were trained on a daily basis. The subjects' total years in track-and-field athletics equaled 4. The Control Group was made of 32 apparently healthy volunteer university students aged 18-23 years, who were subjected to physical loads at the academic physical education classes only.

Results and Conclusions. It is believed that the high myocardial relaxation velocity is common to regularly trained individuals. The weight of evidence suggests that the maximum rate of the left ventricular relaxation in the posterior wall, as a value that indirectly characterizes the time of development of this process during the diastole. Regular physical loads affect the hemodynamic status and heart contractile function of track-and-field athletes. Long-term track-and-field sports training is accompanied by the growth of the left ventricular mass with the absence of its dilation and preservation of the central hemodynamics and cardiac functionality. Under the influence of the long-term track-and-field sports training, there is a tendency to a functionally advantageous increase in the maximum velocity of relaxation of the left ventricular posterior wall.

Keywords: *track and field athletics, myocardium, left ventricle, heart, hemodynamics, physical loads.*

Background. The effects of the regular track-and-field sports training on the morphofunctional processes in the myocardium are currently of great interest, especially when it comes to the parameters of its contractile function - the stroke volume output and the degree of reduction in the anterior-posterior dimension of the left ventricle, which dynamics may help to accurately assess the functional capabilities of the left ventricle [5].

There is evidence that professional runners have an increased systolic discharge and a shortened anterior-posterior dimension of the left ventricle. It is also noted that beginner athletes have a smaller ejection fraction as opposed to untrained athletes [4].

Despite the physiological significance of the cardiac function, the mechanisms of heart adaptation to regular physical loads during the track-and-field training sports process remain understudied [2]. Further development of the targeted track-and-field sports training, as well as the methods to achieve high sports results, requires additional research aimed to assess the impact of regular track-and-field sports training on the central hemodynamics [8].

Objective of the study was to assess the hemodynamic status and left ventricle function in athletes trained on a regular basis.

Methods and structure of the study. Subject to the study were 22 male athletes (12 first-rank athletes

Table 1. *Studied indicators in the testees*

Indicators	Track-and-field athletes, M±m, n=22	Control Group, M±m, n=32
Left atrium size, cm/m^2	1.91±0.04	1.82±0.06
Anterior-posterior dimension of the left ventricle at diastole, cm	5.33±0.10	5.12±0.07
Shortening of the anterior-posterior dimension of the left ventricle, %	34.27±0.93	32.87±0.86
Thickness of the left ventricular posterior wall at diastole, cm	1.19±0.08	1.03±0.05 p<0.05
End-diastolic volume, cm^3/kg	1.81±0.11	1.98±0.07
Systolic discharge, cm^3/kg	1.10±0.10	1.08±0.06
Myocardial mass, cm^3/kg	2.57±0.17	2.18±0.12 p<0.05
Ejection fraction, %	61.65±1.34	60.21±0.80
Maximum velocity of left ventricular relaxation in the posterior wall, cm/s	13.1±1.27	10.2±0.58 p<0.05
Ratio between the end-diastolic volume and the myocardial mass, cm^3/kg	0.70±0.08	0.91±0.07 p<0.01

Note: p – significance of intergroup differences.

and 10 Candidate Masters of Sport of Russia) aged 18-23 years. All the track-and-field athletes taken under observation were trained on a daily basis. The subjects' total years in track-and-field athletics equaled 4. The Control Group (CG) was made of 32 apparently healthy volunteer university students aged 18-23 years, who were subjected to physical loads at the academic physical education classes only.

The subjects' state was analyzed based on the heart ultrasound results recorded in their medical cards. The heart ultrasound was performed on the Ultrasound Echo Aloka SSD-80 (Japan). The left ventricular diastolic volume was calculated [6]. The myocardial mass was estimated by the standard method [3]. The ratio between the left ventricular hypertrophy and the degree of dilation of its cavity was quantified by calculating the values of the end-diastolic volume/mass of the myocardium [3].

Results and discussion. The study found that the considered characteristics of the track-and-field athletes differed from those obtained in CG (see Table 1). The greatest differences between the study groups were associated with the morphological parameters of the left ventricle.

The left atrium size in the athletes exceeded that in the CG subjects by 4.9% only, thus, not reaching the level of significance of the differences. In the athletes, the anterior-posterior diameter of the left ventricle at diastole, tended to increase (by 4.1%) over that in the untrained individuals. A similar pattern was found in relation to the shortening of the size (4.2% higher in the athletes).

The thickness of the left ventricular posterior wall at diastole, was 15.5% higher in the track-and-field athletes than in the CG subjects ($p<0.05$). At the same time, the end-diastolic volume in the athletes tended to concede that in the CG subjects (by 9.3%). Moreover, the stroke volume output rates in both groups were comparable.

The myocardial mass rates were higher (by 17.9%) in the athletes, which indicated the development of cardiac hypertrophy under the influence of training loads. At the same time, these processes did not affect the ejection fraction rate, which was found to be comparable in both groups.

In the left ventricle posterior wall, the maximum relaxation rate was significantly higher in the track-and-field athletes engaged in long-term training (28.4%) than in the non-sporting individuals.

The ratio between the end-diastolic volume and the mass of the myocardium also significantly exceeded that in CG (by 30.0%), thus, indicating a higher level of sensitivity to regular aerobic loads.

The studies indicated the possibility of comparison of the left atrium size, left ventricular dimension, its cavity and volume. A similar state was detected in terms of the central hemodynamics and myocardial contraction (except for the maximum rate of relaxation the left ventricle in the posterior wall). At the same time, the ratio between the end-diastolic volume to the

myocardial mass under the influence of the track-and-field sports training reduced significantly as a result of the growth of the myocardial mass (primarily, the left ventricular posterior wall). The decrease in the ratio between the end-diastolic volume and myocardial mass in the athletes to 0.70±0.08 indicates the predominance of the left ventricular hypertrophy over the dilation of the cavity of this part of the heart.

It becomes apparent that the left ventricular hypertrophy is typical of track-and-field athletes, as evidenced by the increase in the thickness of its posterior wall and its mass, with the constant volume and size of its cavity, which are comparable to those in CG.

It is believed that the high myocardial relaxation velocity is common to regularly trained individuals [7]. The weight of evidence suggests that the maximum rate of the left ventricular relaxation in the posterior wall, as a value that indirectly characterizes the time of development of this process during the diastole [1]. During the current study, this indicator increased in all athletes. At the same time, there is a view that, during ultrasound [3], this indicator is very dynamic and is capable of changing even during a single study and may therefore not be considered very reliable.

Conclusions. Regular physical loads affect the hemodynamic status and heart contractile function of track-and-field athletes. Long-term track-and-field sports training is accompanied by the growth of the left ventricular mass with the absence of its dilation and preservation of the central hemodynamics and cardiac functionality. Under the influence of the long-term track-and-field sports training, there is a tendency to a functionally advantageous increase in the maximum velocity of relaxation of the left ventricular posterior wall.

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Physiological changes in cardiovascular system with vestibular irritation among representatives of game sports

UDC 796.01:612

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Abstract

Objective of the study was to analyze the dynamics changes in the cardiovascular system with vestibular irritation among representatives of game sports.

Methods and structure of the study. Sampled for the study were 63 males (23.6±1.4 years), second-class athletes or higher level from team sports, with at least three years of sports experience: hockey (n=21), volleyball (n=22), football (n=20).

The Control Group (n=19) was made of the apparently healthy students (22.1±0.9 years old), who performed significant muscle loads only during the university physical education classes.

V.I. Voyachek standard turning test to determine functional changes in the cardiovascular system under the influence of vestibular irritation. The cardiovascular response was evaluated by recording the heart rate and blood pressure before and after the turning test (standard option - 5 rotations in 10 s). To include a large number of receptors of the semi-circular canals of the vestibular system, the subjects were asked to rotate turning their heads in both directions (5 rotations in 10 s). To increase the size of the rotation on the vestibular system, the duration of V.I. Voyachek standard turning test was doubled (10 rotations in 20 s).

Results and conclusion. According to the findings, the cardiovascular rate in the hockey players, volleyball players, and footballers was within the normal limits: 64.2±0.59; 61.0±0.75 and 59.6±0.59 bpm, respectively. In Control Group, this rate was also within the norm, though slightly higher than in EG (70.2±0.93 bpm). The subjects' heart rate in response to the vestibular load increased in both groups.

Regular team sports driven training activities increase the level of adaptation to vestibular loads and train the muscle of the heart. In different game sports, motor actions contribute to the formation of a pronounced heart reaction to the turning test with a change in the head position in space. The physiological shifts in the myocardium were seen in the heart rate changes and were most biologically advantageous for the footballers, slightly surpassing those in the volleyball and hockey players. In team sports, the vascular tone and associated blood pressure level do not seem to be clearly related to the specific movements.

Keywords: *volleyball, football, hockey, vestibular system, cardiovascular system.*

Background. Rational muscle activity can significantly enhance metabolic and protective mechanisms of the body [2, 9]. Structured motor activity improves the functionality of the vital organs: heart, lungs, endocrine glands, vessels, and brain [10]. Physical loads activate the vestibular system, which is responsible for the optimum position of the body in space and precise motor actions due to rational redistribution of muscular tone [8]. The importance of the optimal functioning of the vestibular system arises from its involvement in ensuring adequate movement of the body parts in space and its close

interaction with the autonomic systems [3]. The influence of the vestibular system on the cardiovascular one [5, 7] is important to ensure the current physical status in general and fitness level in particular.

Objective of the study was to analyze the dynamics changes in the cardiovascular system with vestibular irritation among representatives of team sports.

Methods and structure of the study. Sampled for the study were 63 males (23.6±1.4 years), second-class athletes or higher level from team sports, with at least three years of sports experience: hockey (n=21), volleyball (n=22), football (n=20).

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V.I. Voyachek standard turning test to determine functional changes in the cardiovascular system under the influence of vestibular irritation. The cardiovascular response was evaluated by recording the heart rate and blood pressure before and after the turning test (standard option - 5 rotations in 10 s). To include a large number of receptors of the semicircular canals of the vestibular system, the subjects were asked to rotate turning their heads in both directions (5 rotations in 10 s). To increase the size of the rotation on the vestibular system, the duration of V.I. Voyachek standard turning test was doubled (10 rotations in 20 s).

Results and discussion. According to the findings, the cardiovascular rate in the hockey players, volleyball players, and footballers was within the normal limits: 64.2±0.59; 61.0±0.75 and 59.6±0.59 bpm, respectively. In Control Group, this rate was also within the norm, though slightly higher than in Experimental Group (70.2±0.93 bpm). The subjects' heart rate in response to the vestibular load increased in both groups.

In the classic version of the Voyachek test, the heart rate was found to increase in both groups: hockey players - by 3.6±0.63 bpm, volleyball players – by 3.2±0.52 bpm, footballers – by 2.1±0.19 bpm; CG subjects - by 5.6±0.19 bpm ($p<0.01$).

The results of the analysis of changes in the heart rate indicated lower rates in the test with the rightward inclination of the head than in that with the leftward inclination. The detected differences in the heart rate response among the team sports representatives were small, yet statistically significant.

The vestibular system adaptation during smooth curvilinear movements is particularly effective when the head is tilted to the right. Obviously, in game sports, this process develops to different degrees. It is believed that a change in the head position is more typical for footballers who have the weakest heart rate response to the head rotation to the right -2.5±0.16 bpm.

Apparently, due to slightly more active motor actions including rotational movements, footballers have a higher level of heart adaptation to sports activities [6].

The study included an analysis of changes in the heart rate of the team sports representatives when performing rotational movements of varying length. It was found that when doubling the duration of the turning test, the vestibular irritation increased by 69.6% in the non-athletes, without a clear proportionality to the increase in the number of rotations. The observed dependence was reversed in the athletes: the weaker the response to 5 rotations, the more pronounced it is to 10 rotations (for the hockey players - 66.7%, volleyball players - 81.2%, footballers – by a factor of 2.1).

In the classic version of the test, the hockey players' heart rate increased by 3.6±0.63 bpm, while under the influence of 10 rotations - by 6.0±0.69 bpm. For the volleyball players, this rate was 3.2±0.52 and 5.8±0.47 bpm, respectively. For the footballers, the equivalent values were 2.1±0.19 and 4.5±0.41 bpm, respectively. Therefore, the cardiac reaction in football players is more pronounced, which stimulates the metabolic processes in the tissues due to the activation of the blood flow in the tissues under increased sports loads [1, 4].

The systolic blood pressure rates were as follows: 112.2±0.52 mmHg for the hockey players, 112.6±0.59 mmHg for the volleyball, and 110.8±0.64 mmHg for the footballers. This rate in CG was slightly higher - 124.5±1.42 mmHg ($p<0.05$).

Under rotational loads, the subjects' systolic blood pressure increased at all the head positions. The increase in the systolic blood pressure in the non-athletes and all athletes was similar: 4.2±0.53; 4.0±0.61; 3.9±0.39 and 3.8±0.76 mmHg, respectively. The detected stability in the dynamics of the systolic blood pressure under rotational loads was

maintained despite the changes in the head position in all groups.

During the test with the doubled rotation time, the systolic blood pressure rate in the team sports representatives increased by about 35.0% as opposed to the classic version of the test. The increase in the systolic blood pressure in the test with the doubled rotation time was significantly higher in the non-athletes - 115.0% ($p<0.01$) than in the regularly trained athletes.

The dynamics of the diastolic blood pressure rates in the athletes performing all types of rotational loads increased slightly in all cases and were comparable for all the testees. The identified features suggest a marked adaptation of the cardiovascular system of the representatives of game sports to rotational loads, as well as its large functional reserves.

Conclusion. Regular team sports driven training activities increase the level of adaptation to vestibular loads and train the muscle of the heart. In different game sports, motor actions contribute to the formation of a pronounced heart reaction to the turning test with a change in the head position in space. The physiological shifts in the myocardium were manifested in the heart rate changes and were most biologically advantageous for the footballers, slightly surpassing those in the volleyball and hockey players. In team sports, the vascular tone and associated blood pressure level do not seem to be clearly related to the specific movements.

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Functional status strengthening in elite racing skiers at final training stage before main start of season

UDC 796.01:612

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Abstract

Objective of the study was to identify the peculiarities of functional adaptation of elite racing skiers at the venue for the final stage of training for the main start of the season in different phases of acute acclimatization.

Methods and structure of the study. Sampled for the study were 8 male racing skiers aged 24-36 years, having the sports qualifications from Masters of Sport to Honored Masters of Sport. The subjects were tested during the 21-day training in the middle altitude conditions (1820 m, Khmelevskiye mountain lakes, Krasnodar Krai), at the final stage of training for the 2021 World Championship in Oberstdorf (Germany) and the 2021 Russian Cup Final in Syktyvkar (Russia).

The athletes were asked to perform 8-min non-maximum muscle work on the Monark cycle ergometer (Sweden) at the resistance load set in accordance with the following protocol: starting stage – 720 kgm/min (120 W), surplus load – 240 kgm/min (40 W), duration of each stage - 2 minutes, pedaling rate – 80 rpm.

The following parameters were measured during the ergometric test: exhaled air parameters, using the automatic gas analyzer Metalyzer-II (Cortex, Germany) – before and during the test, and during the recovery period (first 3 minutes) – to measure the oxygen (% O_2) and carbon dioxide (% CO_2) levels; pedaling rate; lactate concentration – before and after the test, and 3 minutes into recovery, heart rate – using the Polar sports testers, with further data processing in ProTrener (Finland).

The readings of the 1st, 3rd, 5th, 7th, 9th, and 11th days of the acclimatization period (AcP) that covered the entire acute acclimatization phase were used as the basis for the identification of the peculiarities of strengthening of the functional status of the main energy supply systems (oxidative and lactic acid energy systems) at the venue for the final stage of training for the main start of the season.

Results and conclusions. The study enabled to identify the peculiarities of the adaptation processes and determine the most significant individual markers of formation of the oxidative energy system, lactic acid energy system, and cardiovascular system in terms of the middle altitude training (Khmelevskiye mountain lakes, 1820 m). The following parameters turned out to be the most significant: maximal oxygen consumption, lactate concentration, heart rate, balanced ratio of MBC to O2UC and mechanical efficiency coefficients, together with the oxygen pulse value, which reflect the maturity of the regulatory mechanisms. A peculiar feature of the adaptation processes is the established heterochrony and mutual compensation of the studied systems in the acute acclimatization phase. In terms of the selected methodical direction of the training process design (trainings at the altitude of 1820 m, Khmelevskiye mountain lakes), the time-frame to reach the stable level of the functional status is 7 to 11 days.

Keywords: *adaptation to middle altitude conditions, functional status, energy systems (oxidative, lactic acid), acute acclimatization phase, elite racing skiers, final training stage.*

Background. The current level of development of cross-country skiing is determined by continuous improvement of racing skiers' functional capabilities [2, 3, 5]. Trainings in the middle altitude conditions [1, 4, 6] are among the factors that may contribute to the improvement of the athletes' functional status and, as a result, enhancement of their physical fitness level. However, positions related to the strengthening of the athletes' functional status at different stages of acute acclimatization, with simultaneous exposure to harsh environmental conditions, primarily, oxygen deficit, as well as to the training loads performed at the altitude

of 1820 m (Khmelevskiye mountain lakes) chosen as the venue for the final stage of preparation for the 2022 Winter Olympics (officially known as the XXIV Olympic Winter Games), Beijing, China, remain underinvestigated and require a systematic study aimed to scientifically substantiate the athletic training process design.

Objective of the study was to identify the peculiarities of functional adaptation of elite racing skiers at the venue for the final stage of training for the main start of the season in different phases of acute acclimatization.

Methods and structure of the study. Sampled for the study were 8 male racing skiers aged 24-36 years, having the sports qualifications from Masters of Sport to Honored Masters of Sport. The subjects were tested during the 21-day training in the middle altitude conditions (1820 m, Khmelevskiye mountain lakes, Krasnodar Krai), at the final stage of training for the 2021 World Championship in Oberstdorf (Germany) and the 2021 Russian Cup Final in Syktyvkar (Russia).

The athletes were asked to perform 8-min non-maximum muscle work on the Monark cycle ergometer (Sweden) at the resistance load set in accordance with the following protocol: starting stage – 720 kgm/min (120 W), surplus load – 240 kgm/min (40 W), duration of each stage - 2 minutes, pedaling rate – 80 rpm.

The following parameters were measured during the ergometric test: exhaled air parameters, using the automatic gas analyzer Metalyzer-II (Cortex, Germany) – before and during the test, and during the recovery period (first 3 minutes) – to measure the oxygen (% O_2) and carbon dioxide (% CO_2) contents; pedaling rate; lactate concentration – before and after the test, and 3 minutes into recovery, heart rate – using the Polar sports testers, with further data processing in ProTrener (Finland).

The readings of the 1st, 3rd, 5th, 7th, 9th, and 11th days of the acclimatization period (AcP) that covered the entire acute acclimatization phase were used as the basis for the identification of the peculiarities of strengthening of the functional status of the main energy supply systems (oxidative and lactic acid energy systems) at the venue for the final stage of training for the main start of the season.

Results and discussion. The following data were obtained: dynamics of changes in the rate of response to loading on the part of the oxidative energy system and its forming components (MBC, O_2UC), lactic acid energy system, and cardiovascular system (CVS); mechanical efficiency coefficient at the maximal heart rate, oxygen consumption (O_2C) and lactate concentration (LC) (absolute values are presented in the table), together with the estimated percentage at each stage of acclimatization (from 3 to 11 AcP). These data were compared to the data obtained on the first day of stay at the altitude (1 AcP, prior to the acute acclimatization phase) taken as a basal level of physical fitness.

It was found that the relative mechanical power (W_{1440}), after its decrease at the beginning of the acute acclimatization phase (3AC; -0.5%), started to increase from the 5th day of AcP (middle of the acute acclimatization phase), reaching its peak level on the 7th day of AcP (19.29±1.07 kgm/min/kg; +0.6%). The achievement of this work power level was due to the highest intensity of the oxidative energy system functioning: $MOCabs^{7AC}_{(1440)}$=3.415±0.316 l/min (+6.7%) and $MOCrel^{7AC}_{(1440)}$= 45.68±4.03 ml/kg (+7.7%).

We assume that the highest MOC rate on the 7th day of AcP was due to the compensatory role of the oxidative energy system, high anaerobic glycolysis rate from the 3rd to 7th day of AcP (from the beginning to the middle of the acute phase), which, in turn, itself (lactic acid energy system) acted as a mechanism of compensation for oxygen deficiency when performing muscle work from the 3rd to 5th day, reaching its peak level on 5AC ($La^{5AC}_{(1440)}$= 3.70±0.44 mM/l; +22.7%).

This AcP is also notable for the fact that the oxygen consumption level ($MOCabs_{(1440)}$) was formed against the background of the predominance of the external respiration ($MBC^{7AC}_{(1440)}$=98.4±10.8 l/min; +17.0%) over the oxygen uptake by the muscles ($O_2UC^{7AC}_{(1440)}$= 6.0±0.53%; -9.2%), and only starting from the 9th day of acclimatization, there was a steady downward trend in the lung ventilation and increased oxygen utilization, with a minimum deviation from the basal level – 4.1% – on the 11th day of acclimatization ($La^{11AC}_{(1440)}$ = 3.01±0.36 mM/l).

The adaptation processes were the most pronounced in terms of the dynamics of changes in the cardiovascular system functioning. After the increase in $HR^{3AC}_{(1440)}$ = 139.5±10.7; +0.2%, there was a steady downward trend in the pulse cost of work ($HR^{5\text{-}11AC}_{(1440)}$ = -1.2% to -2.5%) and, as a result, the mechanical efficiency improved ($ME^{5\text{-}11AC}_{(1440)}$ = +1.2 to 2.6%), with an increased level on the 11th day of acclimatization.

It should be emphasized that it is during this AcP – from the 5th to the 7th day of acclimatization – that the oxygen pulse rate started to increase steadily ($OP^{5\text{-}7AC}_{(1440)}$ = 7.3-7.1%), thus indicating that the regulatory mechanisms of functioning of the oxidative system started to complete their formation, with the cardiovascular system playing the leading role.

Table. *Dynamics of changes in studied indicators at different stages of acute acclimatization*

Acclimatization timescales	Weight	Power	Physiological parameters								Mechanical efficiency		
			MBC	MOC	MOC/kg	HRmax	O_2C	RQ	O_2UC	La	MEC_{HR}	MEC_{MOC}	MEC_{La}
1 AcP	75.42	19.17	79.8	3.199	42.43	139.2	23.05	1.03	6.60	3.01	10.37	452.3	496.9
3 AcP	75.69	19.07	84.6	3.245	43.05	139.5	23.34	1.04	6.26	3.44	10.38	445.5	425.6
5 AcP	75.19	19.20	90.0	3.390	45.20	137.6	24.74	1.03	6.17	3.70	10.50	426.2	394.6
7 AcP	74.85	19.29	93.4	3.415	45.68	138.5	24.69	1.04	6.00	3.45	10.42	424.8	418.0
9 AcP	74.97	19.25	91.2	3.278	43.83	135.8	24.15	1.04	6.06	3.19	10.62	440.9	452.4
11 AcP	74.98	19.26	87.7	3.269	43.75	135.7	24.16	1.04	6.33	3.01	10.64	441.0	479.7

The final stage of formation of the main energy systems (oxidative, lactic acid) and the cardiovascular system was most evident in the steady approach of the mechanical efficiency coefficient to the basal level of oxygen consumption and glycolytic activity on the 9th and 11th day of acclimatization: $MEC^{9\text{-}11AC}{}_{MOC}$ = 440.9-441.0 kgm/l and $MEC^{9\text{-}11AC}{}_{La}$ = 452.4-479.1 kgm/mM.

Conclusions. The study revealed the peculiarities of the adaptation processes and determine the most significant individual markers of formation of the oxidative energy system, lactic acid energy system, and cardiovascular system in terms of the middle altitude training (Khmelevskiye mountain lakes, 1820 m). The following parameters turned out to be the most significant: maximal oxygen consumption, lactate concentration, heart rate, balanced ratio of MBC to O_2UC and mechanical efficiency coefficients, together with the oxygen pulse value, which reflect the maturity of the regulatory mechanisms. A peculiar feature of the adaptation processes is the established heterochrony and mutual compensation of the studied systems in the acute acclimatization phase. In terms of the selected methodical direction of the training process design (trainings at the altitude of 1820 m, Khmelevskiye mountain lakes), the time-frame to reach the stable level of the functional status is 7 to 11 days.

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Popular physical activities in russian federation: preferences rating survey

UDC 796.011.1

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Abstract

Objective of the study was to survey, analyze and rate the popular physical activity in the Russian Federation.
Methods and structure of the study. We used for the purposes of the study: an online questionnaire survey and statistical mathematical data processing SPSS Statistics 22 software toolkit with graphical presentations and content analyses. We sampled for the questionnaire survey the national population (n=846) in 48 regions of the country dominated by (n=766) the Ivanovo Oblast (n=363), Moscow city (n=236), Moscow Oblast (n=86), Omsk Oblast (n=24), St. Petersburg city (n=18), Nizhny Novgorod Oblast (n=16), Vladimir Oblast (n=15) and Kaliningrad Oblast (n=8) regions. The sample was mostly (n=729, 86.2%) urban, with the rural and small town populations making up only 4.5% and 9.3% of the sample (n=38 and n=79), respectively; with the men and women groups making up 36.3% and 63.7% of the sample (n-307 and n=539), respectively; and with 85.6% of the sample aged 18-59 years (most active group).
Results and conclusion. The questionnaire survey found some 20% of the sample determined for habitual physical education and sports; more than 25% prepared for habitual physical activity on a health-sensitive basis; 1.1% skeptical or unprepared for habitual physical activity; and 2.4% uncertain. In the men and women groups, 75.6% and 68.8% reported determined for habitual physical activity; 1.0% and 1.1% unprepared for it; 21.5% and 27.5% prepared on a health-sensitive basis; and 1.9% and 2.6% uncertain on the point, respectively.
The physical activity preferences of the sample were found gender- and age-specific with apparent influences of the social settings, and this is the reason why a special emphasis is to be made on the socializing aspects of the modern physical activity. The questionnaire survey found the top-20 physical activity favored by the national population including health walking, jogging and cycling (triad 1); fitness, swimming and volleyball (triad 2); football, dancing and bodybuilding (triad 3), followed by yoga, basketball, workout, table tennis, skiing, active team sports and entertainments, aerobics, martial arts, ice/ roller skating, Nordic walking, and ice hockey.

Keywords: *physical activity, Russian population, activity preferences, physical education planning.*

Background. Presidential Decree of July 21, 2020 No. 474 "On the national goals and strategic progress missions of the Russian Federation for the period up to 2030" [3]; "Physical Education and Sports Development" National Program approved by the Governmental Decree of April 15, 2014 No. 302 [4]; "Sports – Life Norm" Federal Project and some other key provisions have set a framework for the popular mass physical education and sport system [1, 2]; and we believe it could be beneficial to facilitate these policies and missions by the popular physical activity surveys to rate the mass physical activities by popularity levels.

Objective of the study was to survey, analyze and rate the popular physical activity in the Russian Federation.

Methods and structure of the study. We used for the purposes of the study: an online questionnaire survey and statistical mathematical data processing

SPSS Statistics 22 software toolkit with graphical presentations and content analyses. We sampled for the questionnaire survey the national population (n=846) in 48 regions of the country dominated by (n=766) the Ivanovo Oblast (n=363), Moscow city (n=236), Moscow Oblast (n=86), Omsk Oblast (n=24), St. Petersburg city (n=18), Nizhny Novgorod Oblast (n=16), Vladimir Oblast (n=15) and Kaliningrad Oblast (n=8) regions. The sample was mostly (n=729, 86.2%) urban, with the rural and small town populations making up only 4.5% and 9.3% of the sample (n=38 and n=79), respectively; with the men and women groups making up 36.3% and 63.7% of the sample (n-307 and n=539), respectively; and with 85.6% of the sample aged 18-59 years (most active group): see Figure 1.

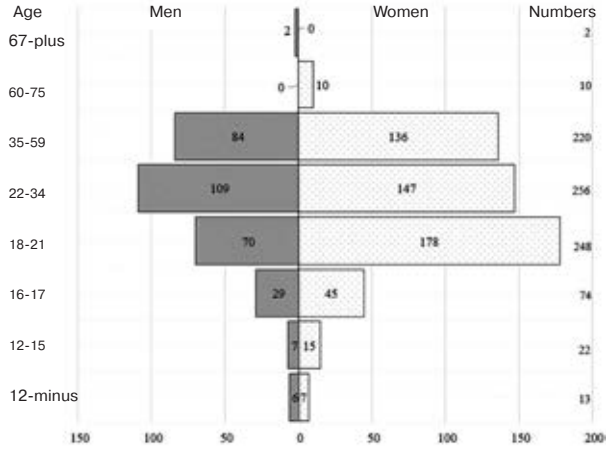

Figure 1. *Age and gender groups in the sample*

Results and discussion. The questionnaire survey found some 20% of the sample determined for habitual physical education and sports; more than 25% prepared for habitual physical activity on a health-sensitive basis; 1.1% skeptical or unprepared for habitual physical activity; and 2.4% uncertain. In the men and women groups, 75.6% and 68.8% reported determined for habitual physical activity; 1.0% and 1.1% unprepared for it; 21.5% and 27.5% prepared on a health-sensitive basis; and 1.9% and 2.6% uncertain on the point, respectively.

The World Health Organization recommends the physical activity averaging at least 60-plus minutes a day for the 15-17 year-olds; and 150-300 middle-intensity or 75 high-intensity minutes per week for the 18-65-plus year-olds. Given in Table 1 are the sample opinions on the need in healthy daily physical activity.

The above healthy physical activity needs reported by the sample were found even higher than the recommended levels. However, the actual popular physical activity, as reported by N.A. Khorkina and M.V. Lopatina, are still under the recommended global WHO standards, despite some growth [5].

The sample mentioned 51 physical activity types in the questionnaire survey. Ranking in the top-20 were health walking, jogging and cycling (triad 1); fitness, swimming and volleyball (triad 2); football, dancing and bodybuilding (triad 3) followed by yoga, basketball, workout, table tennis, skiing, active team sports and entertainments, aerobics, martial arts, ice/ roller

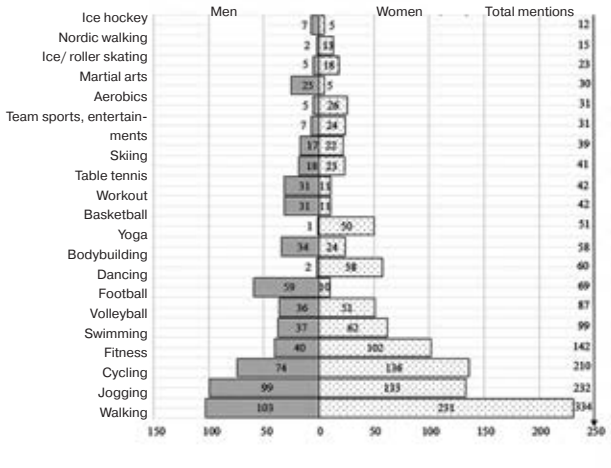

Figure 2. *Physical activity preferences of the sample*

Table 1. *Need in healthy daily physical activity reported by the age and gender groups, %*

Age groups	30min		60min		90-120min	
	Gender groups					
	m	w	m	w	m	w
12-minus	16,7		33,3		50,0	100,0
12-15	12,5	20,0	12,5	20,0	75,0	60,0
16-17	6,9	15,6	27,6	40,0	65,5	44,4
18-21	9,9	15,2	35,2	44,4	54,9	40,4
22-34	10,1	14,2	42,2	46,6	47,7	39,2
35-59	8,1	25,0	40,7	50,7	51,2	24,3
60-75		60,0		30,0		10,0
76-plus	100,0					
Total	9,97	18,15	37,62	44,63	52,41	37,22

Table 2. *Physical activities reportedly preferred by the age and gender groups*

Physical activity	Mentions														Total
	12-minus		12-15		16-17		18-21		22-34		35-59		60-75		
	m	w	m	w	m	w	m	w	m	w	m	w	m	w	
Health walking	2	1	4	5	6	16	17	74	40	67	34	64	-	4	334
Jogging	3	5	2	6	12	15	22	48	35	31	25	28	-	-	232
Cycling	4	3	2	2	7	12	11	48	21	40	29	31	-	-	210
Fitness	1	-	-	1	1	6	13	40	18	32	7	23	-	-	142
Swimming	2	1	2	3	-	3	6	16	12	18	14	20	-	1	99
Volleyball	-	-	-	2	6	6	9	31	7	7	14	5	-	-	87
Football	2	1	3	1	5	1	17	3	24	3	8	1	-	-	69
Dancing	-	-	-	-	-	8	2	28		14		8	-	-	60
Bodybuilding	-	4	1	3	2	2	7	5	16	4	8	6	-	-	58
Yoga	-	-	-	-	-	2	1	11	-	18	-	19	-	-	51
Basketball	-	-	3	-	4	4	11	5	11	1	2	1	-	-	42
Workout	-	-	-	1	7	1	13	3	10	4	1	2	-	-	42
Table tennis	-	-	-	2	2	-	3	12	4	5		3	-	1	41
Skiing	-	-	-	-	-	1	4	3	5	6	8	12	-	-	39
Team sports, fun	-	1	1	2	-	1	1	11	5	7	-	2	-	-	31
Aerobics	-	3	2	-	-	4	1	6	2	6	-	7	-	-	31
Martial arts	3	1	-	-	2	1	6	2	11	1	3	-	-	-	30
Ice/ roller skating	-	-	-	-	-	1	1	8	3	3	1	6	-	-	23
Nordic walking	-	1	-	-	-	-	-	3	1	1	1	6	-	2	15
Ice hockey	-	-	-	-	2	2	1	3	4	-	-	-	-	-	12
Total mentions:															1648

Note: m- men, w- women

Triad 1 Triad 2 Triad 3

skating, Nordic walking, and ice hockey (see Figure 2). Mentioned in addition were also the traditional physical activity dominated by health walking, gardening and mowing.

Given in Table 2 hereunder are the age- and gender-group physical activity preferences. Thus the 60-plus year-olds reported preferring health walking and Nordic walking; the 12-minus year-olds jogging, with the boys also favoring cycling and martial arts, and girls – bodybuilding. The 12-15 year-olds prioritized walking, with the boys also preferring football and basketball, and girls jogging. The 16-17 year-olds prefer jogging and cycling, with the young men and women also favoring workouts and health walking, respectively.

Conclusion. The physical activity preferences of the sample were found gender- and age-specific with apparent influences of the social settings, and this is the reason why a special emphasis is to be made on the socializing aspects of the modern physical activity.

The questionnaire survey found the top-20 physical activity favored by the national population including health walking, jogging and cycling (triad 1); fitness, swimming and volleyball (triad 2); football, dancing and bodybuilding (triad 3), followed by yoga, basketball, workout, table tennis, skiing, active team sports and entertainments, aerobics, martial arts, ice/ roller skating, Nordic walking, and ice hockey.

The survey was completed under Contract № 037310011042000008 for 'Modern popular PA forms and methods customizable to the health conditions on an age- and gender-specific basis' Research Project of the Federal Physical Education Research Institute

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Benefits of physical activity for social adaptation at school

UDC 37.062.5

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Abstract

Objective of the study was to rate the schoolchildren's commitment for the school physical education and sports classes versus their peer relations and friendship survey data.

Methods and structure of the study. Saint-Petersburg Research Institute of Physical Culture (SPRIPC) leads the national research under the international Health Behavior in School-aged Children (HBSC) Project. The Project includes four-year research cycles once in different Russian regions with the large-scale anonymous surveys of school population classified into three age groups (11, 13 and 15 year-olds). The technical and institutional provisions developed by SPRIPC include a web site with a Russian version of the international survey, a cloud database for online surveys, and a special data processing and analyzing software toolkit. This article presents and analyzes the questionnaire survey data mined in the 2017-18 research cycle. Most of the survey data were mined by the web site tools and complemented by hardcopy survey reports obtained from the regional groups.

The schoolchildren's commitment for physical education and sports classes was rated under this study by the physical activity rating standard MVPA indices (moderate to vigorous physical activity) as provided by the WHO.

We split up the sample, for the purposes of the study, into two groups reporting different weekly physical activity in excess of one hour a day. Group MVPA3 included the schoolchildren practicing three days a week, and group MVPA7 included those practicing seven days a week, with gender subgroups in both groups.

Results and Conclusion. The survey data and analysis clearly demonstrate a direct correlation between commitment for the physical education and sports classes and reported quality of the peer friendship with mutual trust and help. As demonstrated by Figures 1-2, the MVPA group 3 boys were tested with a fall on these scales with age – versus the MVPA group 7 boys tested with growth on every of the four scales versus the 13-year-old boys subgroup. The data gives reasons to believe that the physical activity and socialization success are closely correlated in the school sample, with the higher commitment for the physical education and sports classes being clearly beneficial for friendship and – as found by our prior studies under the Project – this friendship in its turn heavily contributes to the physical education and sports motivations.

Keywords: *schoolchildren, peer relations, friendship, physical education and sports activity, physical activity, monitoring.*

Background. School peer relations building with socialization success in the peer groups are ranked among the key social, psychological and physical well-being factors [3, 6, 7]. The interpersonal peer contacts establishing and control skills are very important for the social adaptation and, hence, many aspects of the preschool lifestyles and physical and mental health. This is the reason why the research community gives a special priority to the studies of school peer relations and friendship in the context of the school physical education and sport service [1, 5].

Objective of the study was to rate the schoolchildren's commitment for the school physical educa-

tion and sports classes versus their peer relations and friendship survey data.

Methods and structure of the study. Saint-Petersburg Research Institute of Physical Culture (SPRIPC) leads the national research under the international Health Behavior in School-aged Children (HBSC) Project [4]. The Project includes four-year research cycles once in different Russian regions with the large-scale anonymous surveys of school population classified into three age groups (11, 13 and 15 year-olds). The technical and institutional provisions developed by SPRIPC include a web site with a Russian version of the international survey, a cloud database for the online surveys, and a special data processing and analyzing software toolkit. This article presents and analyzes the questionnaire survey data mined in the 2017-18 research cycle. Most of the survey data were mined by the web site tools and complemented by hardcopy survey reports obtained from the regional groups.

The schoolchildren's commitment for physical education and sports classes was rated under this study by the physical activity rating standard MVPA indices (moderate to vigorous physical activity) as provided by the WHO. The WHO guidelines recommend the schoolchildren's daily moderate to vigorous physical activity necessary for their health protection purposes making up at least one hour [2].

We split up the sample, for the purposes of the study, into two groups reporting different weekly physical activity in excess of one hour a day. Group MVPA3 included the schoolchildren practicing three days a week, and group MVPA7 included those practicing seven days a week, with gender subgroups in both of the groups. Friendships and peer relations were rated by questions probing the emotional, communicative and practical aspects of the reported friendship. For the purposes of the study, we rated friendship in the following four aspects: sharing emotions ("sharing joys and sorrows with friends"), trustful communication ("discussing problems with friends"), mutual help ("friends are really eager to help") and support in difficult situations ("relying on friends if something goes wrong"). We gave a special priority in the analysis to the maximal agreements with the above statements.

Results and discussion. The MVPA3 and MVPA7 groups were tested meaningfully different in every aspect of reported friendship. Figure 1 gives an example of the group shares of the children reporting having friends to share emotions and having trustful communication with – to demonstrate meaningful intergroup differences on these scales. Thus the MVPA3 group was tested with a general sagging trend in the emotions sharing aspect with age, with a minor growth in the 15years-old girls. The highest intergroup differences were found in the 13-year-old girls and 15-year-old boys subgroups.

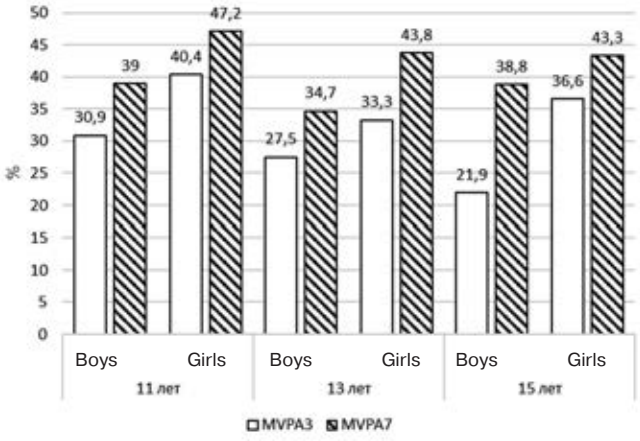

Figure 1. *Group shares reporting having good friends to share joys and sorrows with*

The intergroup differences were less meaningful on the trustful communication scale, with the highest peak in the 13-year-old girls subgroup ($p < 0.05$). Given on Figure 2 are the group shares reporting good mutual peer help and support in difficult situations.

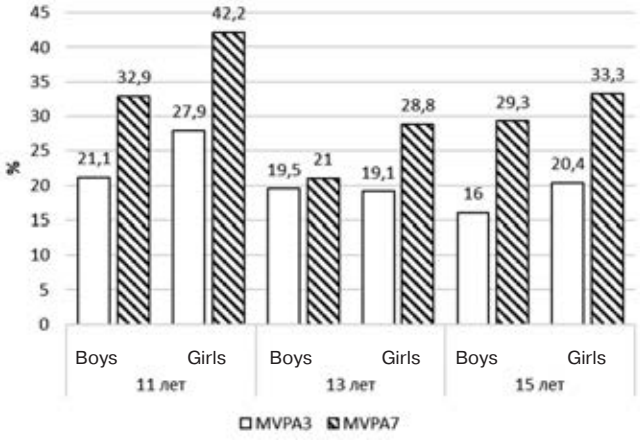

Figure 2. *Group shares reporting having good friends eager to help*

The above test scales demonstrate meaningful intergroup (MVPA3 versus MVPA7) differences, with a peak of mutual help in the 13-year-old boys subgroup.

Conclusion. The survey data and analysis clearly demonstrate a direct correlation between commitment for the physical education and sports classes and reported quality of the peer friendship with mutual trust and help. As demonstrated by Figures 1-2, the moderate to vigorous physical activity group 3 boys were tested with a fall on these scales with age – versus the moderate to vigorous physical activity group 7 boys tested with growth on every of the four scales versus the 13-year-old boys subgroup. The data gives reasons to believe that the physical activity and socialization success are closely correlated in the school sample, with the higher commitment for the physical education and sports classes being clearly beneficial for friendship and – as found by our prior studies under the Project – this friendship in its turn heavily contributes to the physical education and sports motivations.

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Interval training model for universities: mental/ emotional health benefits analysis

UDC 796.011

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Abstract

Objective of the study was to analyze the mental/ emotional health and physical working capacity benefits of an interval training model complementary to the regular academic physical education and sports service.

Methods and structure of the study. We sampled for the study the 17-19 year-old 2-year Saint Petersburg State University of Architecture and Civil Engineering (SPSUACE) students (n=120) and split them up into Experimental and Reference Groups (EG, RG) of 60 people each. The EG was subject to the new interval training model testing experiment in the 3rd semester (September-November) of 2019-2020 academic year. The interval training model of our own design is dominated by the general and strength endurance exercises grouped into two modules. Every module was designed to activate as many muscle groups as possible, avoid monotony and develop expressed albeit modest fatigue.

Module 1 offered the shoulder girdle strength training exercises including prone push-ups, 16kg kettlebell both-hands swinging exercise; 16kg kettlebell lifting to the chin; 16kg bench press; trunk training exercises including alternating-grip pull-ups; sit-ups; and hyperextension practices; plus the leg muscles training exercises including squats and front/ side/ back lunges. The women's subgroup used 2/ 3/ 4kg fitballs as weights in the above exercises; and men also used 5/ 10kg dumbbells. Every exercise was run 4 times for 40s, with 60s rest breaks. Every run included at least 10 reps in the first week, 15 reps in the third and 20 reps in the fifth week. The trainings were run in groups of 3-4 people, with every training session launched at a specific station to go in circles with the group swaps of the stations in the training gym.

Module 2 offered running practices including 10+min moderate-intensity jogging in week 2 to 30min jogging in week 6, with Fartlek intervals (health-sensitive 50-100m sprints) and repeated 10-15m accelerations in couples; with five to eight reps in week 2 to week 6, respectively; plus special sprint and middle-distance running technique excellence exercises in untraditional formats (sideway running and jumping; multidirectional limb workouts; exercises in couples, etc.).

The group mental/ emotional health was tested by the pre- versus post-experimental WAM tests and academic progress analysis (semester 2 versus semester 3).

Results and Conclusion. The new interval training model testing experiment found the model being beneficial for the students' mental/ emotional health standards. The pre- versus post-experimental WAM tests and academic progress analysis found the EG making significant progress in every test versus the RG, i.e. in the wellbeing, activity and mood collectively referred to as the individual health status. It should be mentioned that the highest progresses in the WAM tests were made by the sporting individuals committed for the academic physical education and sports. The study findings give grounds for us to recommend the new interval training model as complementary to the regular academic physical education and sports curriculum.

Keywords: *muscular tone, mental/ emotional health, interval training, physical exercises.*

Background. Well-designed systemic academic physical education and sports service is known to secure good physical fitness, mental/ emotional and physical health as a basis for good physical (physical working capacity) and intellectual working capacity. Many past and modern studies have

proved a direct correlation of the mental/ emotional health and physical health, with the students tested with low physical working capacity reportedly more exposed to mental/ emotional stressors and, hence, they either leave the university or try to cope with the stressors at sacrifice of the bodily adaptation mechanisms that often collapse under stress. The higher is the academic physical working capacity, the higher is the data digesting and processing and decision-making capacity, plus the stress tolerance under academic pressures on the whole and examination stresses in particular [1-3].

Objective of the study was to analyze the mental/ emotional health and physical working capacity benefits of an interval training model complementary to the regular academic physical education and sports service.

Methods and structure of the study. We sampled for the study the 17-19 year-old 2-year Saint Petersburg State University of Architecture and Civil Engineering (SPSUACE) students (n=120) and split them up into Experimental and Reference Groups (EG, RG) of 60 people each. The Experimental Group was subject to the new interval training model testing experiment in the 3rd semester (September-November) of 2019-2020 academic year. The interval training model of our own design is dominated by the general and strength endurance exercises grouped into two modules. Every module was designed to activate as many muscle groups as possible, avoid monotony and develop expressed albeit modest fatigue.

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Module 2 offered running practices including 10+min moderate-intensity jogging in week 2 to 30min jogging in week 6, with Fartlek intervals (health-sensitive 50-100m sprints) and repeated 10-15m accelerations in couples; with five to eight reps in week 2 to week 6, respectively; plus special sprint and middle-distance running technique excellence exercises in untraditional formats (sideway running and jumping; multidirectional limb workouts; exercises in couples, etc.).

The group mental/ emotional health was tested by the pre- versus post-experimental WAM tests and academic progress analysis (semester 2 versus semester 3).

Results and discussion. The pre-experimental mental/ emotional health tests were run in week 1 upon a briefing; and the post-experimental tests in week 13 prior to the academic progress tests. The pre-experimental tests found insignificant intergroup differences, with both groups tested low on average in every test due to multiple objective and subjective factors, including: higher workloads as compared to year 1; faster information flows; living and dieting issues; psychological adjustments to cope with pressures on adaptation systems after the summer holidays; new socializing challenges often fraught with interpersonal frictions; new freedoms associated with growing responsibilities; individual rehabilitation statuses upon the summer holidays; adjustments to the academic stressors, etc.: see Figure 1.

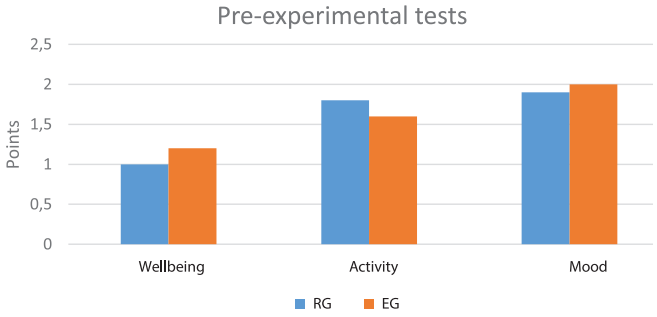

Figure 1. *Pre-experimental WAM test data*

The pre- versus post-experimental tests found the following average progress in the EG versus RG: wellbeing rose by 2.8±1.0 points versus 1.0 points; activity by 3.4±2.0 points versus 1.3±1.2 points; and mood by 3.0±1.1 points versus 1.1±1.0 points, respectively.

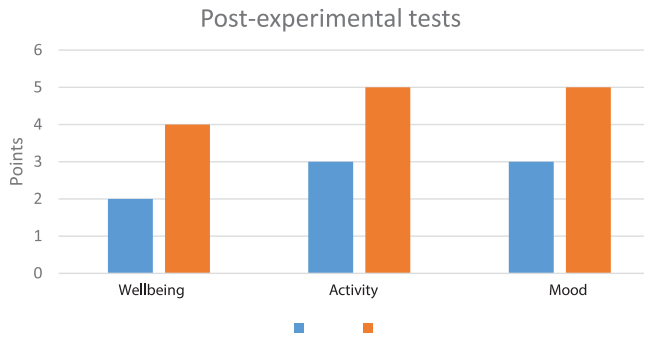

Figure 2. *Post-experimental WAM test data*

The pre- versus post-experimental academic progress analysis found the EG making progress by 1.1 points versus 0.3 points in the RG on average: see Figure 3.

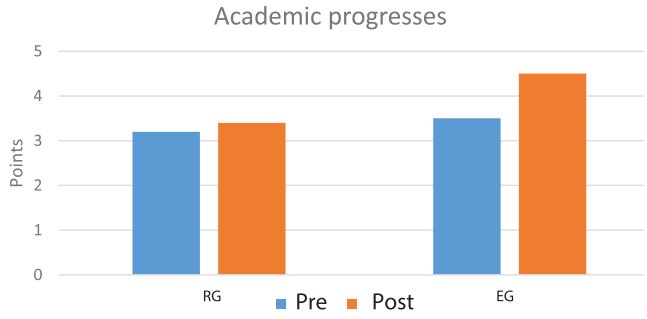

Figure 3. *Group academic progress for the experimental period*

Conclusion. The new interval training model testing experiment found the model being beneficial for the students' mental/ emotional health standards. The pre- versus post-experimental WAM tests and academic progress analysis found the EG making significant progress in every test versus the RG, i.e. in the wellbeing, activity and mood collectively referred to as the individual health status. It should be mentioned that the highest progress in the WAM tests were made by the sporting individuals committed for the academic physical education and sports. The study findings give grounds for us to recommend the new interval training model as complementary to the regular academic physical education and sports curriculum.

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Distant physical education service: individual progress trajectories

UDC 796.011

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Abstract

Objective of the study was to summarize modern practical experiences of academic online Physical Education Theory and make practical recommendations on how the trainer-trainee communication may be improved in the digital education environments.

Methods and structure of the study. Our research team has developed and piloted an online Physical Education Theory course [2] with an institutional model of the digital Physical Education Theory, and analyzed practical benefits of the course. The online physical education course offers a harmonized interpretation of the physical education theory accessible for every trainee notwithstanding some ambiguity of the traditional terms and meanings; is designed on clear logics and rules for delivering the key physical education concepts; and governed by a unified physical education concept. The online physical education course gives a due priority to the physical education service distribution in the faculty so as to timely customize and individualize the physical education formats.

Results and Conclusion. Some students of the online Physical Education Theory course demonstrate poor academic progress and backlogs with low examination grades to effectively stall the online education service. We have addressed this problem by special recommendations for the online education course developers with an emphasis on the interest and progress facilitating motivations. We prioritized the following recommendations: update the interim test sets at least once a year; offer lively interactive learning elements in the course including crosswords, special projects, etc.; encourage the trainees for supplementary courses to facilitate their progress in the online Physical Education Theory.

Conclusion. Having analyzed the practical experience and benefits of the online Physical Education Theory course, we offered practical recommendations for the course trainers and trainees on how the academic progress may be facilitated to avoid or reduce the academic backlogs.

Keywords: *online course, physical education theory, progress trajectory, students, digital education.*

Background. Many specific issues of the modern education service design, goal-setting and management are coming to the forefront nowadays when many higher educational institutions have to make partial or full transitions to the online education service formats [1-3, 5]. For the last decade the modern digital education with special online education technologies has made great progress and was recognized an integral part of many national education systems, with a special contribution from the mass open online courses for the last few years with the audience growth trend indicative of the growing popularity of these formats [6, 9].

As things now stand, Saint Petersburg Polytechnic University (SPPU) offers more than a hundred mass open online courses accessible from external and internal education platforms. The mass open online course models integrated into the regular education curricula and their scopes basically depend on the discipline, with some models facing problems and even failures although they only stimulate them for new solutions [2, 4, 6, 7, 10]. These trends and issues are

increasingly relevant for the academic physical education service with its traditional independent Elective Physical Education Practices and Physical Education Theory modules.

Objective of the study was to summarize modern practical experiences of academic online Physical Education Theory and make practical recommendations on how the trainer-trainee communication may be improved in the digital education environments.

Methods and structure of the study. Our research team has developed and piloted an online Physical Education Theory course [2] with an institutional model of the digital Physical Education Theory, and analyzed practical benefits of the course. The online physical education course offers a harmonized interpretation of the physical education theory accessible for every trainee despite some ambiguity of the traditional terms and meanings; is designed on clear logics and rules for delivering the key physical education concepts; and governed by a unified physical education concept. The online physical education course gives a due priority to the physical education service distribution in the faculty so as to timely customize and individualize the physical education formats [2].

Results and discussion. The online Physical Education Theory course was first piloted in the early 2017 on a 500+ sample of the first-year students. The learning format and physical education service design (with independent learning, one introductory lecture and deadlines for learning and final tests) was found unusual and challenging by the students. The learning process faced certain design and management difficulties and resulted in many academic backlogs and repeated exams. We run a questionnaire survey to find at least 20% of the students having problems in adaptation to the course due to the following key reasons: failures to subscribe for the course on time; missed deadlines for the interim progress tests; inattention and forgetfulness due to overloads from some other academic disciplines.

The above problems were resolved by timely management policies and practices, disciplining requirements from the principles and, importantly, timely help from the faculty always prepared to give explanations on the course specifics and answer the trainees' questions. These efforts facilitated the academic backlogs being drastically cut down in the following semesters. The proved benefits of the online Physical Education Theory course motivated the team for further ambitious initiatives to transform the physical education models and methods with a growing contribution of self-reliant learning formats.

Despite the fact that the key principles of independent learning design and management (including programmed learning models) were formulated long ago [10], the modern distant online learning

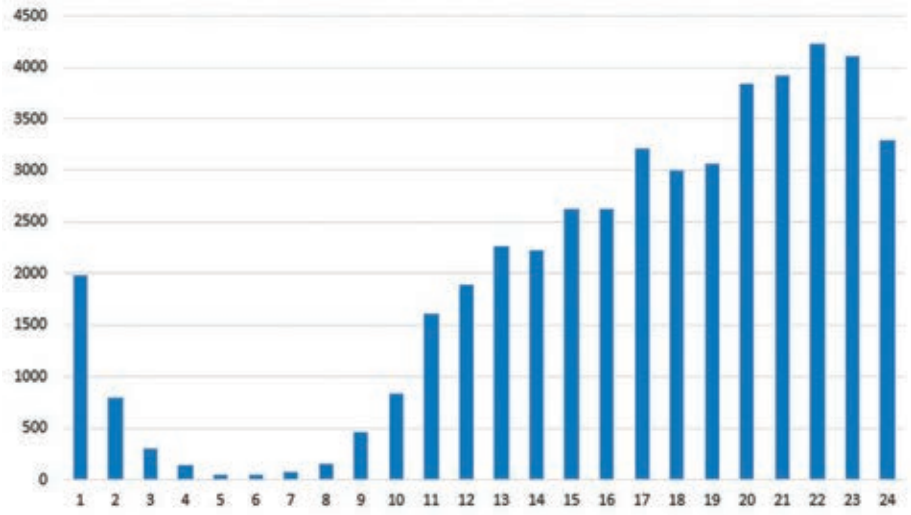

Figure 1. *Daily activity profiles of the online Physical Education Theory course students: numbers on the vertical axis and hours on the horizontal axis*

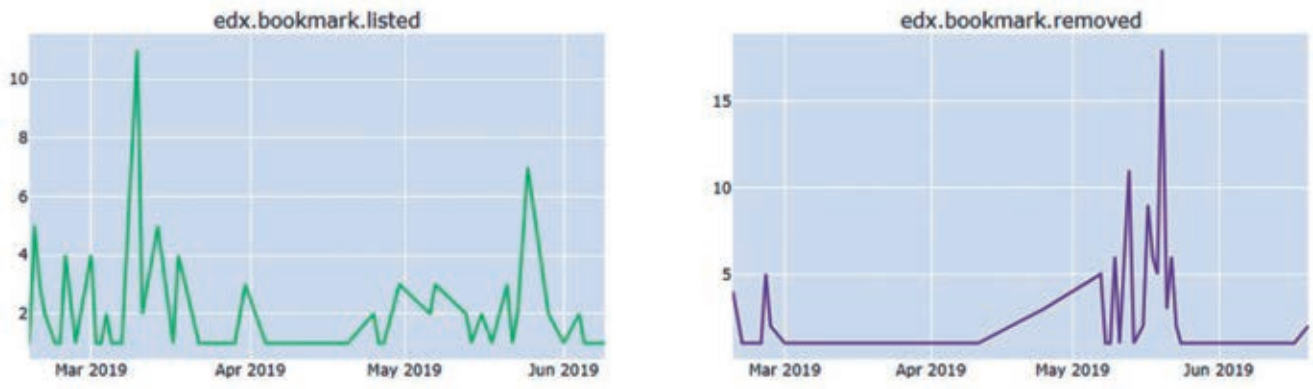

Figure 2. *Semester and exam-time activity profiles of the online Physical Education Theory course students*

systems still need some rethinking and transformation of the principles. The prime reason for that is that the online education service heavily limits direct trainer-trainee communication and offers only indirect contracts in digital environments with the relevant necessary adjustments to the traditional interaction styles.

In methodological terms, the self-reliant learning process in the programmed learning service is driven by the Operant Conditioning Theory by Skinner [8] based on the general behavioristic concept. Skinner offered the following programmed learning principles: (1) Give information in small pieces; (2) Test progress in digesting every piece of information by special tasks; (3) Offer right answers for self-checks; and (4) Give the progress-sensitive individual instructions.

The above items 1-3 obviously refer to the duly systematized online education materials, whilst item 4 needs to be revised since the online educational service limits direct trainer-trainee communication. Our online Physical Education Theory course offers the following trainer-trainee communication options:

1. Direct trainer-trainee communication on the online forums within the course. Such communication should be free of time gaps – that means that every question should be responded within one day at most. This is the reason why the SPPU nominates only specialized teachers to the mass open online courses assisted by the online platform operators and technical staff to keep the teacher timely informed on the incoming questions.

2. The online education service should offer customized options for the fast progressing trainees (in case of the obligatory online education there are quite a few of them) who consider the learning material and pace too easy (see Figures 1, 2).

Some students of the online Physical Education Theory course demonstrate poor academic progress and backlogs with low examination grades to effectively stall the online education service. We have addressed this problem by special recommendations for the online education course developers with an emphasis on the interest and progress facilitating motivations. We prioritized the following recommendations: update the interim test sets at least once a year; offer lively interactive learning elements in the course including crosswords, special projects, etc.; encourage the trainees for supplementary courses to facilitate their progress in the online Physical Education Theory.

Conclusion. Having analyzed the practical experience and benefits of the online Physical Education Theory course, we offered practical recommendations for the course trainers and trainees on how the academic progress may be facilitated to avoid or reduce the academic backlogs.

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New preparatory optional physical education model for foreign students: benefits analysis

UDC 796.01

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Abstract

Objective of the study was to design and analyze benefits of an optional physical education model for the preparatory-course foreign students to facilitate their socio-cultural adaptation to the Russian academic environments.

Methods and structure of the study. We sampled for the new optional physical education model testing experiment the Saint Petersburg Polytechnic University's preparatory-course foreign students (n=68) of the following origins: Asian: China, Mongolia, Vietnam (76.5% of the sample); African: 13.2%, and European - 10.3%.

We designed our optional physical education model for foreign students with the health physical education technologies as required by the valid Federal State Higher Education Standards to include the following two modules: Team Sports (volleyball, basketball, football, table tennis and badminton); and Fitness Technologies (strength and fitness trainings in gyms). The sample was trained using the above modules for one academic year, with the progress tested by tests and the team sports competitions at the Small Olympic Games for the foreign students.

To rate and analyze practical benefits of the new optional physical education model for the preparatory-course foreign students' adaptation to new living and learning conditions, in addition to their competitive fitness and socializing progress tests, we used the standard individual psychology rating Cattell 16 Personality Factor Questionnaire; and the Fiedler-Yasyukova tests of the communicative skills and priorities, understanding of other people, self-esteem etc.

Results and conclusion. The optional physical education model testing experiment found the model being beneficial for the psychological comfort and progress of the foreign students in the mass sports events (facilitated by the optional physical education off-class practices and team sports competitions), with special benefits for the foreign students' adaptation to the Russian university environment. The pre- versus post-experimental tests found progress of the young foreigners on the interpersonal tolerance, optimism, psychological comfort, benevolence and other test scales. Based on the study data and analyses, we would recommend the academic physical education curriculum for the foreign students to be designed and managed with the highest sensitivity to the foreign students' individual psychological and gender-specific personality factors and the regional ethnic and cultural specifics.

Keywords: *physical activity program, personality factors, foreign students' integration.*

Background. Modern Russian higher professional education service facilitates international cooperation by the high quality education service for foreign students, with their inflows considered an indirect indicator of the service quality and competitiveness [2, 4]. The foreign students' adaptation and integration upon entrance, however, may be problematic due to multiple factors being dependent not only on the assistance from the host establishments [1, 5] but also on the foreign students' individual typological traits and the origin-specific ethnic and cultural traditions. Some researchers underline in this context a set of factors of special influence on the foreign students' adaptation including the socio-cultural, socio-communicative, everyday living standards [7], psycho-physiological, cognitive/ learning (adjusted for the language barriers), local traditions (national and regional), climatic conditions, individual mentalities, educational environments (institutional factors) etc. classifiable into the relevant groups.

Many studies of the foreign students' integrating issues faced by the Russian higher education system prioritize the education service customization aspects [5] in the context of personality-typing methods sensitive to the global regions of origin with the relevant findings and recommendations. However, the available study reports give virtually no ideas on how the specific pedagogical technologies should be used to facilitate the socio-cultural adaptation of the young foreigners.

We believe that the national academic educational system needs a special foreign students adaptation facilitating toolkit with combined and versatile technologies including: optional physical education service concept for the foreign students with the necessary psychological and educational support [3]; academic communication standards [4] to integrate the foreign students on the origin-sensitive basis; and the faculty/ peer efforts to encourage the foreign students' engagement in the academic mass sport events and sporting cultures.

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Results and discussion. The optional physical education model was tested as complementary to the regular academic classes, with the foreign students given freedom in opting for the preferred physical activity / sports. These preferences were found the origin- and gender-specific to a degree [1]. Thus the Asian students preferred badminton (Vietnam, China), table tennis (China), basketball (China, Europe), and football (Africa). The girls preferred mostly badminton and fitness trainings. The off-class optional physical education trainings took 90 min twice a week.

Given in Table 1 are the personality factors test data of the sample – indicative to a degree of the potential progresses in the optional physical education classes [2] and their personal physical activity and leisure-time agenda, with a special emphasis on the social adaptation improvement aspects (communication skills, mutual tolerance, open-mindedness, benevolence etc.) in the new living, cultural and learning environments at the Russian university.

Given in Table 2 are the communicative skills and self-esteem Fiedler-Yasyukova test data of the sample [11].

The survey found virtually no gender specifics in the personality factors, whilst the personality types were found related with the regional national cultures as follows:

Table 1. *Cattell personality factors test data of the foreign students' sample, on a 6-point scale*

Group	*Cattell personality factors*				
	Q_1	*E*	*G*	*M*	Q_2
Males (n=43)	2,51	3,05	3,33	3,00	2,15
Females (n=25)	2,54	3,12	3,12	2,46	1,96
Africa (n=9)	3,43	2,71	4,00	3,14	2,14
Asia (n=52)	2,14	3,05	3,02	2,52	1,95
Europe (n=7)	4,20	3,20	4,40	3,40	2,80

Note: Q1 – dynamism, radicalism/ conservatism, rigidity; E - independence, leadership qualities/ obedience, compliance; G - responsibility, diligence/ negligence; M – wide interests/ pragmatism, practicality; Q2 - self-sufficiency, independence from the group/ conformism, collectivism.

Table 2. *Communicative skills and self-esteem Fiedler-Yasyukova test data of the sample*

Group	Fiedler-Yasyukova test rates				
	MPC	LPC	CO	ASO	P
Males	7,31	6,20	7,21	12,45	-1,17
Females	7,37	4,70	6,68	11,20	-8,33
Africa	7,33	4,02	7,83	13,42	6
Asia	7,49	6,02	6,92	12,11	-6,84
Europe	6,78	5,19	6,12	11,18	-8,01

Note: MPC - attitude to friends and relatives; LPC - attitude to unpleasant people; CO - self-esteem; ASO – people understanding ability; P - self-criticism.

- The Asian foreign students are the most conservative, rigid, conformal, focused on stable group communication, pragmatic and undetermined;

- The European foreign students are the least conformable, most independent, leadership-centered, independent in thinking, demonstrating wide interests and highly responsible; and

- The African foreign students are compliant, reluctant to lead, less conformable and rigid than the Asian peers, and close to the Europeans in the scopes of interests and responsibility.

The benevolent attitudes to friends and relatives were tested virtually origin-unspecific and equally high. Young men are generally more confident and kind to the surrounding than women, although the European foreign students are somewhat more skeptical and their African peers less self-critical than the others.

The post-experimental psychological tests of the foreign students in education process found most of the men and women (80.1% and 80.8% respectively) psychologically comfortable in the Russian university environment, with the moods tested more optimistic (24.3% and 34.6%, respectively) [than in the pre-experimental tests].

The interpersonal ethnic/ cultural tolerance pre- versus post-experimental tests in the optional physical education model testing experiment found progress in the women and men groups of 17.4% (4.46 points) and 19.4% (4.18 points), respectively; with the African foreign students tested with the highest (4.84 point) tolerance on average.

Conclusion. The optional physical education model testing experiment found the model being beneficial for the psychological comfort and progress of the foreign students in the mass sports events (facilitated by the optional physical education off-class practices and team sports competitions), with special benefits for the foreign students' adaptation to the Russian university environment. The pre- versus post-experimental tests found progress of the young foreigners on the interpersonal tolerance, optimism, psychological comfort, benevolence and other test scales. Based on the study data and analyses, we would recommend the academic physical education curriculum for the foreign students to be designed and managed with the highest sensitivity to the foreign students' individual psychological and gender-specific personality factors and the regional ethnic and cultural specifics.

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New memory and attention training model to complement elective academic physical education and sports toolkit

UDC 796.011.1

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Abstract

Objective of the study was to develop theoretical and practical provisions for and test benefits of a new memory and attention training model to complement the elective physical education and sports toolkit at universities.

Methods and structure of the study. Based on our prior studies, we designed a new memory and attention training model for university students applicable in the elective academic physical education and sport service. The new memory and attention training model is dominated by special physical training tools to facilitate progress in the attention control and memorizing skills, including a range of problem-solving, hierarchical and ordering practices to improve attention, plus traditional fitness exercises with the verbal and practical instructor's assistance in difficult traditional fitness exercises and active developmental games.

The students' progress in the elective memory and attention training model piloting experiment was tested by the Bourdon's proofreading test, A.R. Luria test and Schulte tables on the pre- and post-experimental basis to rate the memorizing and attention control skills. We sampled for the experiment university students (n=107) and split them up into Experimental and Reference Groups (EG, RG) of 53 and 54 people, respectively. The pre-experimental tests found the groups virtually equal in the attention control and memorizing skills. The EG was trained as required by the new memory and attention training model and the RG was trained by the traditional physical education and sport service in September-December 2019, with the both group trainings run twice a week to total 72 academic hours.

Results and discussion. Most beneficial for the memory and attention training purposes are known to be aerobic practices including running, walking, swimming, skiing, etc., conditional on the training time and intensity being well customized to the daily regimens, semester periods, etc., with a special priority to the natural individual resources and hygienic factors. The new memory and attention training model of our design prioritizes special physical training practices to facilitate progresses in the attention control and memorizing skills by problem-solving, hierarchy-building and ordering practices, plus traditional fitness exercises with the verbal and practical instructor's assistance in difficult traditional fitness exercises and active developmental games. The new memory and attention training elective physical education and sports model for universities was tested beneficial.

The new memory and attention training model implementation algorithm prioritized the following: attention control and memorizing skills tests; sample grouping by gender and primary attention control and memorizing skills subgroups for customized services; attention control and memorizing progress tests in the trainings; and special warm-up, workout and special physical training practices to facilitate individual progress.

Keywords: *university students, elective physical education and sports courses, forms and methods of work, attention, visual and auditory memory.*

Background. The young people's adaptation to the modern academic learning and living stressors is known to expose them to multiple risks of the mental/ emotional/ nervous health disorders with the associating attention control and memory issues and, hence, academic regresses or backlogs.

Many researchers emphasize potential – and still largely underestimated – benefits of the modern physical training tools for the individual mental functions [1] and provide practical evidence of how an intellectual progress may be encouraged by special physical training service [2]. Some studies demonstrate cor-

relations of many mental process aspects (including attention control, memorizing and data processing capacity etc.) with the individual physical fitness and functionality [3], [4]; and underline the expressed positive correlation between the well-designed and managed physical activity and the data processing and analyzing abilities [5]. The studies recommend working capacity of the brain and nervous system being protected and improved by a range of health-sensitive aerobic exercises including running, walking, swimming, skiing, etc. [6].

It is widely assumed at this juncture that habitual physical training facilitates individual intellectual progress, although the relevant study reports give little if any attention to the physical education and sports service methods and tools most beneficial for the memory and attention training purposes at universities. Such methods still need to be offered and their benefits tested. The shortage of efficient memory and attention training service within the academic physical education and sports curricula creates many problems for the memory and attention training service development attempts to complement and improve the existing elective academic physical education and sports toolkit.

Objective of the study was to develop theoretical and practical provisions for and test benefits of a new memory and attention training model to complement the elective physical education and sports toolkit at universities.

Methods and structure of the study. We believe that the memory and attention training models applicable at universities need to be supported by the relevant memory and attention test methods and tools customizable for the student groups ranked by the entrance memory and attention capacities as soon as the students come to the academic physical education and sports classes. The group memory and attention training service should offer the group-skills-specific warm-ups, workouts and special practices, with the academic theoretical and practical physical education and sport service being customized to the actual memory and attention training progress test data.

Of special benefits for the memory and attention training purposes are known to be aerobic physical training tools with a special priority to the natural individual resources and hygienic factors [6]. Based on our prior studies, we designed a new memory and attention training model for university students applicable in the elective academic physical education and sport service. The new memory and attention training model is dominated by special physical training tools to facilitate progress in the attention control and memorizing skills, including a range of problem-solving, hierarchical and ordering practices to improve attention, plus traditional fitness exercises with the verbal and practical instructor's assistance in difficult traditional fitness exercises and active developmental games.

The students' progress in the elective memory and attention training model piloting experiment was tested by the Bourdon's proofreading test, A.R. Luria test and Schulte tables on the pre- and post-experimental basis to rate the memorizing and attention control skills. We sampled for the experiment university students (n=107) and split them up into Experimental and Reference Groups (EG, RG) of 53 and 54 people, respectively. The pre-experimental tests found the groups virtually equal in the attention control and memorizing skills. The EG was trained as required by the new memory and attention training model and the RG was trained by the traditional physical education and sport service in September-December 2019, with

Table 1. *Memory and attention training progress test data of the EG and RG*

Group	Tests				
	Bourdon, c	Luria test, %			Schulte table, s
		excellent	good	acceptable	
Pre-experimental tests					
EG, n=53	9,82±2,13	53,83	26,42	20,75	60,05±17.97
RG, n=54	9,87±2,16	55,55	27,78	16,67	59,76±16,48
p	> 0,01				> 0,01
Post-experimental tests					
EG, n=53	6,24±0,51	67,92	18,87	13,21	46,65±10,95
RG, n=54	8,96±1,45	57,41	20,37	22,22	53,59±13,89
p	0,01				0,01

Note: Bourdon and Schulte tests were free of time limitations

the both group trainings run twice a week to total 72 academic hours.

Results and discussion. The pre-experimental tests found no significant intergroup attention control and memorizing differences in the EG and RG. The post-experimental tests found the EG making progress of 3.58s and 13.40s in the Bourdon and Schulte tests versus the RG progresses of 0.91s and 6.17s, respectively. The memorizing skills rating Luria test found 14.09% the EG making progress to excellent points – versus 1.86% in the RG. The EG progress was also found to cut down the percentages of good and acceptable test points: see the Table.

It should be underlined that most beneficial for the attention control and memorizing skills training were the moderate-intensity physical, mental/ emotional workouts, whilst the high- and low-intensity ones were tested the least and moderately effective, respectively. The EG trainings, therefore, were dominated by the moderate-intensity physical training tools proved most beneficial for the attention control and data processing and memorizing ability improvement purposes. A few minor regresses in the test data may be explained by the individual difficulties in the physical training process due to the inevitable falls in the actual physical fitness, moods, emotions and other factors.

Conclusion. Modern academic learning stressors due to heavy information flows, emotional fatigues and learning pressures associated with unhealthy physical inactivity are known to develop absent-mindedness and undermine the attention control and memorizing resources. Our analysis of the theoretical and practical study reports on the subject found the theoretical and practical provisions for the memory and attention training service in the elective physical education and sports curricula at universities being still underdeveloped and, hence, deserving special research.

Most beneficial for the memory and attention training purposes are known to be aerobic practices including running, walking, swimming, skiing, etc., conditional on the training time and intensity being well customized to the daily regimens, semester periods, etc., with a special priority to the natural individual resources and hygienic factors. The new memory and attention training model of our design prioritizes special physical training practices to facilitate progress in the attention control and memorizing skills by problem-solving, hierarchy-building and ordering practices, plus traditional fitness exercises with the verbal and practical instructor's assistance in difficult traditional fitness exercises and active developmental games. The new memory and attention training elective physical education and sports model for universities was tested beneficial.

The new memory and attention training model implementation algorithm prioritized the following: attention control and memorizing skills tests; sample grouping by gender and primary attention control and memorizing skills subgroups for customized services; attention control and memorizing progress tests in the trainings; and special warm-up, workout and special physical training practices to facilitate individual progress. The memory and attention training service is recommended being prudently customized on the individual attention control and memorizing progress sensitive basis, using modern visual and auditory memory and attention control tests.

Appreciations

The study was sponsored by a special funding under the 'Special competences building in university students by target elective physical education and sports service' Project financed by the 2020 intra-university grant from Yakovlev Chuvash State Pedagogical University.

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Competitive psychophysiological fitness test system for blind judo paralympics elite

UDC 796.088

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Abstract

Objective of the study was to test benefits the competitive psychophysiological fitness test system with analysis of the unconscious/ conscious psychophysiological fitness performance governed by the key nervous processes – in application to the national blind judo Paralympics elite.

Methods and structure of the study. The competitive psychophysiological fitness test system piloting experiment was run in the precompetitive trainings of the national blind judo Paralympics team for the European Championship (IBSA) in July 2019 (Italy), for ten days prior to the event. We sampled for the tests the 23-45 year-old national blind judo Paralympics team members (n=16, including 6 women and 10 men) qualified Honored Masters of Sports (n=2). World Class Masters of Sports (n=7), Masters of Sports (n=4) and Candidate Masters of Sports (n=3) representing 70% of the team. Individual typological specifics were rated by the by E.P. Ilyin's practical motor skills test toolkit using Prognoz Computerized Test System [4]. The individual voluntary psycho-emotional control was rated by the skin tonic activity (electrical resistance) tests indicative of the psycho-emotional stress tolerance. The test system applies a galvanic skin response rating Mind-Reflection biofeedback sensor. The individual competitive fitness was self-rated by the athletes using a special questionnaire survey form with 30 questions, with every aspect rated on a 9-point scale. The competitive fitness may be described as the individual ability to mobilize the competitive resource under competitive pressures. We used the questionnaire survey data to produce the competitive fitness indices to rank the individual competitive stress tolerance and success potential.

Results and Conclusion. The invariant psychophysiological fitness test rates indicative of the blind judo competitors' central nervous system good fitness for competitions may be summarized as follows: (a) moderate-to-highly-strong nervous system that effectively controls involuntary mobilization of the individual natural resource for competitive success; (b) prevalence of the internal balancing skills indicative of the permanent and efficient control of metabolic processes, with high innate aggression (expressed or latent in the precompetitive fitness for the fight) with its modest albeit often decisive contribution to the expected competitive success. Analysis of the central nervous system psychophysiological fitness competitive fitness in the blind judo sport is recommended to give a special priority to correlations of the competitive fitness / competitive success indices with the above psychophysiological fitness test rates.

Keywords: *psychophysiological characteristics, neurodynamic characteristics, competitive reliability, elite blind Paralympic judokas, blind sports.*

Background. Competitive fitness may be interpreted as the individual psychophysiological resource mobilizing setting, with the actual competitive performance determined by a wide range of testable psychophysiological factors of influence [3]. On the way to the XVI Paralympic Summer Games in Tokyo rescheduled for August-September 2021, the national sports community gives a special priority to the psychophysiological fitness tests of blind judo Paralymians since even a minor visual impairment is known to heavily complicate the competitive technical and tactical actions and set special requirements to the precompetitive training systems of the sports elite.

Objective of the study was to test benefits the competitive psychophysiological fitness test sys-

tem with analysis of the unconscious/ conscious psychophysiological fitness performance governed by the key nervous processes – in application to the national blind judo Paralympics elite.

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Results and discussion. The competitive fitness of the sample was tested dominated by the fairs-free strong fighting spirit regardless of the opponents' class and rank, high tolerance to the prefight fever/ apathy, immunity to the autonomic nervous system failures and negative mindsets provoked by the high precompetitive physical and psychological stresses. The sample was tested highly fit for the precompetitive and competitive physical and mental stressors; with the ability to cope with errors and poor performance in the competitive bouts, abstract from negative thinking and come into a must-win mindset for success.

The sample was classified based on the competitive fitness indices into two equal groups, with 50% of the sample self-rating their competitive fitness high (by 7-9 points), and 50% medium (4-6 points). No one in the sample rated either competitive fitness aspect low (by 1-3 points). The neurodynamic functionality (NDF) test data of the sample was grouped into the high, moderate and low.

On the nervous system strength typing scale, (1) 56.25%, 18.75% and 25% of the sample were tested moderate, high and low, respectively; (2) 50%, 25% and 25% of the sample were tested with low, moderate and high nervous system excitation/ motility rates; 3) 80%-plus of the sample was tested high and moderate on the nervous system inhibition scale (43.8% and 37.5%, respectively); and the remaining 18.8% was tested low; (4) on the external mental control/ balance test scale, 81.3% and 18.7% of the sample were tested with domination of external and internal inhibition, respectively; and (5) the internal balance test scale showed a similar picture, with 75% and 25% tested with dominance of excitation and internal inhibition, respectively.

Having analyzed the NDF data correlations with the individual competitive success data at the European Blind Judo Championship (IBSA) in July 2019, we found the correlation directly or indirectly determined by the competitive fitness indices. The Spearman pair rank correlation indices showed significant positive correlation between the individual precompetitive internal balance test rates and the competitive success rates (o = 0,486; p = 0.05; unilateral). Statistically, this means that the internal balance level is closely correlated with the logical nonlinear competitive success variation. In practical terms, we would recommend the internal balance test rates being applied as the potential indicators (rating the achieved precompetitive energy resource mobilizing capacity) to forecast the potential competitive success.

Contributions of the individual psycho-emotional controls into the competitive fitness indices were rated by the basic (relaxation and activation) self-control skills tests. Actually, we tested only 50% of the sample high and moderate on the psycho-emotional control scale. Single-factor variation analysis found the psycho-emotional control being positively correlated with the competitive fitness indices variations – that means that the high mental control improve the competitive fitness in the blind judo sport. The correlation of the mental relaxing ability test rate with the competitive fitness indices may be described as $F(2.13) = 2.83$, $p \leq 0.05$ (unilateral); and the mental activation ability test rate with the competitive fitness indices as $F(2.13) = 2.88$, $p \leq 0.05$ (unilateral).

Conclusion. The invariant psychophysiological fitness test rates indicative of the blind judo com-

petitors' central nervous system good fitness for competitions may be summarized as follows: (a) moderate-to-highly-strong nervous system that effectively controls involuntary mobilization of the individual natural resource for competitive success; (b) prevalence of the internal balancing skills indicative of the permanent and efficient controls of metabolic processes, with high innate aggression (expressed or latent in the precompetitive fitness for the fight) with its modest albeit often decisive contribution to the expected competitive success. Analyses of the central nervous system psychophysiological fitness competitive fitness in the blind judo sport are recommended to give a special priority to correlations of the competitive fitness / competitive success indices with the above psychophysiological fitness test rates.

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Cerebral palsy related complications in adolescent gait biomechanics

UDC 796.077-056.266

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Abstract
Objective of the study was to offer theoretical provisions for special physical training model customizable for the cerebral-palsy-related movement remodeling to physiological motor stereotypes in the adolescent age, to facilitate progress in the postural control and gait biomechanics.
Results and Conclusion. Every cerebral-palsy-diagnosed child is known to develop his/her own walking strategy or movement pattern that can hardly be changed or standardized, otherwise the vertical postural controls may be heavily compromised. One of the key rehabilitation criteria in such cases is the postural control and movement control stability. The cerebral-palsy-related movement disorders form and aggravate spasticity with contractures, and this is why the functionality improvement/ rehabilitation trainings should be geared to remove/ mitigate certain individual clinical syndromes. The study data and analysis showed benefits of special versatile physical trainings for functional progresses of children with cerebral palsy and their protection from potential adaptive overstrains by moderate healthy physical workouts. Such practices are recommended to include static postural control improvement exercises plus obligatory cyclic motor activities with an emphasis on the ground contact control to improve the inter-muscular responses and reflexive fast adaptation mechanisms mobilized and excelled by such physical activity. It should be emphasized that the endurance and strength exercises should be prudently designed and managed with respect to the heart rate variability test data since the autonomous nervous system responses and controls are still incomplete and imperfect in this age group.

Keywords: *cerebral palsy, gait biomechanics, classified cerebral palsy dysfunctions.*

Background. The cerebral-palsy-related motor/ postural control dysfunctions are known to be largely due to the central nervous system disorders in many parts with underdevelopments in their central structures and delayed myelination of nerve fibers associated with abnormal activity of the brain stem structures. Pathological motor stereotypes are finally formed at residual stages of cerebral palsy with the relevant compensatory adaptations that are needed for the orthograde postural control in every locomotion type [1].

Clinical cerebral-palsy-related disorders are commonly grouped into the primary ones caused by the central nervous system pathologies (muscle weakness, spasticity and disharmonies, hyperkinesis etc.); secondary complications of the primary musculoskeletal system defects and developmental disorders (short muscles, contractures, subluxations, dislocations, progressive skeletal deformities – i.e. orthopedic complications); and tertiary protective adaptation mechanisms mobilized by the growing body to offset the above two groups of disorders (gait disorders, dysfunctions, irreducible compensatory patterns, hypokinesia etc.) [4, p. 40].

Of special contribution among the above are the proprioceptive sensitivity dysfunctions with inhibition of signals from joints and tendons, and with the relevant complications for somatognosis. The primary proprioceptive data flow from peripheral structures is inadequate and complicated by hypokinesia and prolonged postural dysfunctions – that means that the

child is unable to correctly perceive and control motor actions to develop a correct bodily control pattern. Intense signals from stressed muscles to the central nervous system in this case effectively hamper the data flow from proprioceptors in ligaments and tendons, particularly when relatively weak, short-amplitude and fine movements are attempted, making the child unable to correctly repeat passive movements and forcing to imitate them instead.

It is also common for cerebral palsy to impair sensory movement control and activity of gamma neurons in the spinal cord associated with permanent kinesthetic disorders in spastic forms [6]; with the children facing difficulties in identifying and naming body parts, fingers, movement vectors, spatial orientations, postures, postural aspects, arm/ hand/ finger positions etc. These issues contribute to the growing motor apraxia or ataxia with the related complications in the vertical postural control and body mass center movement control.

Objective of the study was to offer theoretical provisions for special physical training model customizable for the cerebral-palsy-related movement remodeling to physiological motor stereotypes in the adolescent age, to facilitate progress in the postural control and gait biomechanics.

Results and discussion. Every cerebral-palsy-diagnosed child is known to develop his/her own walking strategy or movement pattern that can hardly be changed or standardized, otherwise the vertical postural control may be heavily compromised. One of the key rehabilitation criteria in such cases is the postural control and movement control stability [5]. The cerebral-palsy-related movement disorders form and aggravate spasticity with contractures, and this is why the functionality improvement/ rehabilitation trainings should be geared to remove/ mitigate certain individual clinical syndromes.

The cerebral-palsy-related gait biomechanics disorders may be interpreted as combinations of pathological factors contributing to the habitual postural control dysfunctions. Thus, the common walking stereotype in case of spastic diplegia is rather monotonous, with the only gait biomechanics differences found in the stride pacing with the ground contact phase variations plus the relevant lower-limb flexion cycling stereotypes, key leg joint movement limitations, plus reductions and deformations in the ground contact curves indicative of the walking postural control issues. The ground contact phase is deformed to shorten the heel/ sole contract times and increase the forefoot contact times [3].

It is also common that spastic diplegia related ground contact disorders are complicated by equinus positions or foot deformities albeit the movement control rhythm ratio may be virtually normal due to the both legs equally compromised. Consequently, the key joint movement patterns in walking are transformed as well. The kinematic disorders may be grouped as follows: (1) primary flexion angles in every leg joint are shifted, with the angular displacements curves moving upward from the zero (standing) line; (2) the interlink angle amplitudes, angular move speeds and accelerations are reduced; and (3) startup and end phase are displaced in the movement cycle.

The cerebral-palsy-related individual vertical controls are typically referred to as the "mobile balance" [2] with constant muscle tone variations in the antigravity muscle groups to stabilize the body mass center and ground contact. Every cerebral palsy case shows postural control disorders, limb movement disharmonies, dominance of flexor adductor and penetrating muscle tones indicative of imbalances in the striated muscles and spinal column development pathologies – as a result of the primary central nervous system dysfunctions with impairments in the reciprocal innervation mechanisms.

It should be emphasized that active movements with sensors-driven activity attentive to feedbacks from the muscular apparatus – stimulate changes in the brain, with progress in responses to afferent signals facilitating improvements in the central nervous system functionality. Neurophysiological analysis of the brain functions in the cerebral-palsy-diagnosed adolescents subject to the movement disorders correction therapy found expressed qualitative/ quantitative transformations in the integrative brain activity due to improvements in the old functional links with new ones being formed, and with progress to the ontogenetically better cortical-subcortical links – to open up new opportunities for the brain functionality improvements in the cerebral palsy cases [3].

The compromised muscle functions largely limit or disable movements and, hence, develop forced postures and motor patterns associated with the musculoskeletal system developmental deficiencies – and that is why the efforts to recover the central nervous system functions may not be successful unless the muscle functionality is improved. When special physical training models are designed, therapists need to

understand well every aspect of the cardiovascular system adaptation to muscle workouts in the cerebral-palsy-diagnosed children. When the individual adaptability is heavily compromised and, hence, physical stress tolerance is relatively low, whilst information about the functional limits, norms and applicable physical activity tests is short or lacking, the energy-cost- and adaptability-sensitive rehab methods may be difficult for design on the individual health issues customized basis [2, p. 126].

Physical inactivity of the cerebral-palsy-diagnosed adolescents contributes to the autonomic regulation disorders with symptoms of sympathicotonia, expressed neurohumoral regulation and vertical postural control dysfunctions. Physical workouts with complex movement coordination in vertical positions with a special attention to the ground contact to activate a wide range of muscle groups – help increase vagotonic activity and ease tones of the sympathetic and central regulation mechanisms in the cerebral-palsy-diagnosed young males; and decrease vagotonic activity with the simultaneous growths in tones of the vasomatory and suprasegmental regulatory centers in their female peers.

Conclusion. The study data and analysis showed benefits of special versatile physical trainings for functional progresses of children with cerebral palsy and their protection from potential adaptive overstrains by moderate healthy physical workouts. Such practices are recommended to include static postural control improvement exercises plus obligatory cyclic motor activities with an emphasis on the ground contact controls to improve the inter-muscular responses and reflexive fast adaptation mechanisms mobilized and excelled by such physical activity. It should be emphasized that the endurance and strength exercises should be prudently designed and managed with respect to the heart rate variability test data since the autonomous nervous system responses and control are still incomplete and imperfect in this age group.

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Foreign sports research models: comparative analysis

UDC 796.01

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Abstract

Objective of the study was to analyze the best institutional models of the sports research systems facilitating success of the global sports leading nations.

Methods and structure of the study. We opted, for the purposes of the study, for an institutional analysis of the foreign sports research systems with a comparative analysis, case studies and practical experience summarizing reviews.

Results and conclusion. Our analysis of the foreign sports research experience showed the leading sports nations persistently facilitating progress of their sports science by prudent governmental policies and practices. The sports science is ranked among the priority policy sectors by the global sports leaders (including the USA, UK, Canada, China and France) that have long been ranked among the Olympic Games winners. The national sports progress and sports research concepts of these nations are still different, with the differences apparently dictated by traditions of the governmental systems and the national sports sector regulation specifics.

Based on the study data and analysis, we have grounds to conclude that the global sports research models are dominated by the following three options. As demonstrated by the success histories of the world sports leading nations, the sports research centers may operate based on major universities (France), or as Olympic training centers (USA, Canada, UK), or as specialized sports research institutes (China). It should be emphasized that the national sports research systems financing models are different as dictated by the national sports sector traditions and specifics.

Keywords: *sports science, sports research institutions, elite sports*

Background. It is common knowledge that modern sports science is critical for progress of the national sports since a well-designed and managed theoretical and practical support provides a sound basis for competitive successes. As far as the foreign sports research experiences are concerned, the global sports leaders acknowledge their successes being largely due to the governmental policies that put national sports high on the national list of priorities.

Objective of the study was to analyze the best institutional models of the sports research systems facilitating successes of the global sports leading nations.

Methods and structure of the study. We opted, for the purposes of the study, for an institutional analysis of the foreign sports research systems with a comparative analysis, case studies and practical experience summarizing reviews.

Results and discussion. Our analysis of the foreign sports research experience showed the leading sports nations persistently facilitating progress of their sports science by prudent governmental policies and practices. The sports science is ranked among the priority policy sectors by the global sports leaders (including the USA, UK, Canada, China and France) that have long been ranked among the Olympic Games winners. The national sports progress and sports research concepts of these nations are still different, with the differences apparently dictated by traditions of the governmental systems and the national sports sector regulation specifics.

Thus, the US sports research system, for example, is headed by the special research divisions of the National Olympic and Paralympic Committee (NOPC) located at the Olympic Sports Training Centers (OSTC) in Colorado Springs, Lake Placid and Chula Vista. Such sports research model is beneficial in many aspects since the practical support is always available in the sports elite training process, with the individual training services timely customize to the actual fitness and performance test data. Since the elite sports in the US are not legally eligible for public funding – as is the case in many other countries – in 2017 the NOPC initiated a special Sports Technologies and Innovations Fund [8]. As provided by the NOPC annual reports of 2018 and 2019, the Fund has accumulated above USD 6,700,000 and USD 7,278,000, respectively [9].

The Canadian sports research model is totally different as it may be described as a network of Canadian Olympic and Paralympic Sports Institutes (COPSI) [4] including seven academic institutions, four of which are located at the Sports Training Centers in the provinces of Calgary, Montreal, Ontario and British Columbia; and the remaining three serve the Multisport Centers in the provinces of Manitoba, Saskatchewan and Atlantic Canada [10]. In contrast to the US system, these sports research establishments are funded by the federal budget through the Sports Canada Agency on applications from the Seize the Pedestal organization [7].

The sports research system in the UK is somewhat similar to the Canadian one with the only difference that the Canadian sports research centers are relatively independent and specialized whilst their theoretical, practical and biomedical support service to the UK sports is headed by the English Institute of Sport (EIS) [3]. The EIS mission is to provide practical support to the sports elite by special sports research services with modern biomechanics research, dieting and rehabilitation recommendations, and the individual training system design and management service for competitive success.

The French sports research model is different from the above. The national sports science is controlled by National Institute of Sports (INSEP) reporting to the national Ministry of Sports [5]. Since 2009, the INSEP is ranked both the leading sports university and the key national sports research center responsible for the national sports elite training for successes in the Olympic and Paralympic Games. Many French sports federations closely cooperate with the INSEP based on the long-term cooperation contracts. The key divisions of the INSEP are the Sports, Expertise and Performance (SEP) Laboratory and the Institute for Biomedical and Epidemiological Research in Sports (IRMES), which mission is to provide theoretical, practical and biomedical support to the sports elite including qualifiers for the Olympic and Paralympic national teams. For the last few years, the SEP Lab and IRMES have been closely testing and monitoring fitness and performance of the national sports elite [10].

The Chinese sports research model is also different. It was back in 1958 that the China Institute of Sport Science (CISS) was established in Beijing as the leading national sports research center [2]. The CISS is similar to the French INSEP in the sense that it reports the relevant government agency – the General Governmental Directorate for Sports in the case. The only difference is that this governmental agency has no academic division, and its core mission is to facilitate the fundamental and practical research in the national sports science and sports technologies for progress of the Chinese sports elite on the global arenas.

Conclusion. Based on the study data and analysis, we have grounds to conclude that the global sports research models are dominated by the following three options. As demonstrated by the success histories of the world sports leading nations, the sports research centers may operate based on major universities (France), or as Olympic training centers (USA, Canada, UK), or as specialized sports research institutes (China). It should be emphasized that the national sports research systems financing models are different as dictated by the national sports sector traditions and specifics.

The study was designed to contribute to the ongoing research on the State Order for the Federal Science Center of Physical Culture and Sport (VNIIFK).

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Physical education and sports sector specialists: supply and demand situation analyis and forecast

UDC 796.075

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Abstract

Objective of the study was to analyze the national physical education and sport sector progress in the context of the federal and regional physical education and sports human resource supply and demand statistics to offer the physical education and sports human resource flow monitoring and forecast model.

Methods and structure of the study. We used for the purposes of the study the tradional theoretical research methods, comparative analysis of the governmental statistical reports 1-FC for 2012-2019, linear regression based forecasts, and a trend analysis with extrapolations. When developing our physical education and sports human resource flow monitoring and forecast model, we gave a special priority to systematic comprehensive analyses of the current progress trends, physical education and sports progress strategy implementation benchmarks and analysis of the physical education and sports human resource supply and demand situation in the context of the sector progress goals.

A systematic approach implies compliance of the key requirements to a data processing system, including: relevance, scalability, progress opportunities, integrity, practical benefits, multilevel design, permanent operation, and visualized presentation of the present situation and progress forecasts; with the monitoring data, reports and analyses being fully accessible for every user as provided by the valid information security codes; and with the regional progress analysis and comparisons, clear structured and coordinated project activities.

In our analysis of the governmental statistical reports, we used standard economic and mathematical modeling methods and correlation analysis to forecast the physical education and sports specialists' supply and demand situations in the federation and regions.

Results and conclusion. Our analysis of the key physical education and sport sector progress trends with the human resource supply and demand statistics for 2012-2019 found the following:

• The trainees-per-trainer ratio in the physical education and sport sector needs to be stabilized to meet the valid federal physical education and sport service standards in terms of group numbers and training schedules and the federal regulations on additional paraprofessional physical education and sport specialist training curricula;

• The physical education and sport specialist supply lags far behind the demand (as demonstrated by the fast growth of the habitually sporting population in every region and physical education and sports domain, including the corporate physical education and sports, clientele of the public sports facilities and other sports organizations.

Regional physical education and sports staff growth forecasts from the relevant governmental agencies – based on the general labor resource accounting and balancing data ignoring the physical education and sports clientele growth forecast that gives 70% growth by 2030 – fail to fairly rate and predict the human resource demand in the physical education and sport sector. Therefore, we recommend the efforts to keep the trainees-to-trainee ratio reasonable and effective being facilitated by the theoretically grounded research with the physical education and sport specialists' supply and demand control recommendations by regions, places of residence and corporate physical education and sport service providers.

Keywords: *physical education and sports human resource supply, specialist demand, statistical reports, analytical system, monitoring, forecast.*

Background. As required by the national physical education and sports sector development and staffing strategies with a special priority to the human resource supply for the sector and sports medicine, further specialist training for the physical education and sports sector will be improved based on the human resource supply and deman situation monitoring, analyses and forecasts, to secure the sector being fully staffed by modern competent and skillful human resource [3]. The physical education and sports human resource demand

and supply statistics will help keep the decision-makers timely informed on the labor market progress trends and other relevant processes, with a special attention to the regional physical education and sports human resource supply and demand situations in need of special staffing decisions to attain the sector progress goals.

Objective of the study was to analyze the national physical education and sports sector progress in the context of the federal and regional physical education and sports human resource supply and demand statistics to offer the physical education and sports human resource flow monitoring and forecast model.

Methods and structure of the study. We used for the purposes of the study the tradional theoretical research methods, comparative analysis of the governmental statistical reports 1-FC for 2012-2019, linear regression based forecasts, and a trend analysis with extrapolations. When developing our physical education and sports human resource flow monitoring and forecast model, we gave a special priority to systematic comprehensive analyses of the current progress trends, physical education and sports progress strategy implementation benchmarks and analysis of the physical education and sports human resource supply and demand situation in the context of the sector progress goals.

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In our analysis of the governmental statistical reports, we used standard economic and mathematical modeling methods and correlation analysis to forecast the physical education and sports specialists' supply and demand situations in the federation and regions [2, 4].

Results and discussion. As was found by the key physical education and sports sector progress reports, the physical education and sports sector cllientele growth pace is much faster than the physical education and sports specialist inflow in the sector. Thus the federal statistical reports of 2012-2019 show the total clientele growing by 82% versus physical education and sports sector staff growing by only 22% for this period. This means that the average number of trainees served by every physical education and sports specialist (trainees-to-trainer ratio, tranees-to-trainee ratio) has grown from 97 to 148 as provided by the federal statistical reports, with the similar growth trends reported by regions. Leading in the growth statistics are the Central, Volga and North Caucasis regions that report the average tranees-to-trainee ratio at up to 170 people.

On the one hand, this growth may be interpreted as indicative of the physical education and sports human resource labor productivity growth; and on the other hand, the national sports training and advancement system reports the average number of trainees-per-trainer standing unchanged at 39 for the last five years. The corporate physical education and sports system (industries, organizations etc.), however, report 590 habitually sporting people per trainer as of 2019, that means that this number has grown up by 260 since 2012 – and no doubt that one trainer can unlikely serve such clientele.

Our analysis of the regional vacancies in the physical education and sports system for the study period found the sector staffing being virtually independent on the formally declared vacancies. Thus the federal statistics give 2% of the vacant positions for the period.

We analyzed the reported physical education and sports specialist's clientele and payroll variation statistics by regions (Figure 1) to find the economic benefits being uneven across the regions. Note that the peaks on the payroll variation curve appear being due to some contingencies – often falling in conflict with the sector progress logics. On the whole, our analysis of the statistical reports 1-FC data demonstated that forecasts of the human resource demand situation in the sector cannot be good enough unless grounded by the regional progress factors and progress trend analyses. The situation is further complicated by the fact that the statistical reports forms make it virtually impossible to forecast the physical education and sports sector demand on a detailed basis, by the key trades and qualifications.

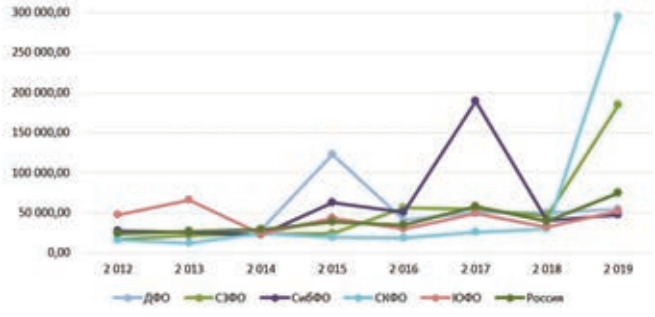

Figure 1. *Average physical education and sport specialist's payroll variation in 2012-2019*

Furthermore, the physical education and sports human resource demand forecasts need to proceed from the assumption that the physical education and sports sector clientele in the coutnry is expected to grow to 33 million for the period of 2020 to 2030 – in excess of the reported 2012-2019 growth trend. Given on Figure 2 hereunder is the physical education and sports sector staff shortage forecast – versus the tranees-to-trainee ratio – if the last five-year growth trend will stay. The trend line predicts further fast growth of tranees-to-trainee ratio although there should be some limit otherwise the human resource service efficiency/ quality will inevitably fall to undermine progress of the sector and further inflow of skilled human resource.

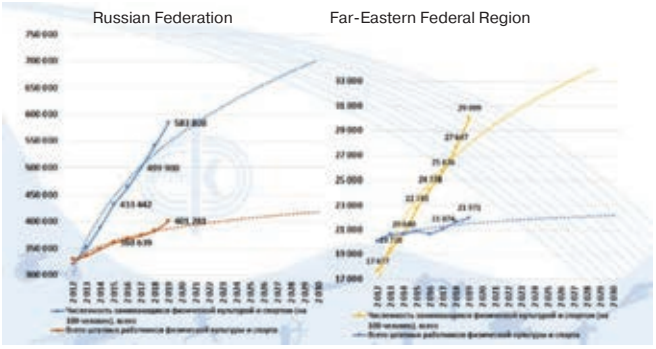

Figure 2. *Physical education and sports sector clientele and human resource growth forecast based on the 2012-2019 statistics*

We have every reason to expect that further growth of demand for the physical education and sport service, unless timely and fully met by supply of the trained physical education and sports specialists, will result in the fast deterioration of the service quality and safety standards. Should the trainees-per-trainer ratio stay at 160 till 2030 (that is very unlikely), the physical education and sport sector will need at least 245 thousand specialists more than now.

Conclusion. Our analysis of the key physical education and sports sector progress trends with the human resource supply and demand statistics for 2012-2019 found the following:

• The trainees-per-trainer ratio in the physical education and sports sector needs to be stabilized to meet the valid federal physical education and sport service standards in terms of group numbers and training schedules and the federal regulations on additional paraprofessional physical education and sport specialist training curricula;

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Regional physical education and sport staff growth forecasts from the relevant governmental agencies – based on the general labor resource accounting and balancing data ignoring the physical education and sports clientele growth forecast that gives 70% growth by 2030 – fail to fairly rate and predict the human resource demand in the physical education and sport sector. Therefore, we recommend the efforts to keep the trainees-to-trainee ratio reasonable and effective being facilitated by the theoretically grounded research with the physical education and sport specialists' supply and demand control recommendations by regions, places of residence and corporate physical education and sport service providers.

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Chess training system digitalizing process

UDC 796.01

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Abstract

Objective of the study was to offer provisions for a digitalized chess training ecosystem using modern digital data processing technologies within an interdisciplinary system control framework.

Methods and structure of the study. We have analyzed for the purposes of the study the best digitalized training ecosystem design and implementation experiences accumulated by universities; and summarized the relevant theoretical and practical educational developments in the digital educational technologies, digital tools and services applicable in the Russian State Social University distance education service on the whole and digitalized chess training service in particular.

Results and conclusion. We believe that further progress of the chess training system will be facilitated by improvements and expansion of the university chess training assets and services with further (up to total) transition to the digital learning materials and aids including the modern high-quality online learning and digitalized training management systems, plus – the last but not least – permanent progress of the chess teachers' digitalized training knowledgebase, competences and experiences.

The experimental digitalized training service was tested beneficial due to the combined new data processing, communication and training technologies with their theoretical and practical electronic toolkits. The service provides a basis for the chess training process automation on an objective progress test basis to make the chess training service much more inclusive and productive. The university resource mobilizing efforts to facilitate progress of the chess training ecosystem have proved particularly beneficial for the students' human resource development and progress encouragement aspects.

Keywords: *chess sport, ecosystem, interdisciplinarity, digital transformation, system control, inclusion.*

Background. Chess training service in Russia has been provided by RSUFCSYT since 1966 and Russian State Social University since 2002. For the last 65 years, RSUFCSYT has trained more than 600 chess coaches and 80 world class grandmasters, and 10 university graduates have won titles of the World and Olympic champions in the individual and team events. Russian State Social University has trained more than 60 chess trainers/ managers and 112 chess trainers for the Grassroots Chess Training in Russia Project for 20 years. It should be emphasized that the latter university with its non-core chess training service has trained more than 20 world class grandmasters, and seven Russian State Social University graduates have won titles of the World and Olympic champions and qualified for the Russian national chess team.

Objective of the study was to offer provisions for a digitalized chess training ecosystem using modern digital data processing technologies within an interdisciplinary system control framework.

Methods and structure of the study. We have analyzed for the purposes of the study the best digitalized training ecosystem design and implementa-

tion experiences accumulated by universities [2, 3, 7]; and summarized the relevant theoretical and practical educational developments in the digital educational technologies, digital tools and services applicable in the Russian State Social University distance education service [4, 8] on the whole and digitalized chess training service in particular [1, 5].

Results and discussion. Since 2012 Russian State Social University takes efforts to implement a chess training ecosystem viewed as the technological mechanism operating within the interdisciplinary chess sport framework: see Figure 1 hereunder.

Figure 1. *Chess training ecosystem in operation at Russian State Social University*

The chess training ecosystem design offers a wide range of opportunities for targeted chess training trainings within its external and internal contours (subsystems). The external contour may be described as the versatile subsystem of the Russian State Social University relations with potential employers and corporate partners (FIDE and CFR), R&D project clientele (ministries of sports, labor and social protection, science and higher education); international partners that offer internships and foreign trainings to the Russian State Social University students; and contributors to International Cup of the Russian State Social University "Moscow Open". The inner chess training contour refers to own chess training assets of Russian State Social University including: International Chess Sport Center; Chess House; Technopark; and the Children's and Youth Sports School; plus the Complex Research Group (CRG), a headliner of the national inclusive chess training.

The chess training ecosystem was designed based on the key pedagogical concepts including the B. Skinner's programmed teaching concept; P.Y. Galperin's staged systematic mental notions and operations formation concept; W. Stern's psychographics method; and I.V. Mikhailova's chess technologies and toolkits digitalization concept. These basic provisions made it possible to largely and effectively transform the pre-electronic-age chess training system of 2002-2013 into the new digitalized chess training system of 2014-2020 that takes full benefits of the modern digital open chess training platforms – and has fast multiplied the target audience among other things [1].

The ongoing productive cooperation of Russian State Social University and Russia-based Dive Software developer has resulted in the following new digital chess training platforms: Anatoly Karpov's Chess Lessons, Chess University, and World Chess Class Digital. Thus the internal contour of the chess training ecosystem now offers both the health-protection and chess training technologies using the MOOC (Massive Open Online Courses) platforms.

This progress in the system resource helped update the chess training service goals, coverage and institutional forms to LMS and effectively apply the modern BigData resources for the Chess University and Anatoly Karpov's Chess Lessons platforms.

Benefits of the new chess training ecosystem at Russian State Social University were proved by an experimental digitalized chess training course offered by the CRG to more than 1000 bachelor students recruited to the offline and online chess training courses in 2020-21. The experimental group digitalized chess training trainings were different from the traditional ones in the chess training service digitalization, modern formats, chess training methods and services. The digitalized chess training model testing experiment was finalized by the statistical processing of the experimental test data with account of the W. Stern longitudinal psychographics concept [6].

In the experimental digitalized chess training service, we tested and processed the test data to standardize and visualize the gradual psychophysical progress of every individual on a general psychograph. Given on Figure 2 hereunder is the psychograph visualizing the pre- versus post-experimental (test 1 versus 8) test data indicative of the individual progress in mnemonic and intellectual functions, psychological traits and mental-emotional controls.

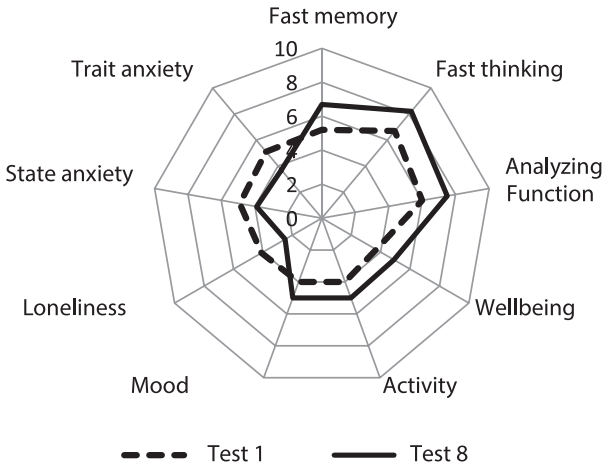

Figure 2. *Pre- versus post-experimental (test 1 versus 8) test data of the experimental group trained at digitalized chess training course in 2020-21*

To simplify the test data analysis, the test rates were converted to a 10-point scale. It should be mentioned that the EG trained in the digitalized chess training format only made significant progress of 1.5 points on the Fast Memory, Fast Thinking and Analyzing Function scales. Having analyzed the psychophysical test data, we would emphasize the EG progress (of 10-16%) on every test scale – that may be interpreted as indicative of the wide-ranging improvements in the psychophysical health and control in the digitalized chess training service.

We believe that further progress of the chess training system will be facilitated by improvements and expansion of the university chess training assets and services with further (up to total) transition to the digital learning materials and aids including the modern high-quality online learning and digitalized training management systems, plus – the last but not least – permanent progress of the chess teachers' digitalized training knowledgebase, competences and experiences.

Conclusion. The experimental digitalized training service was tested beneficial due to the combined new data processing, communication and training technologies with their theoretical and practical electronic toolkits. The service provides a basis for the chess training process automation on an objective progress test basis to make the chess training service much more inclusive and productive. The university resource mobilizing efforts to facilitate progress of the chess training ecosystem have proved particularly beneficial for the students' human resource development and progress encouragement aspects.

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University physical education department students' psychomotor functionality and physical activity analysis

UDC 378.172

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Abstract

Objective of the study was to rate and analyze the 18-19 year-old Physical Education Department students' mental, physiological and physical fitness versus their physical activity.

Methods and structure of the study. We used the following methods: analysis of the relevant study reports; nervous system responses and strength rating tapping test; and the physical fitness tests including plank running and 30s sagittal-plane simultaneous/ alternating hand swing test. We sampled for the study run in 2020-21 the 18-19 year-old Physical Education Department students' (n= 97 including 53 males and 44 females) at three universities.

Results and conclusion. The right-/ left-hand tapping test data (total average tapping frequencies) were found virtually the same for the male and female groups; although the right-hand squared points tapping averages in square 1 were significantly higher in the male group. The left-hand tapping averages were found significantly higher in the male group both in the total average and in squares 1/ 3/ 4/ 5 tapping averages; albeit lower on the whole than the right-hand tapping test data due to the right-hand dominance in the sample.

Habitually sporting and physically active individuals in the sample were tested with significantly higher dynamic endurance in the tapping test and cyclic exercise tests indicative of the good musculoskeletal system fitness and nervous system control. Their unsporting and physically inactive peers were tested low in the nervous system strength / dynamic endurance rating tests and physical fitness tests. The study data and analyses demonstrate the need for the theoretical and practical academic physical education and sport service for the unsporting students to be revised so as to encourage their physical fitness and physical activity sensitive to their individual psychomotor test rates and physical progress agendas and offer customizable physical training models.

Keywords: *18-19 year-old students, tapping test, physical activity, nervous system strength, cyclic exercise test, pace.*

Background. For the last few decades, the national health statistics have reported health deterioration trends for the university graduates [1, 2] – partially due to the entrants' physical fitness and health standards varying at mostly moderate and low levels, with the pedagogical universities' Physical Education Department students being no exclusion [3-5]. The national educational community gives in this context a special priority to new physical activation models to facilitate the professional training, physical fitness and health improvement services.

Objective of the study was to rate and analyze the 18-19 year-old Physical Education Department students' mental, physiological and physical fitness versus their physical activity.

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Education Department students' (n= 97 including 53 males and 44 females) at three universities.

Results and discussion. The right-/ left-hand tapping test data (total average tapping frequencies) were found virtually the same for the male and female groups (32.7±0.9 and 31.5±1.0, respectively); although the right-hand squared points tapping averages in square 1 were significantly higher in the male group (37.8±1.1 versus 34.7±1.1, p <0.05). The left-hand tapping averages were found significantly higher in the male group both in the total average and in squares 1/ 3/ 4/ 5 tapping averages; albeit lower on the whole than the right-hand tapping test data due to the right-hand dominance in the sample. The tapping pace was found to sag with the test time: see Figure 1.

The above curves are generally indicative of the group nervous system strength being low on average. We found the tapping frequency falling since the second 5-second interval to stay at this level till the end. The male group tapping pace was tested higher than the female one; with the right-hand pace significantly above the left-hand one due to the right-hand dominance (p <0.05).

The right-hand square 1 tapping pace in the male group was the highest at 7.6 points/ s to fall thereafter by 18.4% in square 4 (to 6.2 points/ s) and stay at this level till square 6. The female group pace was tested to fall in the same manner by 14.5% from 6.9 to 5.9 points/ s: see Figure 2.

In square 5, the tapping pace was tested to grow by 7.8% (to 6.4 points/ s) and then fall to the minimum, with the gender group differences tested insignificant. The left-hand tapping pace in the male group was tested to fall in squares 1-2 and squares 3-6 – by 9.4% and 20.3%, respectively, versus the startup (square 1) pace. The tapping test pace growth in square 3 to square 2 was estimated at 3.3% in the male group. The female group was tested with the left-hand pace falling by square 4 by 20.8% (from 6.04 to 4.8 points/ s) and slightly grow by 1.6% at the end (square 6).

The individual tapping test data were found to vary with the nervous system strength to allow the sample

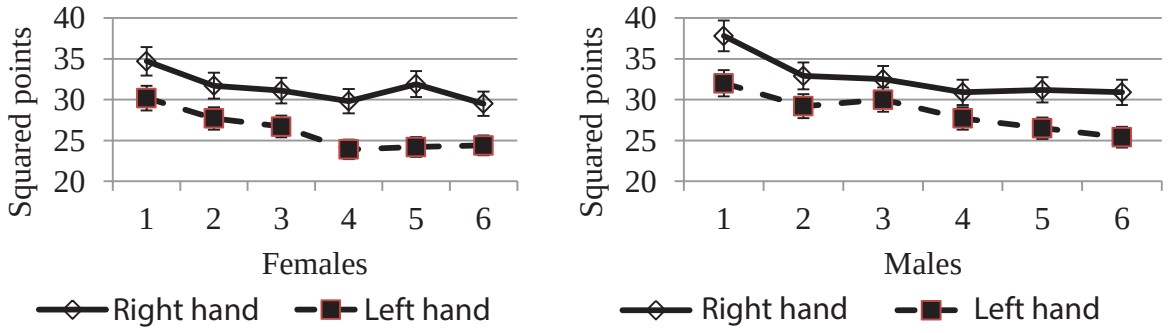

Figure 1. *Tapping test data variation curves for the gender groups*

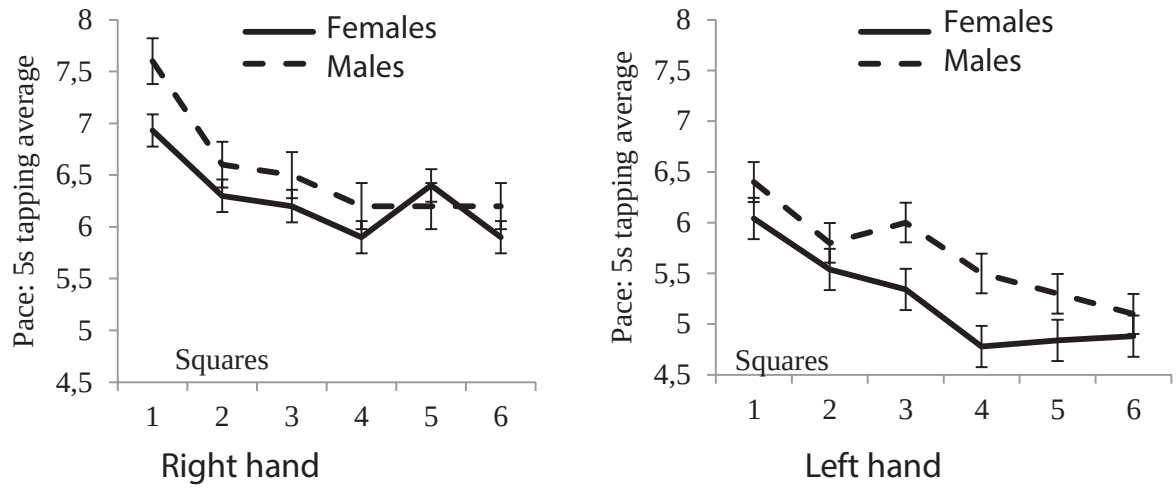

Figure 2. *Right- and left-hand tapping pace variation in the gender groups*

grouping by the nervous system strength levels. We found that the nervous system strength groups generally agreeing with the physical activity groups in the sample. On the whole, 60.4% and 44.2% in the male and female groups (respectively) reported low physical activity limited to the regular academic physical education and sport service plus self-reliant trainings 2 times a week at most. The individuals tested with convex and even tapping test curves and, hence, moderate-to-high nervous system strength, were unsurprisingly found more physically active. 22.6% and 13.6% of the male and female groups (respectively) were ranked with the moderate-to-high nervous system strength and reported habitual off-class physical education and sports complementary to the academic physical education and sport service. These sporting students reported training 3-5 times a week in sports groups plus 30-40-min daily workouts at home varying in emphases and intensities. Some of them (28.6%) reported their weekly trainings averaging 11-plus-hours.

The habitually sporting students were tested significantly higher (1.8 and 1.7 times in the male and female groups, respectively) than their unsporting and physically inactive peers in the plank running test. The similar picture was found for the group averages in the hand swing test, with the habitually sporting males and females tested 2.1 and 1.9 times higher than the unsporting peers.

Conclusion. Habitually sporting and physically active individuals in the sample were tested with significantly higher dynamic endurance in the tapping test and cyclic exercise tests indicative of the good musculoskeletal system fitness and nervous system control. Their unsporting and physically inactive peers were tested low in the nervous system strength / dynamic endurance rating tests and physical fitness tests. The study data and analyses demonstrate the need for the theoretical and practical academic physical education and sport service for the unsporting students to be revised so as to encourage their physical fitness and physical activity sensitive to their individual psychomotor test rates and physical progress agendas and offer customizable physical training models.

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