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Greetings from the Minister of Sport

On behalf of me and the Ministry of Sport of the Russian Federation let me warmly congratulate the editorial board and editorial staff of the Scientific-Theoretical Journal "Teoriya i Praktika Fizicheskoy Kultury" (TPFK) on the 95th anniversary of its founding!

We greatly appreciate the remarkable contribution of the Journal to the development of sports science, training of top professionals, and promotion of knowledge intensive technologies in the sports sector. The "TPFK" Journal has long been a flagship not only of the Russian but also international scientific sports periodicals. I am confident that the journal will keep on expanding its informational power and thus promote close communication and interaction among sport sector specialists, as well as actively involving young scientists in new scientific research.

I wish the editorial board and editorial team all success in maintaining the high level of the Russian scientific sports periodicals, attracting talented authors and grateful readers.

Minister of Sport of the Russian Federation

O. V. Matytsin

Teoriya i Praktika Fizicheskoy Kultury journal:

95th anniversary

On the verge of the centenary of the Teoriya i praktika fizicheskoy kultury journal, I would like to thank the authors and readers of the journal for their support, tireless desire to move forward, develop, get better, and find breakthrough areas of research in the physical education and sport sector.

95 years is a milestone for the scientific and theoretical publication. The editorial staff has gone through a difficult path of formation and development, having become the leader of scientific sports periodicals both in Russia and abroad. The years-long publications of research results make it possible to bring to our wide audience effective solutions to various problems in the physical education and sport sector.

Let me congratulate our readers, authors and colleagues on this remarkable date for the journal. We are still looking forward to your assistance and support in scientific research, to our discussions and professional advice for the benefit of the development of the sport science.

Chief Editor, Doctor of Education, Professor L.I. Lubysheva

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Abstract

Objective of the study was to make a theoretical analysis of the modern sports anthropotechnics in the interdisciplinary knowledge context.

Methods and structure of the study. We made, for the purposes of the study, a systemic historical and technological progress analysis of the physical education and sport sector with summaries of the relevant theoretical, practical and technical research publications.

Results of the study and conclusions. Modern physical education and sports technologies with contributions from advanced anthropotechnical systems make it possible to develop customizable training programs to effectively train the required motor skills and qualities. They offer controlled progress facilitating environments for the key sport-specific motor skills being mastered in the most efficient formats, with the theoretical and practical training service put on a sound, systemic and controlled basis. Modern training simulators and other sports anthropotechnics tools are particularly beneficial for the sport-specific knowledgebase, skills and motor qualities building and perfection purposes attainable on a time-efficient basis. These methods and tools ensure high dependability and longevity of the motor skills and qualities and facilitate the theoretical and practical training service resource being managed on a prudent and effective basis; with due training progress tests; good versatility of the training service; and excellent trained motor skills standardization options to facilitate repetitions and analyses of the sport routines and performances.

Keywords: *sports history, sports technologies and methods, physical education and sports, training simulator, sports anthropotechnics, vibratory mechanical stimulation, sports training, biofeedback, motor skill, theoretical and practical training service*

Background. Modern technical tools applied in physical education and sport service may be referred to as the anthropotechnics in the context of their individual physical progress goals. Anthropotechnics may be interpreted as referring to modern physical education and sports, recreation, rehabilitation, physical training and athletic training service domains. Modern physical education and sport service with its technical tools is generally designed to facilitate individual progress, socialization and self-assertion with a special attention to the cost- and time-efficiency aspects. Modern sports anthropotechnics may be interpreted as the technical toolkits and structures geared to mimic the sport-specific movements and traditional physical exercises in every aspect. Modern sports anthropotechnics may be viewed as the natural product of the scientific and technological progress and a new research subject of interest for the relevant sports research communities (I. Ratov, G. Popov, V. Bal'sevich, A. Skrypko, V. Nazarov, S. Ermakov, S. Dobrovolskiy, S. Evseev, Y. Verhalo, P. G1esk, D. Schmidtbleicher et al.).

Physical-education-and-sport-related anthropotechnics may be defined as a humanistic research field and a natural integral human activity sector geared to facilitate progress in athletic skills and abilities. It shall not be viewed as an alternative to the traditional train-

ing tools as it rather complements them by a special emphasis on the new physical activity forms facilitating physical progress in sports, recreation and individual self-development; with motor activity ranked among the key priorities of the individual lifestyle and progress agenda for the whole life. Practical understanding of the service benefits and the relevant further applications are of special promise since they offer alternative solutions to support anti-doping policies in sports – since the new anthropotechnics applying technologies make it possible to effectively mobilize latent individual mental and physical resources with no need for special performance stimulating agents.

Objective of the study was to make a theoretical analysis of the modern sports anthropotechnics in the interdisciplinary knowledge context.

Methods and structure of the study. We made, for the purposes of the study, a systemic historical and technological progress analysis of the physical education and sport sector with summaries of the relevant theoretical, practical and technical research publications.

Results and discussion.

Technological aspects of anthropotechnics in physical education and sport sector

We have run multiannual studies to offer special technologies geared to improve the sport-specific special physical training and body conditioning methods in a few sport disciplines [5]. Thus our studies in track and field sports (decathlon, jumping and sprint) have shown that muscle vibratory stimulation facilitates progress in the shoulder and hip joint motility combined with efficient strength building effects; with the training benefits peaking on days 7 to 30 upon the vibratory stimulation course. The vibratory mechanical stimulation has proved beneficial for flexibility and strength trainings in many sports, and the technology has won a growing appreciation due to its applicability in the sport-specific competitive routines with special benefits for gymnastics, rowing and track and field sports. The vibratory mechanical stimulation benefits for team sports may also be high enough as apparently being proved by the research by F.K. Agashin, I.P. Ratov [4] and a few other scientists.

Modern science makes it possible to improve the training simulator systems by biofeedback applications – including, for example, muscle strength building technologies with the muscle electrical activity read by skin-fixed electrodes and controlled using visual/ auditory control modules [3].

New psychophysical and psycho-biomechanical technologies [4, 5] make it possible to control athletic performance keeping it within the required kinematic and power limits to master the perfect execution sequences. Of special interest in such technologies is the fact that they are compatible with an artificial control environment and sport-specific environment. These options help design and manage an individualized performance control system to help master some motor skills or achieve the expected fitness levels. The relevant technologies – for instance, the psychophysical ones – use visual/ auditory feedback systems to track the muscle electrical potentials. Psycho-biomechanical technologies are applied in sport-specific environment to set geometric and/ or physical limitations based on holonomic and nonholonomic links and using a variety of external loading drives to force the bodily limbs/ parts move as required by the mastered motor skills.

For the last three decades, the notion of *educational technologies* has made a transition from the *technology in education* to a broader notion of *technology of education* i.e. the *learning process technology*. This term implies new theoretical and practical approaches to analyze, design and manage the educational service. Therefore, modern physical education and sports technologies may be described as follows:

- Theoretically grounded and experimentally proven didactic innovations;
- Optimal and efficient technologies to attain the educational process goals of trainees and instructors/ coaches on a time-, cost- and resource-efficient basis;
- Technologies synergized with the related knowledge fields;
- Equally beneficial (reproductive) for every student group;
- Including programmed macro- and micro-cycles of the education service; and
- Technically versatile and computerized technologies.

Physical education and sports technologies may be defined as the harmonized systemic sets of optimal and effective methods, models and tools geared to attain specific competitive or physical progress/ fitness goals with timely and efficient medical examinations and physical/ performance progress tests.

Modern sports education and didactic technologies contribute to the physical education and sports knowledgebase and intellectual progress vectors based on findings of fundamental sciences. In terms of the four-level physical education knowledge system developed by V. Bal'sevich, technologies are ranked with levels two and three, i.e. refer to the social and biological determinants of the physical education and sports values within specific scientific disciplines (their technological aspects) – to identify specific ways and solutions for implementation of the latest research accomplishments in the physical education and sports practices on an interests-sensitive basis [2].

The natural social demand for top-class athletes urges the sport communities look for the ways to mo-

bilize latent resources of individual physical abilities, with a special priority to the motor skills different from the plain replications of natural movement structures formed by evolution – i.e. synthesized as required by the actual modern demands. Of special benefits for this purpose are the training simulator systems with their artificially controlled environments. The training machines assisted trainings may facilitate the efforts to mobilize the maximal and sub-maximal individual physical resources.

On the eve of the XXII Olympics in Moscow, Professor Vladimir Kuznetsov, world record holder in the javelin throw, came up with *anthropomaximology* as a new philosophical and practical scientific theory. Subject to this theory and scientific field is a healthy top-class athlete expected to demonstrate extraordinary results in sports and other extreme situations, with modern elite sports providing an ideal test ground for the theoretical and practical studies of the sub-maximal individual capabilities and resources [1].

Training and retraining ('reversal learning') in the modern physical education and sport sector is primarily designed to master sport-specific motor skills (key movement techniques). New didactic technologies will be designed to secure progress versus a stepped growth of theoretical and practical progress standards and requirements. The traditional demonstration and explanation methods in the training service may be effectively complemented by visualizing computerized technologies, controlled performance excellence systems and real-time training data flows.

The training-simulator-assisted programmed training systems are generally more accessible for the trainees and customizable to their individual progress needs to ensure the high quality training service. They effectively control physical execution of the sport-specific routines to facilitate the motor skills mastering process. Their modern computerized training tools largely free the instructors/ coaches of the common training workload accounting and analyses enabling them to focus on the creative aspects of the training service and its individualization/ customization priorities. It should be underlined in this context that a training service in the modern physical education and sport sector cannot be limited by only communication and execution domains, due to its multiple psychological and emotional aspects. Anthropotechnics applied in physical education and sport sector help expand the educational service, improve the training provisions and offer a wide range of services to meet the natural individual physical progress needs. To have the modern anthropotechnics effectively integrated into the theoretical and practical training service, the physical education and sport system shall facilitate every technical idea being freely developed to facilitate physical progress agenda of every trainee at no sacrifice for the traditional training toolkits.

Conclusion. Modern physical education and sports technologies with contributions from advanced anthropotechnical systems make it possible to develop customizable training programs to effectively train the required motor skills and qualities. They offer controlled progress facilitating environments for the key sport-specific motor skills being mastered in the most efficient formats, with the theoretical and practical training service put on a sound, systemic and controlled basis. Modern training simulators and other sports anthropotechnics tools are particularly beneficial for the sport-specific knowledgebase, skills and motor qualities building and perfection purposes attainable on a time-efficient basis. These methods and tools ensure high dependability and longevity of the motor skills and qualities and facilitate the theoretical and practical training service resource being managed on a prudent and effective basis; with due training progress tests; good versatility of the training service; and excellent trained motor skills standardization options to facilitate repetitions and analyses of the sport routines and performances.

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Cycled training service for 9-10 year old crawl swimming groups: harmonized technical and physical progress model

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Abstract

Objective of the study was to develop and test benefits of a new harmonized technical and physical fitness model (also referred to as the combined training technology) in application to junior (9-10 year old) crawl swimmers.

Methods and structure of the study. A key concept of the new harmonized technical and physical fitness model was to efficiently integrate the technical and physical fitness training elements to facilitate, on a staged basis, competitive progress in the junior special crawl swimming groups, with three stages of the model designed to (1) master technical basics of the core swimming style; (2) excel the swimming technique; and (3) individualize and make versatile the swimming techniques.

Results and conclusions. The progress tests found the new harmonized technical and physical fitness model being beneficial as verified by the improved movement hydrodynamics and special physical fitness test data plus good progress in the technical aspects of swimming. The new harmonized technical and physical fitness progress algorithms were found efficient as demonstrated by the subsamples' progress in every technical test. The study data and analyses showed benefits of the new harmonized technical and physical fitness model for application in junior swimming groups – as verified by the fast and higher progress of the EG and formal sport qualifications in the core swimming style based on a sound technical toolkits and special physical qualities building and physical training service to lay a good foundation for progress in the future sports careers.

Keywords: *technical and timing aspects, training cycle, youth crawl swimming, physical qualities, technical and physical fitness, combined training technology, motor skills.*

Background. Competitive progress in modern beginner swimming is known to depend on efficiency of the special training systems with a special priority to the technical progress harmonization in every aspect including the movement coordination qualities with the age- and biological-growth-specific variations in junior swimming sport (A.I. Krylov, E.O. Vinogradov, 2017). Modern training systems are designed to secure fast and harmonic progress in every general and special physical quality to provide for good individual technical and tactical progress for competitive success. It is common knowledge that high competitive progress in junior beginner groups may be achieved by prudent training systems that combine due physical fitness and technical and tactical progress facilitating tools, with a special emphasis on the individualized precompetitive training service.

Objective of the study was to develop and test benefits of a new harmonized technical and physical fitness model (also referred to as the combined training technology) in application to junior (9-10 year old) crawl swimmers.

Methods and structure of the study. A key concept of the new harmonized technical and physical fitness model was to efficiently integrate the technical and physical fitness training elements to facilitate,

on a staged basis, competitive progress in the junior special crawl swimming groups, with three stages of the model designed to (1) master technical basics of the core swimming style; (2) excel the swimming technique; and (3) individualize and make versatile the swimming techniques. The new harmonized technical and physical fitness service was implemented based on the progress facilitating institutional and practical training service provisions to guarantee the training stage specific goals being attained as follows:

Stage 1 goal was to successfully master every technical element conditional on the good prior physical fitness, with elementary technical progresses tested and harmonized with due attention to the individual physical qualities and individual swimming technique specifics.

Stage 2 goal was to further harmonize (keep in synch) the technical and physical progress elements of the training service to secure the techniques being excelled based on sound sport-specific physical qualities, with a special emphasis on the technical efficiency and stroke control and strength elements.

And *Stage 3 goal* was to individualize and secure versatility of the swimming style based on the advanced and focused physical fitness and precompetitive training service. A special priority at this stage was given to the motor skills synchronizing, stability and versatility plus the special speed-strength endurance training elements with the workload stepping on an individualized basis in the precompetitive training periods. This training stage was designed to ensure at least Class II-III qualifications for the junior swimmers.

We sampled for the new harmonized technical and physical fitness model testing experiment the 9-10 year old swimmers (n=33: 18 boys and 15 girls) from the beginner special groups trained at the Olympic Training Center for Swimmers; and split up the sample into Experimental Group (EG) and Reference Group (RG). The RG was trained as required by the standard crawl basics mastering program for sports schools compliant with the valid Federal Sports Training Standard for junior swimming sport.

To effectively test progress in the model testing experiment, we used the test systems yielding numerical test data with variability analyses to keep track of the synchronized technical and physical fitness progress and special physical quality variations. Technical progress was secured by reasonably varied specialized synchronized and combined training tools, with the tests providing reliable feedback data flow on the synchronized technical fitness progress to timely make necessary adjustments to the training service on a reasonably individualized basis.

Results and discussion. The progress tests found the new harmonized technical and physical fitness model being beneficial as verified by the improved movement hydrodynamics and special physical fitness test data plus good progress in the technical aspects of swimming. The new harmonized technical and physical fitness progress algorithms were found efficient as demonstrated by the subsamples' progress in every technical test: see Tables 1, 2.

As demonstrated by the experiment, the general rhythm of movements and stroke cycle structure was tested to improve in the EG, with a special progress in the work phase and preparatory phase times. The progress was achieved by focused technical trainings with special training tools and swimming practices. The swimming rhythm ratios in the EG were tested to grow significantly higher than in the RG – partially due to the RG trainings traditionally focused on a parity of the working phase and preparatory phase in the swimming motor skills. As a result, the EG was tested with a significantly higher stroke strength with more efficient and prolonged movement control.

Progress of the movement hydrodynamics in the EG was secured by a special emphasis on the physical qualities and technical elements harmonizing aspects and efficient stroking kinematics. As a result, the EG demonstrated a special progress in the stroke length, pace control and swimming technique efficiency and effectiveness, with the more rational structure of the swimming cycle. The RG progress in these elements was lower since the traditional training system still gives little attention to the relevant training aspects.

Table 1. *Pre- versus post-experimental technical and physical fitness test data: girls' subgroups*

Tests	EG		RG	
	pre-exp.	post-exp.	pre-exp.	post-exp.
Full stroke cycle, s	1,36±0,10	1,51±0,18	1,34±0,09	1,50±0,08
Work phase time, s	0,68±0,04	0,80±0,07	0,67±0,03	0,80±0,03
Preparatory phase time, s	0,39±0,02	0,30±1,0*	0,37±0,01	0,35±0,03*
Inertial glide time, s	0,27±0,03	0,34±0,5	0,20±0,01	0,29±0,02
Stroke strength rate, points	50,0±1,7	59,7±0,3*	49,1±3,3	56,2±2,4

Note: *$p \leq 0.05$

Table 2. *Pre- versus post-experimental technical and physical fitness test data: boys' subgroups*

Tests	EG		RG	
	pre-exp.	post-exp.	pre-exp.	post-exp.
Full stroke cycle, s	1,36±0,10	1,51±0,18	1,34±0,09	1,53±0,05
Work phase time, s	0,68±0,04	0,80±0,07	0,69±0,03	0,85±0,07
Preparatory phase time, s	0,37±0,02	0,31±1,0	0,37±0,01	0,33±0,02*
Inertial glide time, s	0,27±0,03	0,36±0,5	0,18±0,01	0,29±0,04
Stroke strength rate, points	50,0±3,7	56,9±0,3*	55,1±3,3	55,2±2,4

*Note: *p≤0.05*

The new harmonized technical and physical fitness model testing experiment showed benefits of the new training system that helped efficiently synchronize the technical and physical training elements for the fast technical progress of the junior sample. Success of the new model was interpreted to be due to the special emphasis on the efficient integration of the key technical elements and progress in the key sport-specific physical qualities to facilitate motor skills mastering and further excellence for stability and reasonable versatility of the individual techniques and tactics and, hence, for competitive successes.

Conclusion. The study data and analyses showed benefits of the new harmonized technical and physical fitness model for application in junior swimming groups – as verified by the fast and higher progress of the EG and formal sport qualifications in the core swimming style based on a sound technical toolkits and special physical qualities building and physical training service to lay a good foundation for progress in the future sports careers.

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Dynamics of maximal strength and strength endurance indicators in rhythmic gym-nasts

UDC 796.412

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Abstract

Objective of the study was to profile the maximal strength and strength endurance variations with age in the 6-10 year old female rhythmic gymnasts.

Methods and structure of the study. We made, for the purposes of the study, summaries of the relevant literature and run maximal strength/ strength endurance tests of the 6-10 year old gymnasts' sample (n=99), with the test data processed by the standard mathematical statistics tools, and with the data array variations rated by the Student's t-test.

Results and conclusions. The study data and analyses showed the 8-9 year period being the most sensi-tive for the maximal strength and strength endurance trainings in female rhythmic gymnastics. The right and left carpal strength (right and left carpal strength) were tested to grow in the 9- versus 6-year-olds by 46.0% (4.7 kg) and 40.0% (3.9 kg), respectively. Therefore, the sport community is recommended to give a special priority to the 8-9 year period in the training process. It should also be emphasized that the strength endurance was tested to plateau in the 6-8 year period; that means that rhythmic gymnasts' coaches should make an emphasis on the strength endurance and maximal strength trainings in the most sensitive 8-9 year period.

Keywords: *rhythmic gymnastics, variation, training system, maximal strength, strength endurance, speed strength, coordination skills, tests*

Background. Competitive progress in beginner rhythmic gymnastics is known to depend on the physical fitness [9] on the whole and maximal strength and strength endurance in particular. Rhythmic gymnastics as a high-coordination-intensive sport discipline that gives a special priority to the relevant physical qualities [2, 5, 6]. Youth rhythmic gymnastics is a highly competitive sport and the gymnasts have to fast excel in the movement coordination qualities in every event of the all-around tournaments for success. Modern routines require from the gymnasts demonstrating top movement coordination skills with their perfect timing attained by the optimal, maximal and sub-maximal perfectly controlled efforts. The study was designed to rate the strength endurance and maximal strength versus the routine execution amplitudes, coordination skills, accuracy and artistry with the standard technical and artistry rating scores. Motor skills in the modern rhythmic gymnastics are rather diverse and multisided, with strength qualities ranked among the key competitive success factors [2, 4, 6].

Objective of the study was to profile the maximal strength and strength endurance variations with age in the 6-10 year old female rhythmic gymnasts.

Methods and structure of the study. We made, for the purposes of the study, summaries of the relevant literature and run maximal strength/ strength endurance tests of the 6-10 year old gymnasts' sample (n=99), with the test data processed by the standard mathematical statistics tools, and with the data array variations rated by the Student's t-test.

Results and discussion. Given on Figure 1 hereunder are left/ right carpal strength test data of the sample – that were found to generally grow with age, with the peak achieved at 8-9 years of age. Thus the right carpal strength rates were tested to grow by 15.6% (p <0.001) by 9 years of age, i.e. by 2.9 kg to 13.0 kg versus the 6-year-olds right carpal strength: see Table 1 hereunder.

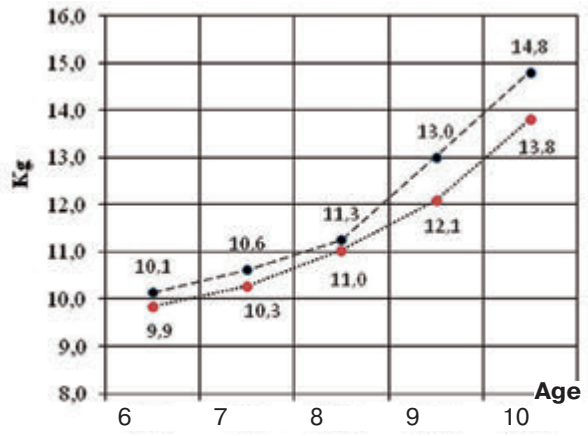

Figure 1. *Carpal strength test rates of the sample: .– – – –. Left carpal strength. . . . . Right carpal strength*

The left carpal strength test rates were found to vary similar to the right carpal strength: see Figure 1, with the 8-9 year-olds tested with progress in both of the tests peaking by 10 years of age. The year-to-year right and left carpal strength growth was estimated to average 115.6% and 109.5% (p <0.001), respectively, with the left carpal strength peak of 13.8 kg achieved by 10 years of age, with a significant (p <0.001) progress versus that of the 9 year-olds. The maximal basic (versus the 6 year-olds') right and left carpal strength growth was estimated at 46.0% (4.7 kg) and 40.0% (3.9 kg) and rated significant (p <0.001). Given on Figure 2 are the strength endurance (straight leg lifts on a gymnastic wall) test data.

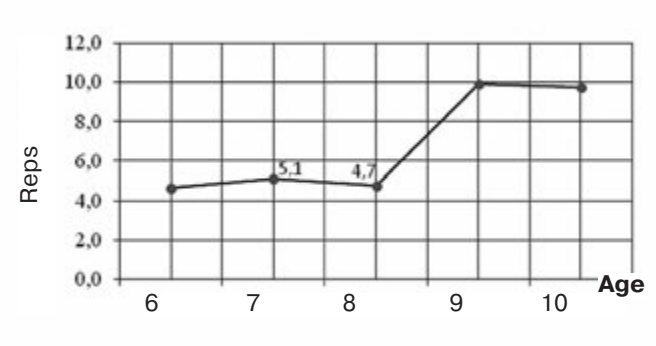

Figure 2. *Strength endurance test data (straight leg lifts on a gymnastic wall test) of the sample*

The strength endurance test rates were found to smoothly grow in the 6-7 year period from 4.6 to 5.1 times; followed by a sag to 4.7 times by 8 years of age, with this timely regress then followed by a sharp and almost twofold growth from 4.7 to 9.9 times in the 8-9 year period; and virtually no progress (plateau) in the 9-10 year period: see Figure 2. Therefore, the strength endurance was tested to fast progress in the 8-9 year period, with the absolute basic significant (p <0.001) growth averaging 5 times.

Conclusion. The study data and analyses showed the 8-9 year period being the most sensitive for the maximal strength and strength endurance trainings in female rhythmic gymnastics. The right and left carpal strength (right and left carpal strength) were tested to grow in the 9- versus 6-year-olds by 46.0% (4.7 kg) and 40.0% (3.9 kg), respectively. Therefore, the sport community is recommended to give a special priority to the 8-9 year period in the training process. It should also be emphasized that the strength endurance was tested to plateau in the 6-8 year period; that means that rhythmic gymnasts' coaches should make an emphasis on the strength endurance and maximal strength trainings in the most sensitive 8-9 year period.

Table 1. *Right carpal strength test rates of the sample, kg*

Age	Rank	Absolute basic growth	Absolute relevant growth	Basic growth rate, %	Relevant growth rate, %	Basic growth, %	Relevant growth, %	p
6	10,1							
7	10,6	0,5	0,5	104,8	104,8	4,8	4,8	> 0,05
8	11,3	1,1	0,6	110,9	105,9	10,9	5,9	< 0,05
9	13,0	2,9	1,8	128,3	115,7	28,3	15,7	< 0,001
10	14,8	4,7	1,8	146,0	113,8	46,0	13,8	< 0,001
Average			1,2		110,0		10,0	

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New mental conditioning models for curling sport elite

UDC 796:092

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Abstract

Objective of the study was to test benefits of two new mental conditioning models for the curling sport elite.

Methods and structure of the study. The authors sampled for the first mental conditioning model testing Experiment 1 (run in autumn of 2019) the 18-21 year old elite (qualified CMS and MS) curlers (n=12) and used pre-experimental self-confidence/ self-esteem tests to split up the sample into Experimental and Reference Groups (EG, RG), with the EG composed of the athletes tested with lower self-confidence. The EG was trained using the "Correction" Mental Conditioning Module of the "Module Compact" Training System designed by the Instrumental Psychological Systems Ltd.. The EG was trained for 14 days to test benefits of the new rhythmic-suggestive correction model – for the first time in application to elite curlers; whilst the RG mental conditioning service was traditional, with every athlete offered four individual 45-minute consulting sessions with a sport psychologist for 2 weeks.

Results and conclusions. Both mental conditioning models were tested fairly beneficial for application in the curling sport elite trainings. The Rhythmic-Suggestive Correction model was tested to improve the group self-esteem test rates by 18.7% in the EG versus 7.3% in the RG. And the Key Decisions Therapy mental conditioning model was tested to improve the wellbeing, activity and mood self-rates of the EG even in the period of the high-intensity physical sport-unspecific trainings, with the autonomic activity ratios found indicative of good fitness for high competitive energy costs.

Keywords: *curling sport, mental fitness, mental conditioning techniques, rhythmic-suggestive correction model, Key Decisions Therapy model, autonomic activity ratio.*

Background. Modern curling sport is unique among other team sports in the sense that every stone shooting action and competitive success on the whole highly depends on every team member's skills and fitness and quality of the teamwork on the whole with its mutual trust, understanding and support [2]. As things now stand, however, the sport community still reports the need for special research to develop efficient mental conditioning methods, models and tools.

Objective of the study was to test benefits of two new mental conditioning models for the curling sport elite.

Methods and structure of the study. The study was run under the Modern Training Systems for Olympic Sports (with Curling Case Study) Research Project approved by the Ministry of Sports Order No. 1034 of 12.14.2018 "On approving a thematic plan for special research in the physical education and sports sector to set missions for the research organizations and higher educational institutions reporting to the Ministry of Sports of the Russian Federation for 2019-2021".

We sampled for the first mental conditioning model testing Experiment 1 (run in autumn of 2019) the 18-21 year old elite (qualified CMS and MS) curlers (n=12) and used pre-experimental self-confidence/ self-esteem tests to split up the sample into Experimental and Reference Groups (EG, RG), with the EG

composed of the athletes tested with lower self-confidence. The EG was trained using the "Correction" Mental Conditioning Module of the "Module Compact" Training System designed by the Instrumental Psychological Systems Ltd. [3]. The EG was trained for 14 days to test benefits of the new rhythmic-suggestive correction model – for the first time in application to elite curlers; whilst the RG mental conditioning service was traditional, with every athlete offered four individual 45-minute consulting sessions with a sport psychologist for 2 weeks.

Experiment 2 was designed to test benefits of the Mental Diagnostics and Conditioning Model by M. K. Efanova (patent RU 2 645 406 C1 dated 02.21.2018). We sampled for Experiment 2 the 19-36 year old elite (qualified CMS and MS) curlers (n=14). The Key Decisions Therapy mental conditioning session was run only once on an individual basis, with the experiment timed to the preparatory period of the annual training cycle (July-August 2019); with the sample progress rated by the standard WAM tests and autonomic activity rating Luscher test adapted by K. Shiposha [4].

Results and discussion. The pre- versus post-experimental self-confidence test data of the EG and RG yielded by the rhythmic-suggestive correction model testing Experiment 1 are given in Table 1 hereunder.

Table 1. *Pre- versus post-experimental self-confidence test data of the sample (n=12): rhythmic-suggestive correction model testing Experiment 1, points*

№	Group	Pre-experimental	Post-experimental
1	CG	18	19
2		14	16
3		16	17
4		14	16
5		17	18
6		20	20
X ± m		16,5 ± 2,3	17,7 ± 1,6
1	EG	16	18
2		14	17
3		15	18
4		14	19
5		14	16
6		17	19
X ± m		15,0 ± 1,3	17,8 ± 1,2

As demonstrated by the above Table, the post-experimental self-esteem/ self-confidence test rates were virtually the same in both of the groups. Both mental conditioning methods, as far as the average values are concerned, were tested beneficial and may be recommended for practical application. Note that the EG was pre-tested with 10% lower self-esteem on average than the RG: thus in RG three athletes were ranked with the highest self-confidence and decision-making category versus only one in the EG. The post-experimental tests of the RG found no variation in the top-three self-confidence rates, whilst every EG individual was tested with good progress, with 4 athletes ranked with the high-self-esteem category.

Experiment 1 was finalized by a qualifying competition for places in the youth national team of the Russian Federation. Both groups joined the tournament to compete with the non-sampled peer teams; and the tournament was won by the EG members. This competitive success gives us good grounds to believe that the new rhythmic-suggestive correction model is highly beneficial for application in the precompetitive training systems of the curling sport elite.

Experiment 2 was run to test benefits of the new Key Decisions Therapy model [1] for elite curlers: see the test data hereunder on Figures 1 and 2. The Key Decisions Therapy model was used in the general physical fitness period of an annual training cycle with high-intensity cyclic workloads unspecific for competitive curling sport – and, hence, exposing the athletes to potential risks of functional disorders and distresses. Nevertheless, the test data were indicative of a high positive impact of the single Key Decisions Therapy session.

Note that Key Decisions Therapy model tests found no mental conditioning regress in the sample, with a special progress tested on the Mood scale – that is rather unusual for the draining monotonous high-intensity training period in the annual training cycle. Despite the high sport-unspecific physical trainings, the sample was tested immune to usual pre-pathological conditions due to the Key Decisions Therapy model. The elite sample was tested with a notable growth of the sympathetic tone in the autonomic nervous system and, hence, better fitness for high energy costs. At the same time, the relatively moderate autonomic activity ratios may be interpreted as indicative of an optimal mobilization levels and reasonably balanced/ healthy competitive fitness different from an unhealthy prestart fever. These findings demonstrate benefits of the Key Decisions Therapy model for the precompetitive mental conditioning service to curling sport elite.

Conclusion. Both mental conditioning models were tested fairly beneficial for application in the curling sport elite trainings. The Rhythmic-Suggestive Correction model was tested to improve the group self-esteem test rates by 18.7% in the EG versus 7.3% in the RG. And the Key Decisions Therapy mental conditioning model was tested to improve the wellbeing, activity and mood self-rates of the EG even in the period of the high-intensity physical sport-unspecific

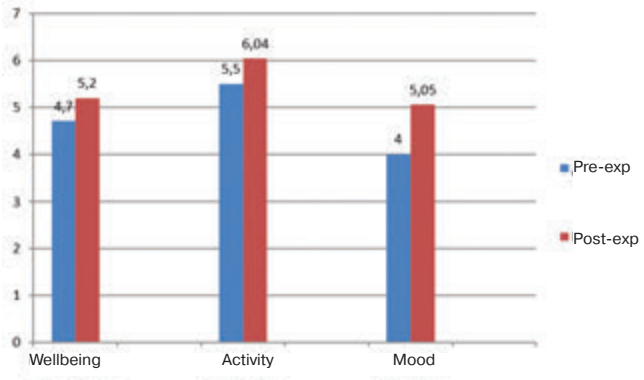

Figure 1. *Pre-versus post-experimental WAM test data of the sample (n=14): Key Decisions Therapy model timed to preparatory physical fitness period in the annual training cycle*

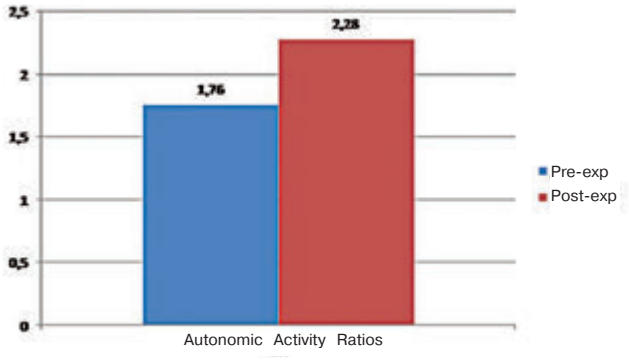

Figure 2. *Pre-versus post-experimental autonomic activity ratios of the sample (n=14): Key Decisions Therapy session timed to the preparatory physical fitness period of the annual training cycle*

trainings, with the *autonomic* activity ratios found indicative of good fitness for high competitive energy costs.

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Psychophysiological characteristics of college students with different motor modes

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Abstract

Objective of the study was to assess the psychophysiological characteristics of students with different levels of motor activity and identify changes in the most important health indicators.

Methods and structure of the study. The study involved the 16-18 year-old students with different motor activity modes. The following psychophysiological characteristics were assessed: vital capacity measured in liters by an air spirometer; heart rate, arterial blood and pulse pressure measured at rest using a semi-automatic OMRONM1 Compact tonometer; simple and complex visual-motor reaction, simple auditory-motor reaction; the tapping test was run using the hardware-software complex "Sports Psychophysiologist". All measurements were taken in view of the circadian and circaseptan biorhythms.

The outcome test data were processed using the variation statistics method in accordance with the principles set out in V.B. Korenberg's manual (2008).

Results and conclusions. The findings showed that additional physical loads have a positive effect on most parameters reflecting the activity of the main functional systems of the student's body. Moreover, the greatest differences were observed in the vital capacity and sensorimotor response rates.

Keywords: *psychophysiological characteristics, motor mode, health, sensorimotor response.*

Background. There is currently an increase in the number of students suffering from a wide range of chronic diseases. The major cause of poor health of children and young people is the underestimation of a healthy lifestyle in its importance for the development of physical and spiritual health, character education.

Additional physical training activities can be viewed as a way to systematically reduce the the negative impact of adaptation to new conditions associated with intense learning activities of students [3, 4].

Objective of the present study was to assess the psychophysiological characteristics of students with different levels of motor activity and identify changes in the most important health indicators.

Methods and structure of the study. The study involved apparently healthy male students of the Russian International Academy for Tourism (aged 16-18 years), who were divided into three groups: Group 1 – students not engaged in a certain kind of physical training and sports activities in addition to the compulsory physical education classes, with the volume of motor activity of 2 hours per week (n=28); Group 2 – students engaged in recreational physical education practices in addition to the compulsory physical education classes, with the volume of motor activity of 6 hours per week (n=32); Group 3 – students engaged in professional sports in sports schools in addition to the compulsory physical education classes, with the volume of motor activity of 8 hours per week (n=22).

Table 1. *Cardiorespiratory system functionality rates in students with different levels of motor activity*

Parameters	Non-sporting students	Students engaged in recreational physical education practices	Student athletes	p_1	p_2	p_3
Heart rate, bpm	92.28±2.84	81.45±3.43	76.17±1.90	<0.05	>0.05	<0.001
Systolic blood pressure, mmHg	126.69±4.66	118.32±4.01	111.41±2.89	>0.05	<0.01	<0.01
Diastolic blood pressure, mmHg	84.28±1.87	79.41±2.29	72.71±1.80	>0.05	<0.01	<0.01
Pulse rate, mmHg	34.28±0.95	40.12±1.24	41.44±1.14	>0.5	>0.5	>0.05
Vital capacity, l	3.28±0.10	4.86±0.17	5.47±0.15	<0.01	<0.001	<0.05

Note. p_1 – significance of differences in the average values between the students engaged and not engaged in additional physical training and sports activities; p_2 – significance of differences in the average values between the student athletes and those not engaged in additional physical training and sports activities; p_3 – significance of differences in the average values between the student athletes and those engaged in additional physical training and sports activities.

The following psychophysiological characteristics were assessed in the 16-18 year-old male students: vital capacity measured in liters by an air spirometer; heart rate, blood and pulse pressure measured at rest using a semi-automatic OMRONM1 Compact tonometer; simple and complex visual-motor reaction, simple auditory-motor reaction; the tapping test was run using the hardware-software complex "Sports Psychophysiologist" [1]. All measurements were taken in view of the circadian and circaseptan biorhythms.

The outcome test data were processed using the variation statistics method in accordance with the principles set out in V.B. Korenberg's manual (2008).

Results and conclusions. The analysis of the subjects' heart rate (HR), systolic (SBP) and diastolic blood pressure (DBP) rates revealed that these rates were higher in the students with a lower level of motor activity than in those engaged in additional physical training and sports activities (see Table 1). Nevertheless, there were statistically significant differences in the HR values between the non-sporting students and students of the other two groups. In terms of blood pressure, there was a significant decrease in the rates (within the normal range) in the group of student athletes. There were no significant differences in the pulse rate (PR) values.

However, the students engaged in the recreational physical education practices in addition to the compulsory physical education classes had the high VC rates and HR and BP rate within the normal range. The decrease in the HR and BP rate in the group of student athletes indicated the economization of the circulatory system. At the same time, the student athletes were found to have the high external respiration rates. All of this testifies to the improvement of the pulmonary function in the students engaged in the recreational physical education practices and professional sports.

The central nervous system (CNS) plays a leading role in the processes of bodily adaptation to the ever-changing environmental conditions. As shown in Fig. 1, the time of the complex sensorimotor response to light in the students of all the study groups exceeded the time of the simple visual-motor reaction. This was due to the differentiation of the signal, i.e. the increase in the response time needed to recall how exactly to respond to a signal. Signal differentiation is the difference between the simple and complex sensorimotor response time, and the weaker the nervous system the greater its time. In our study, the time taken to differentiate the signal was 191.43 ms in the students not engaged in additional physical training and sports activities, 88.39 ms in those engaged in recreational physical education practices, and 26.85 ms in the students engaged in professional sports. That is, the more intense the physical loads and the greater the volume of motor activity, the more advanced and stronger the nervous system becomes. There was also a statistically significant increase in the time of the simple sensorimotor response to sound and light in the students with the lowest level of motor activity compared to the students of the other two groups.

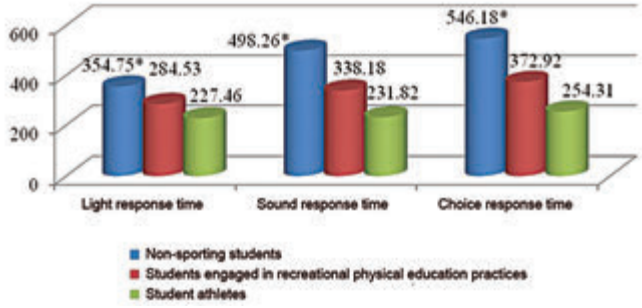

Fig. 1. *Sensorimotor response time in students with different levels of motor activity (*-p<0.01), ms*

The tapping test used to determine the maximum hand movement rate revealed not only the movement rate per unit of time but also the typological features of the nervous system. Figures 1 and 2 illustrate the dynamics of changes in the hand movement rate per 1 minute in the student athletes. The convex type of the curve indicates a strong nervous system [2]. The test rates in the students who were engaged in additional recreational physical education practices were identical throughout the entire testing period, and only by the end of testing there, was a reduction in the hand movement rate, which indicates a flat (normal) type of the nervous system. The students not engaged in additional physical training and sports activities were found to have a descending (weak) type of the nervous system. The total number of hand movements in the student athletes was significantly higher than that in the other two groups ($p<0.01$). At the same time, the hand movement rate per unit of time in the students not engaged in additional physical training and sports activities was the lowest as opposed to the average hand movement rate per 1 minute in the students engaged in recreational physical education practices.

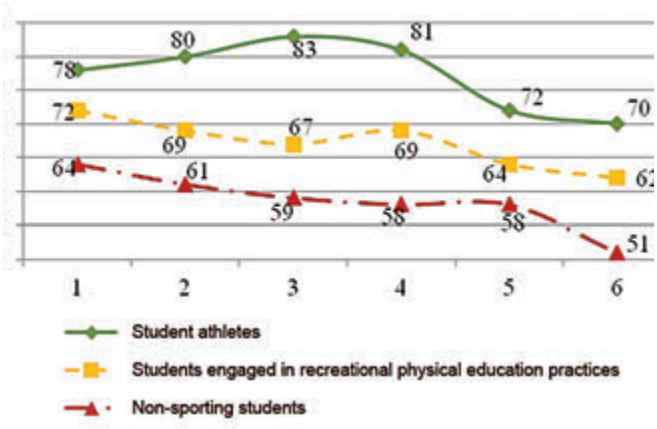

Fig. 2. *Tapping test rates in students with different levels of motor activity (at six 10-second intervals), number of taps*

Conclusions. Additional physical loads have a positive effect on most parameters reflecting the activity of the main functional systems of the student's body. Moreover, the greatest differences were observed in the vital capacity and sensorimotor response rates.

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Factors of emotional burnout in work of rhythmic gymnastics coaches

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Abstract

Objective of the study was to profile and analyze the emotional burnout in the national rhythmic gymnastics coaching community.

Methods and structure of the study. We used for the purposes of the study the following methods: WAM (wellbeing, activity, mood) self-test system adapted by V.A. Doskin et al.; Maslach Burnout Inventory (MBI) adapted by N.E. Vodopyanova [1]; and our own Emotional Burnout Profiling Questionnaire Survey in application to the rhythmic gymnastics coaches. We sampled for the survey (run in February 2020) rhythmic gymnastics coaches from St. Petersburg and Penza cities (n=28, with 23 covered by every questionnaire survey method) and split up the sample into Group 1 (n=10) and Group 2 (n=13) with the coaching experiences under and over 10 years, respectively.

Results of the study and conclusions. The study found the rhythmic gymnastics coaches highly exposed to many emotional burnout triggers including not only the occupational ones but also those related to communication with the trainees' families including family pressures in non-business hours. These and other emotional burnout triggers were found to result in early emotional burnouts in the rhythmic gymnastics coaching community with many relevant negative consequences including professional regresses.

Keywords: *emotional burnout, rhythmic gymnastics, coach.*

Background. Emotional burnout defined as a result of multiannual job-related stressors and interpersonal tensions, is also often referred to as the occupational burnout [3, 4]. Emotional burnout and related issues has long been subject for research in sport psychology although such studies are traditionally focused on athletes rather than coaches [2, 5], with a special priority to the emotional burnout forecast, diagnostics, control and mitigation/ prevention issues.

Objective of the study was to profile and analyze the emotional burnout in the national rhythmic gymnastics coaching community.

Methods and structure of the study. We used for the purposes of the study the following methods: WAM (wellbeing, activity, mood) self-test system adapted by V.A. Doskin et al.; Maslach Burnout Inventory (MBI) adapted by N.E. Vodopyanova [1]; and our own Emotional Burnout Profiling Questionnaire Survey in application to the rhythmic gymnastics coaches. We sampled for the survey (run in February 2020) rhythmic gymnastics coaches from St. Petersburg and Penza cities (n=28, with 23 covered by every questionnaire survey method) and split up the sample into Group 1 (n=10) and Group 2 (n=13) with the coaching experiences under and over 10 years, respectively.

Results and discussion. WAM test rated the Wellbeing and Mood of the sample below 4 points – indicative of a certain psychological stress; and Activity above 4 points albeit still below the 5 to 5.5 point norm, with the intergroup differences found insignificant ($p > 0.05$).

Table 1. *Group WAM and MBI test data*

Test scale	Group 1 (10-minus years of coaching experience), n=10	Group 2(10-plus years of coaching experience), n=10	Criterion	p
Wellbeing	3,22±1	2,62±0,79	$U_{Эмп}$ = 39	>0,05
Activity	4,21±0,45	4,04±0,5	$U_{Эмп}$ = 54.5	>0,05
Mood	2,47±0,68	2,4±0,84	$U_{Эмп}$ = 54	>0,05
Emotional Exhaustion	25,2±6,46	20,07±4,71	$U_{Эмп}$ = 35	<0,05
Depersonalization	10,8±4,56	7,38±4,07	$U_{Эмп}$ = 38.5	>0,05
Professional success	36,8±3,79	39,23±4,16	$U_{Эмп}$ = 42	>0,05

The MBI tests rated both groups moderate on the Emotional Exhaustion and Depersonalization scales and low on the Professional Success scale – that is indicative of a moderate emotional burnout; with a statistically significant intergroup difference ($p < 0.05$) detected only on the Emotional Exhaustion scale: see Table 1 hereunder.

The test data show that the rhythmic gymnastics coaching service exposes the coaches to emotional burnout and the relevant mental issues. The sample emotional burnout was tested in need of further special detailed survey. We used for this purpose our own Emotional Burnout Profiling Questionnaire Survey form: see the survey data visualized on Figures hereunder. Figure 1 gives a weekly workload analysis – it showed most of the sample (71%) reporting more than one job, and 54% reporting overtimes.

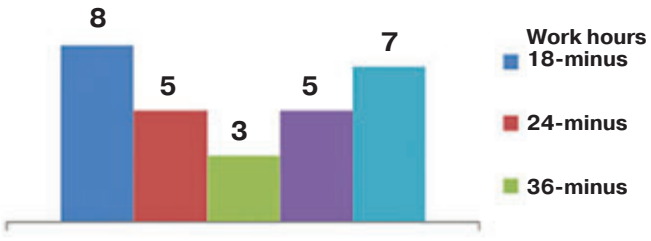

Figure 1. *Weekly workload analysis of the rhythmic gymnastics coaching sample, n=28*

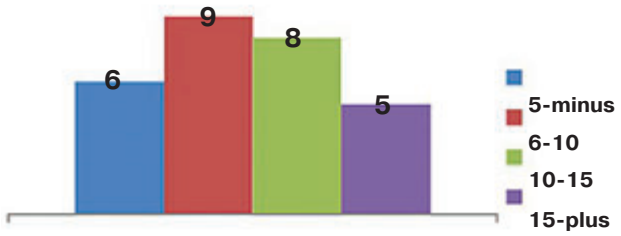

Figure 2. *Competitions per year reported by the sample, n=28*

Furthermore, the questionnaire survey found only 29% having extra sources of income and, therefore, having to work overtime.

46% of the sample reported their trainees competing 10-plus times per year (Figure 2) – that means that they are exposed to competitive stressors virtually every month, if the precompetitive summer training cycles are taken into account. No wonder that the competitive stressors undermine their mental health standards sooner or later.

Note that the present rules and traditions require from the rhythmic gymnastics coaches to provide a refereeing service in the competitions or delegate their refereeing authorities, otherwise they are fined. For the refereeing service, the coaches are expected to obtain and renew the relevant certificates at their own financial and time costs. Thus the Class II referees need to be recertified at least once a year due to the multiple updates to the rhythmic gymnastics rules of refereeing in the Russian Federation. It is not unusual for the modern rhythmic gymnastics competitions to last very long. Thus 32% of the sample reported the competitions averaging 6-10 hours, and 36% reported 10-plus hours of refereeing service on the competitive days.

Moreover, the refereeing stressors are further complicated by the need to coach own trainees during the events. Such draining, stressful and highly emotional work days cannot but expose the coaches to a wide range of physical, mental and physiological disorders.

The coaching service is further stressed by the potential tension with the trainees' families. The family contacts and climate are known to heavily influence the modern rhythmic gymnastics coaching service and competitive progresses of the trainees, despite the fact that they remain invisible and uncontrolled by the training and competitive systems. The survey found 54% reporting some kind of pressure from the families; 61% being in conflicts with the families; and

79% complaining that families use to bother them in non-business time.

Conclusion. The study found the rhythmic gymnastics coaches highly exposed to many emotional burnout triggers including not only the occupational ones but also those related to communication with the trainees' families including family pressures in non-business hours. These and other emotional burnout triggers were found to result in early emotional burnouts in the rhythmic gymnastics coaching community with many relevant negative consequences including professional regresses.

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‘Psycho-emotional booster’ kinesiological module: benefits for psychomotor fitness of 11-13-year-old racing skiers

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Abstract

Objective of the study was to rate and analyze benefits of a new ‘Psycho-emotional booster’ kinesiological module training system to improve psychomotor fitness of the 11-13 year old cross-country racing skiers.

Methods and structure of the study. The study was run at Children and Youth Sport Schools (CYSS) #1 in Tomsk Oblast. We sampled for the study the 11-13 year old male racing skiers (n=40) and split them up into Experimental and Reference Groups (EG, RG) of 20 people each. We used the following research methods: analyses of the theoretical and practical literature on the subject; psychomotor fitness tests using a "Sports Psychophysiologist" Computerized Test System with the following tests: hand response to visual signal; response to auditory signal; hand tapping test; and the flashing frequency limit test; plus an educational experiment; and a standard mathematical data processing statistical toolkit.

Results of the study and conclusions. The new ‘Psycho-emotional booster’ kinesiological module training system testing experiment was found beneficial for the 11-13 year old racing skiers’ trainings as verified by the significant progress of the EG versus RG in the psychomotor fitness test rates and competitive events for the test period. It gives us good ground to recommend the new ‘Psycho-emotional booster’ kinesiological module training system for application in other sports for the stress tolerance, psychomotor fitness progress and competitive performance improvement purposes.

Keywords: *kinesiological module, psychomotor fitness, ski race, theoretical and practical trainings.*

Background. Modern ski racing sport is getting increasingly competitive with the fast progress in the skiing styles, equipment, accessories and services. The skiing elite has to intensify the training systems and, hence, revise requirements to the individual kinesiological resource profiled by the relevant psychomotor performance test rates. Experts underline the growing need for excellent psychomotor fitness for competitive success [1, 2, 5, 6, 10]; and this is the reason why the national sport community gives a special priority to the new psychomotor fitness methods and tools and their benefits for the nervous system performance, stress tolerance, resource mobilizing under pressure, prestart fever control etc. for individual competitive progress [3, 4, 8, 9].

Objective of the study was to rate and analyze benefits of a new ‘Psycho-emotional booster’ kinesiological module training system to improve psychomotor fitness of the 11-13 year old cross-country racing skiers.

Methods and structure of the study. The study was run at Children and Youth Sport Schools (CYSS) #1 in Tomsk Oblast. We sampled for the study the 11-13 year old male racing skiers (n=40) and split them up into Experimental and Reference Groups (EG, RG) of 20 people each. We used the following research methods: analyses of the theoretical and practical literature on the subject; psychomotor fitness tests using a “Sports Psychophysiologist” Computerized Test Sys-

tem with the following tests: hand response to visual signal; response to auditory signal; hand tapping test; and the flashing frequency limit test; plus an educational experiment; and a standard mathematical data processing statistical toolkit.

Results and discussion. We developed the 'Psycho-emotional booster' kinesiological module training system with the combined training tools to improve the mental controls, psychomotor fitness and resource mobilizing skills of the sample: see Table 1.

To EG and RG training microcycles were designed to simulate the competitive workloads with the relevant psychomotor fitness support, rehabilitation and improvement tools. Both groups were trained up to 2 hours 4 times a week using the even, interval, repetitive and competitive training formats. The training model testing experiment took 1 year. Given in Table 2 hereunder are the EG versus RG training systems.

Given in Table 3 hereunder are the EG versus RG progress test rates.

The above data analysis shows the EG making significant progress in every test versus the RG – that may be interpreted as indicative of the practical benefits of the new 'Psycho-emotional booster' kinesiological module training system. We also classified the EG and RG into the high, moderate and low psychomotor fitness progress subgroups – as recommended by the "Sports Psychophysiologist" Computerized Test System developers [7]. The classification showed the EG making a good progress as its high psychomotor fitness subgroup had grown from 20% to 60% for the test period. The moderate and low-progress subgroups in the EG were tested to stand at 30% and drop from 50% to 10%, respectively.

The high psychomotor fitness subgroup in the RG was tested to stay unvaried at 25%, with the moderate and low progress subgroups in the RG tested to grow from 25% to 30% and fall from 50% to 45% for the test period, respectively. It should also be mentioned that the EG made a good competitive progress in the municipal/ regional competitions – versus no progress in the RG.

Conclusion. The new 'Psycho-emotional booster' kinesiological module training system testing experiment was found beneficial for the 11-13 year old racing skiers' trainings as verified by the significant progress of the EG versus RG in the psychomotor fitness test rates and competitive events for the test period. It gives us good ground to recommend the new 'Psycho-emotional booster' kinesiological module training system for application in other sports for the stress tolerance, psychomotor fitness progress and competitive performance improvement purposes.

Table 1. *Elements of the new 'Psycho-emotional booster' kinesiological module training system*

Practices	Description	Note
Prone to jumps	Trainee will jump from a prone position with straight arms tight to the sides in response to an auditory signal (whistle, clap, etc.)	15 reps
Recumbent to jumps	Trainee will jump from a recumbent position with arms tight to the sides as soon as possible in response to a visual signal	15 reps
Front rushes on the move	Trainee will stand with the straight arms tight to the sides, and rush to a mark on a visual right/ left signal and come back as soon as possible – to immediately respond to a new signal. The right/ left run distances are the same (3/5 m)	3 right reps, 3 left reps
Back forward rushes on the move	Trainee will stand back to the run track with the straight arms tight to the sides, rush to a mark on a visual right/ left signal and come back as soon as possible – to immediately respond to a new signal. The right/ left run distances are the same (3/5 m)	3 right reps, 3 left reps

Table 2. *EG versus RG training systems*

Training element	Time	RG	EG
Pre-training warm-up	30 min	Even aerobic skiing, general physical progress exercises, runs, gym practices	'Psycho-emotional booster' exercises followed by even skiing; 'Psycho-emotional booster' exercises followed by the core training part
Precompetitive warm-up	30 min	general physical progress exercises, relaxed skiing	'Psycho-emotional booster' exercises followed by even skiing

Table 3. *Pre- versus post-experimental psychomotor fitness test data of the sample*

Test	Test stage	EG (n=20)	RG (n=20)	p
		$\overline{X} \pm \sigma$	$\overline{X} \pm \sigma$	
Response to visual signal, s	Pre-exp.	0,37±0,07	0,35±0,04	> 0,05
	Post-exp.	0,22±0,09	0,37± 0,08	< 0,05
	p	0,04	0,8	
Response time, s	Pre-exp.	0,461±0,075	0,459±0,085	> 0,05
	Post-exp.	0,323±0,040	0,421±0,055	< 0,05
	p	0,04	0,4	
Visual signal time, s	Pre-exp.	3,8±0,7	4,3±0,5	> 0,05
	Post-exp.	2,4±0,5	4,4±0,3	< 0,05
	p	0,03	0,6	
Auditory signal time, s	Pre-exp.	7,8±0,6	7,6±0,4	> 0,05
	Post-exp.	3,8±0,7	6,4±0,6	< 0,05
	p	0,01	0,6	
Tapping test, taps per min	Pre-exp.	52,3±7,5	48,5±8,7	> 0,05
	Post-exp.	62,3±8,6	55,59±10,2	< 0,05
	p	0,03	0,04	
Flash frequency limit test, s	Pre-exp.	24,2±6,4	25,6±5,2	> 0,05
	Post-exp.	18,3±4,2	26,6±4,6	< 0,05
	p	0,02	0,5	
Flash distinguishing frequency, s	Pre-exp.	32,5±5,3	30,6±4,8	> 0,05
	Post-exp.	21,3±2,4	30,2±4,5	< 0,05
	p	0,03	0,5	

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Sport orienteering practices and their impact on cognitive mental processes in students

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Abstract

Objective of the study was to analyze benefits of a new academic orienteering sport model for progress in the ACMT (attention control, memorizing and thinking) skills.

Methods and structure of the study. We used for the purposes of the study the following research methods: analyses of the theoretical and practical literature on the subject; ACMT skill tests [1, 6, 7] in the new orienteering sport model testing academic experiment; academic progress surveys; and standard mathematical statistics tools for the test data processing. The study was run in September through December 2019 at the National Research Tomsk State University. We sampled the 18-21 year old males (n=18) and split them up into Experimental and Reference Groups (EG, RG) of 9 people each. The EG standard physical training system was complemented by the new orienteering sport model of our design; and the RG trainings were dominated by traditional bodybuilding practices with physical progress tests. Both groups were trained twice a week for 90 minutes, with the practical trainings complemented by the standard theoretical physical education and sports classes.

Results and conclusions. The study data and analyses showed the new orienteering sport model being beneficial for the ACMT (attention control, memorizing and thinking) skills of the sample, with particularly significant progress found in the attention control and memorizing skills tests. Therefore, the new orienteering sport model may be recommended as complementary to the standard academic physical education and sports curricula for its proven psychophysical progress benefits and growing popularity in the young people's communities.

Keywords: *physical education and sports, orienteering sport, cognitive progress, students.*

Background. Lately the national academic physical education community has given a growing priority to the studies to offer new physical education and sports toolkits to both to promote physical activity among students and facilitate their intellectual progress. Of special promise in this potential toolkit is the modern orienteering sport that is getting increasingly popular the world over including Russia – with its popular mass sports events such as the annual "Rossiyskiy Azimut" (English: Russian Azimuth) tournament for different age groups. The sport discipline is particularly appreciated for its sport-specific physical fitness standards and ACMT (attention control, memorizing and thinking) qualities needed for competitive success. An orienteering sport competitor needs to be highly skilled in map reading, practical orienteering in different terrains, competitive anticipations and responses, attention control and memorizing qualities to fix and use every landmark in competitions and in the performance analysis thereafter. In addition, he/she shall have a good stress tolerance as the competitive performance is always affected by many stressors including weather conditions, pressures from rivals and spectators, difficult terrains, unexpected problems on the run, etc. [3-5, 8]. We believe, therefore, that the modern orienteering sport may be highly

beneficial both for the special academic orienteering sport groups and as a complementary discipline for the standard academic physical education and sports curricula to facilitate and harmonize the students' physical and intellectual progress [2].

Objective of the study was to analyze benefits of a new academic orienteering sport model for progress in the ACMT (attention control, memorizing and thinking) skills.

Methods and structure of the study. We used for the purposes of the study the following research methods: analyses of the theoretical and practical literature on the subject; ACMT skill tests [1, 6, 7] in the new orienteering sport model testing academic experiment; academic progress surveys; and standard mathematical statistics tools for the test data processing. The study was run in September through December 2019 at the National Research Tomsk State University. We sampled the 18-21 year old males (n=18) and split them up into Experimental and Reference Groups (EG, RG) of 9 people each. The EG standard physical training system was complemented by the new orienteering sport model of our design; and the RG trainings were dominated by traditional bodybuilding practices with physical progress tests. Both groups were trained twice a week for 90 minutes, with the practical trainings complemented by the standard theoretical physical education and sports classes.

Results and discussion. The EG theoretical and practical trainings included both the physical and ACMT progress facilitation practices in classes and outdoors, including, e.g., the following practices [8-10].

1. Cut the map into squares or triangles and give a few to every competitor to reassemble them, with a few difficulty stepping options. Prior to the test, the competitors are given a look at the uncut map to later on mobilize their attention and memory for the reassembling exercise.

2. Two identical maps are cut into 5x5cm pieces, with the pieces turned over, shuffled up like in the pexeso game to form a rectangular mix. The competitors will then open up two pieces at a time and remove them if they are identical, otherwise put them back. This practice is geared to develop the short-term and figurative memory and attention.

3. "Shifters" practice implies an orienteering map for ski races being cut to make 10 segments indicating two points and the connecting thread in between. The segments will then be glued to the back of the map. The competitors will memorize the check points 1 and 2 and the connecting thread, to find them on the front side, with the performance checked by matching when allowed. The practice is geared to improve figurative memory and attention.

4. Objects-finding on the map, with the competitors checking every object found (non-scaled objects, pits, bumps, etc.) under time pressure. The practice is designed to improve attention.

Given in Table 1 hereunder are the ACMT progress test data of the sample.

As demonstrated by the above test data, EG was tested with a significant progress versus RG in the attention control and memorizing skills tests; with both groups tested with significantly different progress on the thinking skills scale ($p > 0.05$).

Conclusion. The study data and analyses showed the new orienteering sport model being beneficial for the ACMT (attention control, memorizing and thinking) skills of the sample, with particularly significant progress found in the attention control and memorizing skills tests. Therefore, the new orienteering sport model may be recommended as complementary to the standard academic physical education and sports curricula for its proven psychophysical progress benefits and growing popularity in the young people's communities.

Table 1. *Pre- versus post-experimental ACMT test data of the EG (n=9) and RG (n=9)*

Tests	Test stage	EG			RG			p
		$\overline{X}$	±	σ	$\overline{X}$	±	σ	
Attention control, s	Pre-exp.	36,0	±	5,36	36,1	±	3,22	>0,05
	Post-exp.	31,8	±	3,29	34,0	±	6,42	< 0,05
	p	p < 0,05			p>0,05			
Memorizing, count	Pre-exp.	5,0	±	1,12	5,1	±	1,11	>0,05
	Post-exp.	7,0	±	1,58	5,2	±	1,42	< 0,05
	p	p < 0,05			p>0,05			
Thinking, errors	Pre-exp.	9,0	±	4,58	8,0	±	1,58	>0,05
	Post-exp.	8,0	±	1,58	8,1	±	1,42	>0,05
	p	p>0,05			p>0,05			

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Pre-season mental conditioning model for 8-9 year-old tennis players

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Abstract

Objective of the study was to theoretically substantiate and test practical benefits of a new pre-season mental conditioning model for the 8-9 year old tennis players.

Methods and structure of the study. We sampled the 8-9 year old trainees of the Siberian Tennis Center (n=20) for the mental conditioning model testing experiment and split them up into Experimental and Reference Groups (EG, RG). The EG training was complemented by theoretical and practical mental conditioning model of our design; and RG was trained in the traditional system with standard mental conditioning elements. The experimental mental conditioning model included 18 hours of lectures and practices in the following subjects: performance visualizing techniques; pre-season behavioral control; relaxing and activating techniques; positive controlled thinking during matches; competitive mental fitness; and target mental qualities [1, 3]. The group mental fitness was tested by the pre- and post-experimental tests. Note that the intergroup differences of the pre-experimental test data were insignificant ($p > 0.05$).

Results and conclusions. The study data and analyses showed benefits of the new pre-season mental conditioning model for the 8-9 year old tennis players as verified by the model testing experiment at the Siberian Tennis Center in Tomsk. The new mental conditioning model may be recommended for application in the national sport schools that offer youth tennis training services for pre-season mental conditioning and competitive progress.

Keywords: *mental conditioning, mental fitness, tennis players, competitive performance.*

Background. Modern sports progress analysis shows that due institutional and practical sporting lifestyle encouragement provisions for young population groups are critical for national success on the global sports arenas; with the modern tennis being no exclusion. In 2005, the Russian Tennis Federation revised the age classes for the Russian Tennis Tour to replace the 10-12 year old class with a 10-minus year old class [3]; and the tennis coaches had to revise the beginner group training systems correspondingly for the earlier competitive progress goals. Theoretical analysis of the modern beginner theoretical and practical training systems showed that they still assign too short time for the pre-season mental conditioning tools due to the traditionally little attention paid to these issues.

Objective of the study was to theoretically substantiate and test practical benefits of a new pre-season mental conditioning model for the 8-9 year old tennis players.

Methods and structure of the study. We sampled the 8-9 year old trainees of the Siberian Tennis Center (n=20) for the mental conditioning model testing experiment and split them up into Experimental and Reference Groups (EG, RG). The EG training was complemented by theoretical and practical mental conditioning model of our design; and RG was trained in the traditional system with standard mental conditioning elements. The experimental mental conditioning model included 18 hours of lectures and practices in the following subjects: performance visualizing techniques; pre-season behavioral control; relaxing

and activating techniques; positive controlled thinking during matches; competitive mental fitness; and target mental qualities [1, 3]. The group mental fitness was tested by the pre- and post-experimental tests. Note that the intergroup differences of the pre-experimental test data were insignificant (p> 0.05).

Results and discussion. The post-experimental state and trait anxiety test rates yielded by the Spielberger State-Trait Anxiety Inventory (STAI) tests showed significant progress of the EG versus RG (p <0.05): see Figure 1.

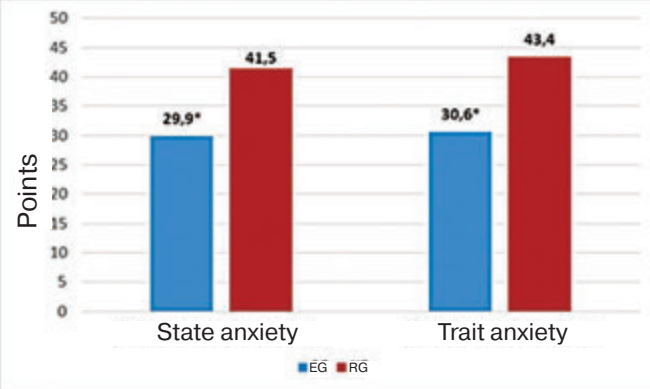

Figure 1. *Post-experimental group anxiety test averages: Spielberger State-Trait Anxiety Inventory (STAI) tests* *p<0.05

The post-experimental state and trait anxiety test rates in the EG were significantly lower than in the RG – due to the fact that the EG successfully mastered the mental conditioning tools to mitigate anxiety and get fit for competitive stressors. The post-experimental state anxiety averages in the EG varied around the moderate level (with a low level rated by 30 points); whilst the trait anxiety rates were slightly higher than state anxiety (see Fig. 1), although still significantly lower than the pre-experimental ones – 31-44 points versus 45 points, respectively – that is indicative of a good progress [1]. The RG was tested with virtually no variations on the state and trait anxiety test scales: both of the test rates remained high due to the still limited pre-season mental conditioning trainings.

The Frester Stress Symptom Test found significant (p <0.05) EG vs. RG differences in responses to the following stressors: high pressure; past competitive failure; past loss to the upcoming adversary; and hostile crowd: see Figure 2.

The study data and analyses showed benefits of the new mental conditioning model for emotional control in matches – with special benefits from the visualization techniques including the 'post-match errors clean-up' method to help the young players feel refreshed, focused and fit for every next match. The special post-match behavioral control techniques were found to improve the mental conditioning and analyses prior to, during and after the matches to help the players fairly rate own success and failures versus strengths and weaknesses of the opponents.

Of special interest was the 'hostile crowd' stressor ranked equally high by both groups, although the EG still was still significantly lower (p <0.05) on this scale versus the RG. Knowing the high sensitivity on the young tennis players to this stressor, we would recommend giving a special attention to the relevant mental conditioning tools including trainings with a wide variety of auditory, visual, tactile and other distracters to improve the athletes' adaptability to unexpected competitive situations.

Average emotional control test rates of the EG and RG were found significantly (p <0.05) different, particularly on the Competitive Fitness scale (see Figure 3), with the EG tested close to the maximal 10 points i.e. highly fit in contrast to the RG. The post-experimental Y.Y. Kiselev Thermometer Tests found the EG vs. RG differences statistically insignificant (p> 0.05) on most of the peer/ coach relationships rating scales – that may be interpreted as indicative of a good team spirit at the Siberian Tennis Center and high respect to the coaches from the young athletes and their families.

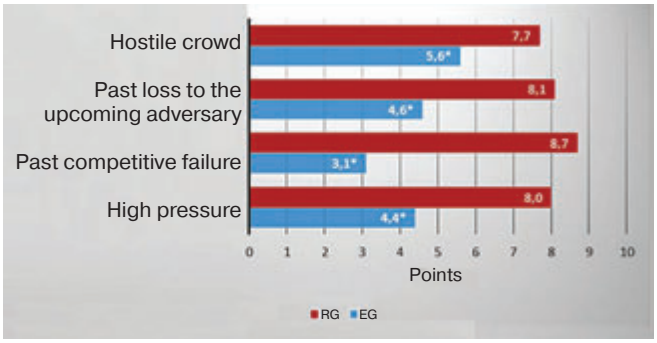

Figure 2. *Post-experimental group averages in the Frester Stress Symptom Test* *p<0.05

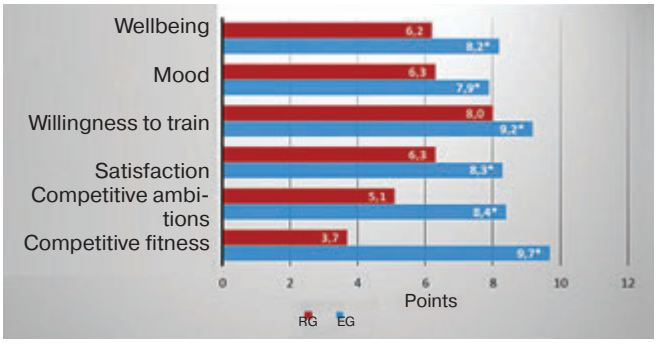

Figure 3. *Post-experimental emotional control test averages of the EG and RG: Y.Y. Kiselev Thermometer Test* *p<0.05

Conclusion. The study data and analyses showed benefits of the new pre-season mental conditioning model for the 8-9 year old tennis players as verified by the model testing experiment at the Siberian Tennis Center in Tomsk. The new mental conditioning model may be recommended for application in the national sport schools that offer youth tennis training services for pre-season mental conditioning and competitive progress.

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Kinesiological educational technology in physical education of preschoolers

UDC 796.011.3

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Abstract

Objective of the study was to analyze physical fitness benefits of a new kinesiological educational technology complementary to the preschool physical education service.

Methods and structure of the study. We sampled for the study (run at 'Montessori' Preschool Education Establishment #4) the 5-6 year-old preschoolers (n=88) and split them up into Experimental and Reference Groups (EG, RG) of 44 people each (20 girls and 24 boys). We called the new physical education service model kinesiological since it makes an emphasis on the physical activation and psychomotor progress i.e. on the kinesiological potential mobilizing aspects. The kinesiological educational technology may be defined as the systemic psychomotor/ physical fitness progress method with the relevant physical education service design, management and progress testing components for success of the physical education service. The kinesiological educational technology design and content was analyzed in our prior study. The kinesiological-educational-technology-complemented preschool physical education service is different from the traditional one by its kinesiological exercises that may be grouped as follows: (1) body midline balancing practices; (2) transitional exercises; (3) energizing exercises; and (4) stress tolerance and confidence building exercises.

Results and conclusions. The study found that the physical fitness facilitating preschool kinesiological educational technology model shall be based on the following institutional and educational provisions for success:

• Test the 5-6 year-olds' kinesiological potential to obtain the body mass and length; carpal dynamometry; somatomotor (flexibility, strength, speed, endurance) qualities test rates; psychosomatomotor qualities (kinematic and dynamic coordination, motor balance, motor memory); and psychomotor qualities (simple/ complex reactivity, multimodal and multi-type) test rates.

• Establish progress-facilitating kinesiological environments in groups, gyms and on the outdoor playgrounds; support the group trainings with practical guidelines to facilitate psychomotor progresses (kinesiological exercises demonstrating schemes and photos, accessories like bags and balls of different weights and sizes, didactic materials for kinesiological practices etc.).

• Train the preschool physical education instructors, teachers and update the families on the benefits of age- and personality-specific kinesiological exercises. Offer family training workshops "Brain gymnastics: brain gym" and consult families in the preschool physical education service process.

• Run regular kinesiological exercises progress tests in the preschool physical education groups and make timely corrections to the theoretical and practical preschool physical education process when necessary.

Keywords: *kinesiological potential, preschool physical education, kinesiological educational technology, physical fitness.*

Background. For the last decades the national educational system has given a growing priority to the young people's physical activation initiatives to counter the reported regresses in the age-specific kinesiological potential i.e. the body functionality, psychophysical development and physical fitness [1-3]. The preschool physical education system emphasizes the need for preschoolers to master a variety of key motor skills related to running, walking, skiing, jumping, throwing, climbing etc., otherwise

they may be unfit for the socializing games and, later on, for productive learning activities. The kinesiological potential underdevelopments in different elements are considered by the research community as triggers of potential adaptability issues in the educational process that need to be timely addressed by the relevant educational methods, models and tools [1, 4, 5]. This is the reason for a special interest to the new kinesiological potential mobilizing and developing methods and technologies applicable in the preschool physical education system.

Objective of the study was to analyze physical fitness benefits of a new kinesiological educational technology complementary to the preschool physical education service.

Methods and structure of the study. We sampled for the study (run at 'Montessori' Preschool Education Establishment #4) the 5-6 year-old preschoolers (n=88) and split them up into Experimental and Reference Groups (EG, RG) of 44 people each (20 girls and 24 boys). We called the new physical education service model kinesiological since it makes an emphasis on the physical activation and psychomotor progress i.e. on the kinesiological potential mobilizing aspects. The kinesiological educational technology may be defined as the systemic psychomotor/ physical fitness progress method with the relevant physical education service design, management and progress testing components for success of the physical education service. The kinesiological educational technology design and content was analyzed in our prior study [6].

The new kinesiological educational technology testing experiment with analysis of its benefits was run in September 2018 through August 2019. The kinesiological-educational-technology-complemented preschool physical education service is different from the traditional one by its kinesiological exercises that may be grouped as follows: (1) body midline balancing practices; (2) transitional exercises; (3) energizing exercises; and (4) stress tolerance and confidence building exercises.

Group 1 exercises are geared to facilitate harmonized limbs, eyes and ears activation with both brain

Table 1. *Pre- versus post-experimental physical fitness test data of the EG and RG girls' subgroups*

Test	Test stage	RG, n=20					EG, n=20					p
		$\overline{X}$	±	σ	±	m	$\overline{X}$	±	σ	±	m	
Standing long jump, cm	Pre-exp.	110,2	±	18,4	±	0,1	105,8	±	15,6	±	0,1	0,3
	Post-exp.	113,6	±	21,1	±	0,7	117,6	±	11,2	±	0,1	0,1
	p	0,2					0,01					
1kg ball throw, cm	Pre-exp.	173,8	±	25,5	±	0,5	174,6	±	35,8	±	0,7	0,9
	Post-exp.	190	±	22,4	±	0,3	226,1	±	20	±	0,1	0,04
	p	0,1					0,01					
3x5m shuttle run, s	Pre-exp.	7,2	±	0,9	±	0,08	7	±	0,7	±	0,02	0,5
	Post-exp.	6,7	±	0,8	±	0,03	6,5	±	0,7	±	0,01	0,6
	p	0,01					0,01					
Front lean, cm	Pre-exp.	2,9	±	2,9	±	0,03	3,1	±	3,1	±	0,04	0,4
	Post-exp.	3,5	±	2,5	±	0,01	7,4	±	4,1	±	0,05	0,01
	p	0,3					0,01					
5m ball catching, points	Pre-exp.	2,4	±	1,3	±	0,01	2	±	1,1	±	0,04	0,5
	Post-exp.	2,8	±	1,7	±	0,06	4	±	0,7	±	0,08	0,02
	p	0,1					0,01					
Monopodalic balance, s	Pre-exp.	33,2	±	11	±	0,9	37,7	±	16,1	±	0,7	0,5
	Post-exp.	57,1	±	12,5	±	0,5	86,5	±	17,6	±	0,6	0,04
	p	0,01					0,01					
Figure of eight	Pre-exp.	27,7	±	9,6	±	0,6	26,3	±	8,5	±	0,6	0,7
	Post-exp.	24,2	±	9,9	±	0,4	18,2	±	4,8	±	0,4	0,04
	p	0,01					0,01					

hemispheres mobilized for effective integration of thinking and movement mechanisms. The practices help the child effectively move and think at the same time and process data from specific to general aspects and vice versa, moving across the body midline and thereby facilitating the children's progress in reading, writing, basic/ fine motor skills, movement coordination and many other aspects.

Group 2 includes the transitional exercises geared to relax the muscles and tendons, with a special attention to the muscle extension when coming back to the natural relaxed state and the relevant brain control to facilitate relaxation and fitness for further cognitive activity. Such practices activate short-term memory, improve mathematical skills and help focus attention and improve coordination to move and think simultaneously [1].

Group 3 includes the energizing exercises focused on the speed and intensity of the nervous processes, i.e. flows of impulses from cells to groups of nerve cells in the brain. These practices help develop the attention focusing skills and improve the brain oxygenation and stress tolerance.

And *Group 4* stress tolerance and confidence building exercises are geared to stabilize the nervous processes, mitigate emotional stresses, make the children fit for learning, and facilitate their progresses in the socializing and self-control domains [4]. It should be mentioned that the above psychomotor progress facilitating kinesiological exercises effectively complement the preschool physical education service in the warm-up, basic and final training components.

Results and discussion. Given in Table 1 hereunder are the kinesiological educational technology benefits demonstrating physical fitness test data of the girls' subsample.

The above data shows significant EG progress ($p < 0.05$), particularly in the standing long jump and 1kg ball throw tests, with the EG and RG progress estimated at 23.8% and 8.2%, respectively. The progress tests found significant progress in the group agility as verified by the 5m ball catching, monopodalic balance and figure-of-eight tests ($p < 0.05$). The boys' subgroups were tested with the similar progress in the kinesiological educational technology testing experiment.

Conclusion. The study found that the physical fitness facilitating preschool kinesiological educational technology model shall be based on the following institutional and educational provisions for success:

• Test the 5-6 year-olds' kinesiological potential to obtain the body mass and length; carpal dynamometry; somatomotor (flexibility, strength, speed, endurance) qualities test rates; psychosomatomotor qualities (kinematic and dynamic coordination, motor balance, motor memory); and psychomotor qualities (simple/ complex reactivity, multi-modal and multi-type) test rates.

• Establish progress-facilitating kinesiological environments in groups, gyms and on the outdoor playgrounds; support the group trainings with practical guidelines to facilitate psychomotor progresses (kinesiological exercises demonstrating schemes and photos, accessories like bags and balls of different weights and sizes, didactic materials for kinesiological practices etc.).

• Train the preschool physical education instructors, teachers and update the families on the benefits of age- and personality-specific kinesiological exercises. Offer family training workshops "Brain gymnastics: brain gym" and consult families in the preschool physical education service process.

• Run regular kinesiological exercises progress tests in the preschool physical education groups and make timely corrections to the theoretical and practical preschool physical education process when necessary.

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Physical activity for longer and more quality life of senior people

UDC 796.034.2

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Abstract

Objective of the study was to survey the factors of influence of the senior population physical activity and offer a life quality improvement physical training model.

Methods and structure of the study. We run, for the purposes of the study, a SF-36 questionnaire survey [5] at the National Research Tomsk State University's physical education Department, and a life quality improvement physical training model testing experiment that took 3 years. The experimental physical training service was provided by a physiotherapist and doctor and included theoretical classes (introductory and final parts of 10 minutes each and 40-minute main part) plus practical circuit physical training service, with 2-3-days rest breaks. The female sample was split up into a Younger Group (YG, n=20) of 62-66 year-olds and Senior Group (SG, n=15) of 71-74 year-olds, with both groups trained for 1 hour twice a week. The YG was trained under an Active Longevity physical training program (1 gym and 1 swimming pool session); and the SG training system was dominated (80%) by swimming practices plus standard physical conditioning exercises (20%). The group progresses were tested by the pre- versus post-experimental tests and surveys.

Results and conclusions. The questionnaire surveys and physical training model testing experiment showed the undoubted need for special physical activation and physical training service to senior population groups geared to facilitate their further productive and active work; mitigate the burden on the age-specific health service system; cut down the relevant social costs; and mitigate the potential negative impacts on the national socio-economic progress agenda.

Keywords: *senior people, ageing issues, physical activity, physical exercises, life quality, life expectancy, active longevity, physical training, questionnaire survey, health rate.*

Background. The growing life expectancy rates reported by statistical services of the Russian Federation urge the relevant governmental agencies to give a special priority to the population aging related challenges to mitigate the potential negative impacts on the national socio-economic progress agenda [2-4]. Presently the national policies in this domain are geared to set due provisions to facilitate the health- and age-sensitive inclusion of the professionally competent and able senior population in active labor. Such policies are expected, on the one hand, to reduce the financial burden on the active younger population by reducing the social costs and, on the other hand, improve the seniors' living standards, life quality and active longevity in the context of the naturally high demand of this group for health services [1].

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training service was provided by a physiotherapist and doctor and included theoretical classes (introductory and final parts of 10 minutes each and 40-minute main part) plus practical circuit physical training service, with 2-3-days rest breaks. The female sample was split up into a Younger Group (YG, n=20) of 62-66 year-olds and Senior Group (SG, n=15) of 71-74 year-olds, with both groups trained for 1 hour twice a week. The YG was trained under an Active Longevity physical training program (1 gym and 1 swimming pool session); and the SG training system was dominated (80%) by swimming practices plus standard physical conditioning exercises (20%). The group progresses were tested by the pre- versus post-experimental tests and surveys.

Results and discussion. The pre-experimental survey found 58.6%, 37.9% and 3.5% of the sample self-rating their health as mediocre, good and excellent on a 5-point scale; with none of the respondents checking the "bad" option. Furthermore, about 50% of the sample reported their health and physical fitness "slightly" limiting (average score) their everyday vital physical activity (food bags carrying, going upstairs, covering a 1-plus km distance etc.). And about 50% of the sample reported difficulties in some or a few daily chores they had to stop due to fatigue or inability to complete the work for other reasons.

Emotions are a commonly known to be of special influence on the life quality, psychophysical health, working capacity, family climates and relationships with friends, neighbors, colleagues, etc. We surveyed the sample how often for the last 4 weeks the emotional issues required extra willpower from them to keep up the family/ job/ social contacts, and 43.6%, 46.5% and 9.9% rated such complicating emotional issues influential, non-influential and somewhat influential, respectively, on a five-point scale. It should be emphasized in this context that sociologists do believe that good social contacts/ communications are indispensable for successful 'secondary socialization' of seniors whose circles of live contacts tend to narrow with age living them lonely and, hence, susceptible to the relevant life quality and life expectancy issues.

An international survey by the Global Age Watch Index demonstrated that the seniors' life quality and life expectancy rates heavily depend on their health rate and mental/ social wellbeing, particularly in the 60-plus year old groups. It should be noted in this context that the Russian Federation is now ranked only 86th on the lists of the senior population health indices i.e. with the least developed nations [1].

This was the reason for us to survey the sample on how often and much for the last month they suffered from physical pain and to what extent the psychophysical discomforts hampered their indoor chores and outdoor activities. Most of the sample (85.3%) reported very little to moderate pains that were of little influence (65% reported little of some influence) on their performance or work completion rates. Despite the fact that only 14.7% reported feeling 'no pains at all', 34.5% reported being successful and timely in their day-works, that means that about 20% of the pain-reporting respondents are still quite effective in their daily chores.

It should be mentioned that none of the sample reported "severe' and 'very severe" pains for the last month otherwise they could hardly qualify for the sample. Furthermore, a fairly high share (27.6%) of the sample reported their physical and emotional issues for the last month having no effect on their social contacts including relationships with families, friends and colleagues. This finding demonstrates once again the importance of social contacts for senior people who tend to rank them more important than whatever health disorders. Findings of a somatic health survey were of special interest for us. Regardless of the actual physical and mental health rates, most of the both groups (48.7%) rated their health as good as the peers' health, and 33.3% rated their health excellent for their age group.

Prior to developing the physical training models for both age groups, we surveyed the actual physical activity for the last month and profiled it by the scopes and intensities – using a Physical Activity Questionnaire Survey form we designed based on the International Physical Activity Prevalence Study (www.ipaq.ki.se). The questionnaire survey tested the physical activity formats with the quantitative and qualitative rating criteria to find if and to what extent the sample is fit for the physical training model in the functional and psychophysical fitness domains.

Having analyzed the responses, we tested both groups with the following last-month physical activity (on a 3-point scale): 36.4% were tested with physical inactivity (physical activity under 21 points); 45.5% with poor physical activity (21-28 points) and only 18.1% with fair age-specific physical activity (28-plus points). These data gave us the grounds to rank 80% of the age group with the sedentary lifestyle detrimental to their mental and physical health and potentially hampering their everyday chores.

The post-experimental survey was run in March 2020 (six months after the physical training model testing experiment) to rate health of the sample and make adjustments to the physical training model in view of the sample comments and ideas. We used a special questionnaire survey form with a special priority to the physical training service update and efficiency improvement aspects. The questionnaire survey found 93.4% of the sample (both groups) rating their health 'much better' and 'slightly better', and only 6% reporting 'some worsening' of the perceived

health rate after the experiment. In addition, 64.3% and 14.3% of the sample reported moderate and high progress in the walking speeds, respectively.

Furthermore, 85.3% of the sample favored a combined (group plus individual) training model, and 70.5% acknowledged benefits of the group trainings as compared to the individual ones, particularly when such trainings are assisted and controlled by designated physical education coaches or instructors. The sample also emphasized the desire to have a privileged access to sports clubs among the other mass senior population's physical activation and sporting initiatives.

It should be mentioned that none of the sample had doubts about the physical training service benefits for the seniors' life quality and active longevity and ranked the physical training service high among the other physical activity factors, with a special preference for the group training service models including professional and individualized instructor's service, his/her own good look and healthy lifestyle, plus reasonable diversity of the physical training systems customizable to the age- and health-specific needs, physical progress agendas and other factors.

Conclusion. The questionnaire surveys and physical training model testing experiment showed the undoubted need for special physical activation and physical training service to senior population groups geared to facilitate their further productive and active work; mitigate the burden on the age-specific health service system; cut down the relevant social costs; and mitigate the potential negative impacts on the national socio-economic progress agenda.

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Benefits of Khanty ethnic games for physical activity optimization in elementary schools in northern areas

UDC 796.011.3

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Abstract

Objective of the study was to analyze benefits of the Khanty ethnic active games model complementary to the standard elementary school physical education service.

Methods and structure of the study. The new Khanty ethnic active games model piloting study was run at the Salmanov Gymnasium in Surgut city. We made analysis and summaries of the theoretical and practical literature on the subject to find the most beneficial Khanty ethnic active games tools for the elementary school Khanty ethnic active games database. We sampled unsporting elementary schoolchildren (n=60) for the new Khanty ethnic active games model testing experiment and split them up into Experimental and Reference Groups (EG, RG) of 30 people each. The RG training was governed by the traditional physical education curriculum, whilst the EG physical education trainings were complemented by the Khanty ethnic active games toolkit with competitions. The group progress was tested by the pre- versus post-experimental functionality and physical fitness tests.

Results and conclusions. The Khanty ethnic active games model testing experiment to complement the standard elementary school physical education service showed the model being beneficial as verified by the significant EG versus RG progress in the functionality / physical fitness tests.

The study data and analyses showed the new Khanty ethnic active games model complementary to the standard elementary school physical education service being beneficial for the optimization of physical activity of elementary schoolchildren. The pre- versus post-experimental tests showed significant progress of the EG versus RG on every functionality/ physical fitness test scale both in the boys and girls subgroups.

Keywords: *physical activity, physical education, physical development, physical fitness, elementary school, Northern areas, Khanty ethnic active games.*

Background. The Khanty-Mansi Autonomous Yugra Territory presently reports ethnically diverse population, with the indigenous peoples of the Far North estimated at only 2% of the total. The traditional ethnic active games and sporting culture of the indigenous population groups deserve special interest and analysis for potential application in the elementary schoolchildren's physical activity initiatives to complement the standard elementary and higher-level education curriculum. A few modern experts in the Northern indigenous cultures including S.A. Dneprov [3], V.P. Krasilnikov [4], V.I. Prokopenko [5] and N.I. Sinyavsky [6] give a special priority to the studies of the local traditional ethnic physical education systems and tools that offer a wide range of elementary school games and sporting practices [1, 2]. Thus the traditional games of Khanty children were found highly beneficial for the age-specific physical education systems, particularly in the health improvement and adaptability building aspects of special importance for the people living in the harsh climatic conditions of the Khanty-Mansi Autonomous Yugra Territory.

Objective of the study was to analyze benefits of the Khanty ethnic active games model complementa-

ry to the standard elementary school physical education service.

Methods and structure of the study. The new Khanty ethnic active games model piloting study was run at the Salmanov Gymnasium in Surgut city. We made analysis and summaries of the theoretical and practical literature on the subject to find the most beneficial Khanty ethnic active games tools for the elementary school Khanty ethnic active games database. We sampled unsporting elementary schoolchildren (n=60) for the new Khanty ethnic active games model testing experiment and split them up into Experimental and Reference Groups (EG, RG) of 30 people each. The RG training was governed by the traditional physical education curriculum, whilst the EG physical education trainings were complemented by the Khanty ethnic active games toolkit with competitions. The group progress was tested by the pre- versus post-experimental functionality and physical fitness tests.

Optimal physical activity is referred to herein as the physical development, functionality and physical fitness levels comfortable for the life quality assurance purposes and achievable by the physical education knowledgebase building service with practical well-designed and managed age-specific physical education experience accumulated in reasonably individualized physical education practices including games, contests, tournaments, etc.; recreational activities; motivational initiatives; self-reliant physical activity forms; encouraging interest in practical sports/ physical education models; role models to develop the relevant sporting behavioral models; studies of the external factors of influence, incentives for physical progress and bodily responses to the trainings (with account of the weather conditions, training process intensity etc.); most efficient physical activity models and tools to meet the natural need for physical activity; special physical qualities building tools; functionality and adaptability improvement techniques; studies of the biological and social determinants of the age- and situation-specific physical activity; etc.

To optimize the elementary school physical activity, we selected the most beneficial ethnic Khanty physical education tools, outdoor games and competitions including: "Who is faster?" ("Pasty ne"), "Run like a bear" ("Pupi nevere"), "Rings" ("Kis"), "Hoop play" ("Kusy yunt"), "Ring play" ("Corky emuni"),"Ball control" (" Puksel"), "Stick throws on target" ("Popyl yengev"),"Arcane throws' (Tynzyan), "Sledge jumps" (" Porunchkve Patev "), "Snow Arrow" ("Tutnel"), "Deer catching" ("Vyarkukota"), "Hare footprints" ("Chaver Lak"), "Games with Stick" ("Turkemleli") etc.

Results and discussion. The pre- versus post-experimental tests found significant intergroup differences on the functionality / physical fitness test scales: see Tables 1, 2.

The Khanty ethnic active games model testing experiment to complement the standard elementary school physical education service showed the model being beneficial as verified by the significant EG versus RG progress in the functionality / physical fitness tests.

The progress was significant for the EG boys (particularly in the heart rate, diastolic blood pressure, standing long jump, prone push-ups, 30s sit-ups and 1000m race tests) and EG girls (particularly in the vital capacity, heart rate, diastolic blood pressure, prone push-ups, standing front bends and 1000m race tests).

Conclusion. The study data and analyses showed the new Khanty ethnic active games model complementary to the standard elementary school physical education service being beneficial for the optimization of physical activity of elementary schoolchildren. The pre- versus post-experimental tests showed significant progress of the EG versus RG on every functionality/ physical fitness test scale both in the boys and girls subgroups.

Table 1. *Post-experimental functionality / physical fitness test rates of the EG and RG: boys subgroups*

Test	EG	RG
Vital capacity, l	1,7±0,08	1,6±0,07
Heart rate, beats per min	82,3±1,21*	92,4±1,82*
Systolic blood pressure (SBP), mmHg	102,8±1,64	107,4±2,33
Diastolic blood pressure (DBP), mmHg	63,1±1,47**	68,9±2,21**
Standing long jump, cm	160,1±3,01•	147,3±2,42•
Prone push-ups, count	24,3±1,61••	15,6±1,87••
30s sit-ups, count	26,7±1,42•••	22,1±1,04•••
Standing front bends, cm	7,7±1,01	6,9±1,17
1000m race, min	4,3±0,04◊	4,8±0,05◊

*Note: *, **, •, ••, •••, ◊ – intergroup difference significance rates,* p≤*0.05*

Table 1. *Post-experimental functionality / physical fitness test rates of the EG and RG: girls subgroups*

Test	EG	RG
Vital capacity, l	1,6±0,05*	1,4±0,05*
Heart rate, beats per min	82,9±2,01**	90,0±2,23**
Systolic blood pressure (SBP), mmHg	97,0±2,34	99,6±1,91
Diastolic blood pressure (DBP), mmHg	58,5±1,16•	65,8±2,14•
Standing long jump, cm	148,7±2,40	147,6±2,42
Prone push-ups, count	15,9±1,66••	10,7±1,23••
30s sit-ups, count	24,8±1,73	22,3±1,84
Standing front bends, cm	19,7±1,71•••	14,6±1,63•••
1000m race, min	4,4±0,06◊	4,9±0,07◊

*Note: *, **, •, ••, •••, ◊ – intergroup difference significance rates, p≤0.05*

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Postural control improvement training model with biological feedback capacity for seniors

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Abstract

Objective of the study was to develop and test benefits of a new postural control training model with the biofeedback capacity and stabilographic simulator systems for seniors.

Methods and structure of the study. We sampled for the new postural control training model testing 6-month experiment 55+ (59±3.2 on average) year olds (n=40, including 7 men and 33 women) with no diagnosed musculoskeletal and nervous system disorders. The sample gave informed consents for the tests, and the test protocol was approved by the National Research Tomsk State University's Ethics Committee. The sample was split up into Experimental and Reference Groups (EG, RG) of 20 people each. RG trainings were dominated by the standard health-improvement gymnastics with a special emphasis on the body balancing and movement coordination skills. The RG trainings were run once a week for 45 minutes and complemented by self-reliant 45-min home trainings reported in the checklists and training logbooks.

The EG training was the same as the above plus complemented by biofeedback-assisted postural control training module using Stabilan-01-2 (made by NPO Neurosoft, Ivanovo, Russia) computerized stabilography system.

Results and discussion. The new biofeedback-assisted postural control training model was tested beneficial as verified by the significant progress of the EG in the static/ dynamic body balancing skills, with decreased body mass center spread areas in the sagittal and frontal planes and shrinkage of the body mass center ellipse on the test stabilograms. The EG was tested with significant progress in the vestibular control reasonably independent of the visual analyzer.

Keywords: *senior age, postural control, stabilometry, biological feedback.*

Background. Aging process is known to suppress sensory systems sensitivity and musculoskeletal system functionality up to severe postural disorders [9, 12] particularly serious for the 65+ year-olds as reported by the health and social support systems the world over. Thus the US statistics report 6% and 13% of the medical care costs of the 65+ years old groups associated with falls and falls-specific injuries and lethal cases. The UK health system reports about 10% of the ambulance calls from the 65+ year-olds due to falls, with about 60% of these cases resulting in hospitalizations [12]. On the whole, this age group is hospitalized due to falls five times more often than for all other health issues [9, 12].

Regardless of the actual reasons and complications, falls often result in severe maladjustment of seniors with serious changes in their lifestyles – due to not only the physical injuries and related disabilities and physical limitations as such but also the psychological complications diagnosed in almost 50% of the repeated fall-and-injury cases. These people report growing fears of new falls and related anxiety issues that often force them stay home and increase the burden of dependence on their relatives, friends

and other caregivers. This is the reason why postural control training systems may be highly beneficial for the senior people post-traumatic socializing initiatives [13].

Presently the research community ranks modern biofeedback-assisted models among the most promising non-invasive rehabilitation service models for seniors [8, 11], particularly when they complement the standard health improvement physical trainings with the motor skills rehabilitation and special adaptive motor stereotypes formation elements [2, 5]. Progress in such trainings is known to bring benefits for the seniors' mental and emotional health and socializing initiatives [6, 10].

Objective of the study was to develop and test benefits of a new postural control training model with the biofeedback capacity and stabilographic simulator systems for seniors.

Methods and structure of the study. We sampled for the new postural control training model testing 6-month experiment 55+ (59±3.2 on average) year olds (n=40, including 7 men and 33 women) with no diagnosed musculoskeletal and nervous system disorders. The sample gave informed consents for the tests, and the test protocol was approved by the National Research Tomsk State University's Ethics Committee. The sample was split up into Experimental and Reference Groups (EG, RG) of 20 people each. RG trainings were dominated by the standard health-improvement gymnastics with a special emphasis on the body balancing and movement coordination skills. The RG trainings were run once a week for 45 minutes and complemented by self-reliant 45-min home trainings reported in the checklists and training logbooks.

The EG training was the same as the above plus complemented by biofeedback-assisted postural control training module using Stabilan-01-2 (made by NPO Neurosoft, Ivanovo, Russia) computerized stabilography system. The trainings were facilitated by a Pictures Building simulator and developmental Tetris simulator. The individual progresses were rated by motor pathologies diagnostics, treatment and rehabilitation Trust-M computerized system and biofeedback-assisted Target and Rally test systems. Progresse of the body balancing functions was rated by the pre- versus post-experimental tests using the Stabilan-01-2 system, with the tests run on a slippery surface modeled by GYMSTICK Power Slider 61131-PRO system.

Results and discussion. The pre- versus post-experimental postural control tests found significant progress in both groups, with the EG tested with a higher progress on the whole. Thus in the Romberg's test, the eyes-open postural control statokinesiograms were found to grow almost twice in the EG versus a 40% growth in the RG, with both groups tested with the performance growth. The post-experimental tests found the mean standard deviation of the body pressure center (after the biofeedback-controlled trainings to change in the sagittal plane in the RG, and in both the sagittal and frontal planes in the EG.

The post-experimental stability limit tests found a 35% growth of the front/ back stability limits in the EG. The sensory-vestibular tests found the ellipse length falling by 25% in the RG in the right-left head turning movements – versus a twofold fall in the EG. The vestibular balance test found progress of 5% and 12% in the RG and EG, respectively. It should be emphasized that the stabilographic rehabilitation simulators with the biofeedback capacity were found beneficial for the body mass center control and body balancing skills improvement trainings [7]. The simulator assisted trainings helped improve the movement and postural control with the relevant improvements in the everyday self-servicing and home chores. Of special benefits in the postural control training model were the rehabilitation games that were found to fast improve the upright postural control, minimize the walking/ standing fall/ injury risks and improve the stride and pace on the whole [2-4]

It is also important that the game scenarios with their competitive aspects and natural emotional responses and interest boosting effects helped improve the group motivations for the trainings and, hence, benefits of the postural control training model. A special emphasis was made on the stressors modeling situations to help the trainees cope with their fears and develop the autonomic response control skills to successfully suppress and mitigate the mental/ emotional stress and make progress in the health and postural control improvement trainings [1]

Conclusion. The new biofeedback-assisted postural control training model was tested beneficial as verified by the significant progress of the EG in the static/ dynamic body balancing skills, with decreased body mass center spread areas in the sagittal and frontal planes and shrinkage of the body mass center ellipse on the test stabilograms. The EG was tested with significant progress in the vestibular control reasonably independent of the visual analyzer.

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Aerobic trainings to facilitate cognitive progress in adolescents

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Abstract

Objective of the study was to theoretically analyze the available research data on the benefits of the controlled aerobic training models for cognitive progress in the adolescent growth period.

Results and conclusions. The available studies on the subject demonstrate correlations between aerobic training, brain structure and functions and cognitive qualities in the adolescent growth period. Therefore, adolescents are recommended special sporting highly-intensive aerobic activities as beneficial for both their physical health and brain structure and functionality. However, a few aspects of the aerobic training facilitated cognitive progress in this age group are still underexplored as yet – including, e.g., correlations between the controlled aerobic training and brain formation plus neurological and cognitive functions. A few recent studies have found anaerobic trainings being of special effects on the brain and behavior [4], although practical benefits of classified aerobic training still need to be substantiated on a more detailed basis.

Keywords: *adolescents, aerobic trainings, cognitive functions, physical activity, physical training.*

Background. Many studies have found correlations between physical activity and cognitive performance [5, 8], with habitual physical trainings proved being among the key factors for sustainable cognitive progress [14]. Physical trainings keep the central nervous system alert to actively process data related to the muscular system performance with muscle contractions or relaxations, postural control data etc. – with activation of the cerebral cortex and subcortical centers, excitation and inhibition processes, strong and mobile nervous system responses [11], new intra- and intersystem connections etc. [2]. Some studies demonstrate benefits of controlled physical activity for learning progress at schools [1]. It was also found that aerobic trainings facilitate data processing in children samples [8] i.e. improve the brain performance [3].

Every aerobic training method – including swimming, jogging, intensive walking and cycling – is known to improve oxygen supply to every cell and, therefore, bring multiple benefits for the cardiovascular system performance and prevention of diseases [9] including type 2 diabetes mellitus and some specific cancers. In addition, aerobic training has been proved beneficial for neurological and cognitive functionality of children and seniors [10]. Adolescent age subject to a special analysis herein is a period of fast formation and maturation of the brain when it becomes particularly sensitive to physical activity on the whole and aerobic training in particular. Modern physical training tools may have different age-specific developmental effects on the brain from childhood to adulthood. It should be emphasized that the adolescent growth period is particularly sensitive to physical trainings with the brain, nervous system and cognitive functionality developmental effects.

Objective of the study was to theoretically analyze the available research data on the benefits of the

controlled aerobic training models for cognitive progress in the adolescent growth period.

Results and discussion. *Adolescent physical activity rating methods* are basically dominated by progress self-rating systems, accelerometers and fitness tests [13]. Commonly accepted progress self-rating methods offer standard checklists/ questionnaires to fix the physical activity types and intensity for some time period (day, week, month and year). This method is popular due to its cost-efficiency and user friendliness, although the outcome data are often rather subjective – particularly in the adolescent samples that tend to overstate their physical activity. Physical activity rating accelerometers are much more objective and make it possible to rate physical activity for some time period (normally 7 to 10 days); whilst modern comprehensive aerobic training tests of adolescent samples yield test data on the maximal oxygen consumption (VO2 peak/ VO2 max) among other things, although such objective test systems are more difficult in application and data processing as they require special equipment and longer time and may be inconvenient or uncomfortable for the samples for many reasons. Therefore, knowing the pros and cons of every accessible physical activity rating methods, analysts often have to use a few tests to fairly rate benefits of one or another physical training model for cognitive progress.

Physical activity, academic progress and cognitive functions. Many studies have reported positive correlations between physical activity, learning progress and cognitive performance in adolescents [6]. Physical activity has been found particularly beneficial for learning progress in reading and math. In addition to the general learning progress, some studies have analyzed correlations of physical trainings with progress in specific cognitive qualities and abilities including attention control, planning, problems solving skills, operational memory, and restraining controls. These cognitive abilities are considered essential both for learning progress at school and success in professional careers and social agendas on the whole. Thus a study of a large 15-year-old sample found aerobic trainings more beneficial than daily moderate-to-vigorous physical activity forms in the operational reaction and accuracy improvement aspects as verified by the attention-stop and restraint control tests and analyses.

Two studies analyzed cognitive progresses in adolescent samples facilitated by standard physical exercises. The first study found the aerobic training to improve spatial control in the 15-18 year-old males, with a special progress made in a virtual spatial orienteering (Morris virtual water maze) test by a high-intensity aerobic training group versus the peer lower-intensity aerobic training group [7]. The second study of the 16-year-old sample found the high-intensity aerobic training group more successful in a spatial associative learning test, inhibition rating colored words stringing test and cognitive versatility rating Wisconsin cards sorting test [12].

Further aerobic training benefits rating experimental studies of the adolescent samples generated more data on the subject. Thus a 4-month physical training of a random sample (n=70 aged 12-14 years) was designed to rate the physical training intensity and types versus progress in specific cognitive skills including verbal/ non-verbal communication, abstract reasoning, spatial control and counting skills. The study found a significantly better progress in the high-intensity physical training group (trained 4 days per week with the heart rate averaging 120 beats per minute) in every tested cognitive quality versus the lower-intensity physical training peer group trained 2-4 times per week. One more study of the aerobic training fitness of a 9-10 years old sample found improvements in the spatial short-term memorizing skills for one year of trainings by the most sensitive period on the verge of adolescence.

Conclusion. On the whole, the available studies on the subject demonstrate correlations between aerobic training, brain structure and functions and cognitive qualities in the adolescent growth period. Therefore, adolescents are recommended special sporting highly-intensive aerobic activities as beneficial for both their physical health and brain structure and functionality. However, a few aspects of the aerobic training facilitated cognitive progress in this age group are still underexplored as yet – including, e.g., correlations between the controlled aerobic training and brain formation plus neurological and cognitive functions. A few recent studies have found anaerobic trainings being of special effects on the brain and behavior [4], although practical benefits of classified aerobic training still need to be substantiated on a more detailed basis.

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Surgut university students' gender- and age-specific physical activity survey

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Abstract

Objective of the study was to survey the physical activity and sedentary lifestyle in the Surgut university student community versus the relevant IPAQ data reported by the EU.

Methods and structure of the study. We randomly sampled for the survey the Surgut university students (n=376) including the 19.2±1.7 years old males (n=160, 42.6%) and 19.5±1.7 years old females (n= 216, 57.4%) who gave their written informed consent for the survey run in 2015-2016.

Results of the study and conclusions. The male and female physical activity in the Surgut sample averaged 1804 MET-min/ week and 1707 MET-min/ week, respectively – much lower than in the Croatian peer sample (3242 MET-min/ week and 2979 MET- min/ week, respectively). Note that the Croatian sample in its turn was rated physically underactive versus the Tuzla University (Bosnia and Herzegovina) sample with its female and male energy costs of 6013 MET-min / week and 4619 MET-min / week, respectively [4]. Weekday and weekend high-intensity physical activity of the Surgut females was rated at 1937 ± 592 min/ week and 649 ± 283 min/ week, and male high-intensity physical activity at 1741 ± 585 and 610 ± 300 min/ week, respectively. The Surgut females were found to stand higher on these scales than their peers from Poland, Czech Republic, Hungary and Slovakia. The same is true for the male groups. The female weekday high-intensity physical activity was tested significantly higher than the male high-intensity physical activity both in the Surgut and the EU samples.

The gender- and age-specific questionnaire survey of the Surgut university students found their physical activity being very low regardless of the gender. Therefore, due institutional and academic physical education and sports service design and management projects are recommended to effectively encourage and promote health-centered higher-intensity physical activity as an alternative to the growing unhealthy sedentary lifestyles in the student communities

Keywords: *physical activity, gender groups, sedentary behavior, IPAQ.*

Background. For the first two decades of the new millennium the global physical activity has been reported to further fall in every population group including the university student communities despite the common belief that this social group is the most active and mobile [13]. A special priority in the physical activation initiatives will be given to modern training technologies and school physical education and sports design and management models. These physical activity initiatives need to be based on a reliable scientific database on the actual physical activity and physically inactive (sedentary) behaviors in the student communities, with such data obtainable by questionnaire surveys including the internationally accepted and popular IPAQ [9] that have been successfully used in many countries [5, 2] to find that many students' physical activity varies far under the bottom levels recommended by the WHO and the College of Sports Medicine (150 minutes of moderate-intensity physical activity or 75 minutes of high-intensity physical activity per a week); with only 7% of student population found reasonably active, and 25.8% inactive for a long time.

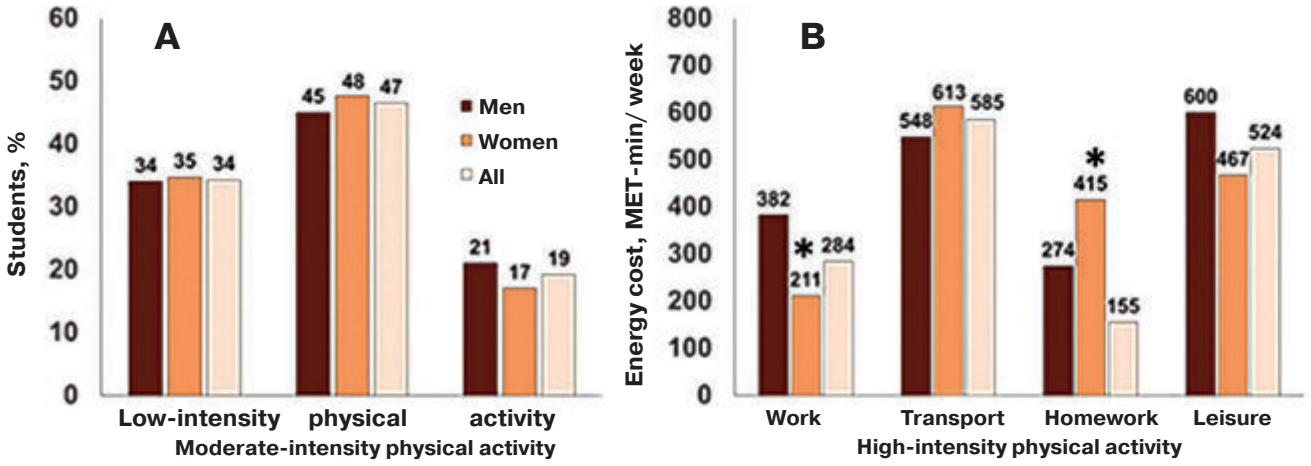

Figure 1. *Physical activity intensity rates of the sample (A) and domain-specific physical activity (B)*
** p <0.05*

The IPAQ surveys in many countries have found rapid expansions of physical inactivity with sedentary behavior/ lifestyles (the relatively new terms for the global research community) [12]. Sedentary lifestyle – that has lately become a subject to special research – is interpreted as the alert but dominantly sitting or reclined inactive lifestyle with the energy cost of ≤1.5 METs [7] that gives rise to cardiovascular diseases, diabetes, obesity and related mortality growth, with the sedentary-lifestyle-related health risks found to be little mitigated by a moderate-intensity physical activity practiced on an irregular basis [10]. The physical activity versus sedentary lifestyle rating studies and analyses are relatively new, and the relevant research shall be in special priority in analyses of the modern social lifestyles.

Objective of the study was to survey the physical activity and sedentary lifestyle in the Surgut university student community versus the relevant IPAQ data reported by the EU.

Methods and structure of the study. We randomly sampled for the survey the Surgut university students (n=376) including the 19.2±1.7 years old males (n=160, 42.6%) and 19.5±1.7 years old females (n= 216, 57.4%) who gave their written informed consent for the survey run in 2015-2016. The sample was surveyed by a Russian version of the online IPAQ on the energy and time costs of their low-, moderate- and high-intensity physical activity for the last 7 days classified by 4 standard domains (work, transport, homework/ gardening and leisure). The survey data were processed as recom-

Table 1. *Detailed gender-specific physical activity ranked by the intensity classes, domains and sedentary lifestyle, min/ week, X̄; 0.95 CI*

Physical activity classes	Female group, n=216	Male group, n=160	Total, n=376
Work	54 (36; 72)	95 (71; 118)*	71 (57; 86)
Transport	177 (150; 204)	158 (131; 185)	169 (150; 188)
Home/ garden	123 (102; 144)	74 (56; 91)*	102 (88; 116)
Leisure	102 (83; 121)	129 (103; 155)	114 (98; 129)
MPA	181 (156; 205)	141 (114; 168)*	164 (146; 182)
HPA	27 (21; 36)	43 (30; 56)*	35 (28; 42)
Walking	247 (215; 280)	271 (233; 309)	257 (233; 282)
Total physical activity	456 (413; 499)	455 (403; 508)	456 (423; 489)
Sedentary lifestyle, weekdays	1937 (1858; 2016)	1741 (1650; 1832)*	1854 (1793; 1914)
Sedentary lifestyle, weekends	649 (611; 687)	610 (563; 657)	632 (603; 662)
Total sedentary lifestyle	2943 (2830; 3056)	2696 (2566; 2825)*	2838 (2752; 2924)

*Note: HPA high-intensity physical activity, MPA moderate-intensity physical activity, LPA low-intensity physical activity, X̄ arithmetic mean, 0.95 CI confidence interval; * p <0.05 for gender group difference*

mended by the IPAQ standard [9] using a special software toolkit [1].

Results and discussion. The survey rated roughly one of three students with low physical activity, one of two with moderate-intensity physical activity and one of five with high-intensity physical activity: see Figure 1 hereunder. The physical activity domains were found gender-specific, with the males rated higher on the work and high-intensity physical activity scales; and females rated higher on the homework, moderate-intensity physical activity and weekend high-intensity physical activity scales ($p < 0.05$). No significant gender differences were found on the leisure, walking and total physical activity scales.

The physical activity data ranked by 4 quartiles generated the quartile-specific low, moderate and high-intensity physical activity values. No one was found to sit 3 hours per day in quartile 1. The physically inactive low-intensity physical activity groups were found to grow 28.6 to 40.4% and 25.7 to 40.3% in the female and male groups in the 3-6 and 6-9 daily hour quartiles, respectively. Within the domains, an ANOVA analysis found no correlation between physical activity and age in the male and female groups; although the male physical activity was found to correlate with the body mass index (BMI) in the homework $F(44, 114) = 1.74$; $p = 0.0102$) and leisure $F(52, 106) = 2.4859$; $p = 0.0000$) domains. The male moderate physical activity, total physical activity and walking energy costs were also BMI-dependent ($F(59, 99) = 1.4759$; $p = 0.0436$), $F(22, 125) = 1.8324$; $p = 0.0505$), $F(50, 98) = 1.4715$; $p = 0.0525$), respectively. No such correlations were found in the female group.

The physical activity versus age profiling analysis found nonlinear regressions in the work, transport, walking, total physical activity and high-intensity physical activity domains in the male group. The female group was tested with no correlation in the work and high-intensity physical activity domains, and the male group in the transportation and total physical activity domains. The homework and high-intensity physical activity energy costs in the male group are described by the following regression equations: $y = 9536\text{-}861x + 19.9x2$ ($r = -0.2034$; $p = 0.0099$) and $y = -8723 + 1043x\text{-}23.16x2$ ($r = 0.2575$; $p = 0.0010$), respectively. In the female group, the energy costs in the transportation, walking and total physical activity domains are described by equations $y = 9536 + 383x\text{-}11.08x2$, $r = -2614$; $p = 0.0361$; and $y = 3956\text{-}220x + 3.0x2$, $r = -0, 2085$; $p = 0.0021$; $y = 6190\text{-}344x + 5.83x2$, $r = -0.1522$; $p = 0.0253$, respectively. And the male high-intensity physical activity is estimated by $y = -3283 + 425x\text{-}7.23x2$, $r = 0.1578$; $p = 0.0463$.

Discussion. Analyses of the recent research literature on the university students' physical activity show an uncontrollable growth of the sedentary behaviors increasingly referred to as the "sedentary epidemic" [6]. Thus the leisure-time students' low-intensity physical activity on the verge of physical inactivity is reported at 23% for the North-Western Europe, 30% for the Central and Eastern Europe, 39% for the Mediterranean countries and 44% for the developing countries [8], with a higher-intensity leisure-time physical activity in the student communities found to clearly correlate with the individual heath agendas and issues. However, the awareness of the physical activity being correlated with health standards still largely fails to motivate students for active lifestyles since only 40-60% of the samples were found to know the incidence of cardiovascular diseases being physical activity dependent.

The gender- and age-specific IPAQ survey data of the Surgut sample was matched with that of the EU and Ukraine peer samples. The comparative analysis found 34% of the Surgut sample physically inactive – versus 12.5% and 14.9% in the Visegrad Four (Czech Republic, Poland, Slovakia and Hungary) and Ukraine, respectively [3]. Furthermore, 47% of the Surgut sample was tested with moderate-intensity physical activity versus 68.1% and 72.8% in the EU and Ukraine, respectively; whilst the high-intensity physical activity shares were found virtually the same: 19%, 19.4% and 12.3%, respectively.

The male and female physical activity in the Surgut sample averaged 1804 MET-min/ week and 1707 MET-min/ week, respectively – much lower than in the Croatian peer sample (3242 MET-min/ week and 2979 MET- min/ week, respectively). Note that the Croatian sample in its turn was rated physically underactive versus the Tuzla University (Bosnia and Herzegovina) sample with its female and male energy costs of 6013 MET-min / week and 4619 MET-min / week, respectively [4]. Weekday and weekend high-intensity physical activity of the Surgut females was rated at 1937 ± 592 min/ week and 649 ± 283 min/ week, and male high-intensity physical activity at 1741 ± 585 and 610 ± 300 min/ week, respectively. The Surgut females were found to stand higher on these scales than their peers from Poland, Czech Republic, Hungary and Slovakia [11] with their weekday and weekend physical activity reported at 432 ± 201 min / week and 297 ± 199 min/ week, respectively. The same is true for the male groups, with their weekday and weekend physical activity making up 393 ± 237 min / week and 313 ± 232 min / week, respectively. The female weekday high-intensity physical activity was tested significantly higher than the male high-intensity physical activity both in the Surgut ($p = 0.0015$) and the EU samples ($p = 0.0000$).

Conclusion. The gender- and age-specific questionnaire survey of the Surgut university students

found their physical activity being very low regardless of the gender. Therefore, due institutional and academic physical education and sports service design and management projects are recommended to effectively encourage and promote health-centered higher-intensity physical activity as an alternative to the growing unhealthy sedentary lifestyles in the student communities.

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Postural control weight training model for university students

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Abstract

Objective of the study was to analyze benefits of a new postural control weight training model for university students with postural disorders.

Methods and structure of the study. We sampled for the new postural control weight training model piloting and testing experiment the National Research Tomsk State University students (n=12) diagnosed with expressed postural disorders and split them up into a Stooped group (SG) and Lordotic group (LG) of 6 people each. The pre-experimental tests found no significant intergroup differences in the physical fitness and functionality test rates ($p>0.05$). We also used the O.A. Aksenova shoulder indexing test and the cervical/ lumbar lordosis tests [4] for the purposes of the study. The experiment included preparatory and main stages of 4 mesocycles each, with every 4-week mesocycle including 4 weekly microcycles. The postural control weight training model offered two 90-minute trainings a week, with 2-3-day rest breaks, with every training session including the traditional warm-up, core training and cool-down phases.

Results and discussion. It is shown that the main cause of postural disorders in the sagittal plane is the muscular imbalance arising from the uneven development of force between the flexor muscles and spine extensors, while postural disorders in the frontal plane are due to the asymmetric development of the muscles of the right and left sides of the core. It should be noted that the pre-experimental tests rated the thoracic kyphosis within the pre-pathologic range – versus the post-experimental tests that found the shoulder index coming back to norm (90-100%).

Keywords: *weight trainings, postural disorders, training system, university students.*

Background. The valid academic Physical Education and Sports and Elective Physical Education and Sports curricula offer no special physical training services to prevent and correct postural disorders, whilst the traditional physical education systems, tools and technologies have proved virtually ineffective for these purposes. The academic physical education research and health communities recommend special postural disorders prevention and correction practices to strengthen the dorsal, cervical, abdominal and shoulder muscle groups to develop harmonious muscular corsets for good static/ dynamic postural controls in whatever studies-specific activities. Many experts in the national academic physical education community, however, are still skeptical about the actual benefits of different weight training systems for the postural disorders prevention and correction purposes, notwithstanding the fact that proponents of a few special weight training systems refer to a few study reports demonstrating such benefits [1-3].

Objective of the study was to analyze benefits of a new postural control weight training model for university students with postural disorders.

Methods and structure of the study. We sampled for the new postural control weight training model piloting and testing experiment the National Research Tomsk State University students (n=12) diagnosed with expressed postural disorders and split them up into a Stooped group (SG) and Lordotic group (LG) of 6 people each. The pre-experimental tests found no significant intergroup differences in the physical fitness and functionality test rates ($p>0.05$).

We also used the O.A. Aksenova shoulder indexing test and the cervical/ lumbar lordosis tests [4] for the purposes of the study. The experiment included preparatory and main stages of 4 mesocycles each, with every 4-week mesocycle including 4 weekly microcycles. The postural control weight training model offered two 90-minute trainings a week, with 2-3-day rest breaks, with every training session including the traditional warm-up, core training and cool-down phases.

Results and discussion. Postural disorders are known to be caused by muscular imbalances due to disharmonic stresses in the spine flexors and extensors that trigger mostly the sagittal postural disorders; whilst the frontal postural disorders are generally caused by the developmental asymmetries/ disharmonies of the side muscles in the muscular corset. Such disorders cannot be easily corrected since the correction/ rehabilitation efforts have to solve, in addition to the posture correction issues, multiple issues in the spine therapy and health recovery services.

The pre-experimental tests were designed to rate the group postural disorders and physical fitness. Then the groups were subject to introductory/ preparatory trainings for the postural control weight training model with sanitary/ hygienic instructions (on keeping clean the work stations, daily routines, health sleeping, diets, healthy physical activity etc.), with the mental control and post-training rehabilitation basics.

The experimental postural control weight training phase included 4 main microcycles with the following different weight training practices: warm-up weight

Table 1. *Sample postural control weight training session design*

	Weight training exercises and their focus	Dosage	Notes
1.	*7-12-min warm-up phase*		
1.1	Cardio warm-up	1-2 minutes	Moderate-pace practices with a special focus on technique and joint gymnastics
1.2	Joint gymnastics	1-2 minutes	
1.3	Dynamic stretching	2-3 minutes	
1.4	Lead pre-training practices	3-5 minutes	
2.	*65-75-min core weight training phase*		
2.1	Weight training semi-squats: stand with the feet shoulder-wide with the barbell/ bodybar on the shoulders, take a top mid-grip with tight shoulder blades, and make semi-squats	80% of the maximum; 4 cycles of 6 reps each	Keep the trunk vertical when squatting with a special focus on the key muscles Keep the trunk strictly vertical
2.2	Bench pull: sit on the bench with the feet fixed, take a wide top grip, and pull the weight	70% of the maximum; 4 cycles of 6 reps each	Keep the lower back bent. Wait for up to 2s at the top point. Slow-pace flexions and accelerated extensions
2.3	Bent standing deadlift: stand with the feet shoulders-wider, lean forward, take a top mid grip and pull the weight to the chest	70% of the maximum; 4 cycles of 6 reps each	
2.4	Shrugs (weight lift by shoulders): stand with the feet shoulder-wide with the weight down in hands, take a top mid grip, and pull the weight up by shrugging	80% of the maximum; 4 cycles of 6 reps each	Keep the lower back bent. Wait for up to 2s at the top point. Slow-pace flexions and accelerated extensions
2.5	Bench press hyperextension: lie prone with your hips pressed to the bench/ horse, fix the legs; and flex the dorsal muscles to straighten your body. Use extra weight on the shoulders for difficulty	80% of the maximum; 4 cycles of 6 reps each	
2.6	Abs crunches: lie recumbent with your legs fixed and hands up on the head; and make sitting moves. Use extra weight on the chest for difficulty	70% of the maximum; 4 cycles of maximal reps	Wait for up to 2s at the top point. Slow-pace flexions and accelerated extensions
3. 8-14-min final cool-down phase			
3.1	Post-training relaxation static/ dynamic exercises	3-5 relaxing bench/ hanging/ leaning/ stretching exercises	Slow moves with deep breathing

training making up 50-60% of the individual maximums; step weight training at 60-70% of the maximum; shock weight training at 70-80% of the maximum; and cool-down/ rehabilitation weight training making up 40-50% of the maximum. The postural control weight training practices were designed on the commonly accepted concepts (gradualness, adequacy, etc.) using the classical strength building methods including the moderate weight training tools with the weights kept at 50-70% of the individual maximums. The core part of every training session was designed to build up strength of the underdeveloped muscle groups to correct the spinal disorders, straighten out the pathological muscular conditions, with the weight training systems individualized for the diagnoses, personal health conditions and physical fitness test rates using varied weights and equipment (barbells, dumbbells, rubber bands, resistance bands, etc.) plus a few trainer machines to strengthen the trunk muscles.

With the individual progresses and adaptations in the training process, the training system was customized to step up the weight training timeframes and intensity so as to effectively develop the key muscle groups critical for the posture correction and static/ dynamic postural control. Strength and muscle mass building components were dominated by the harmonized moderate-intensity training exercises in the overcoming, yielding and mixed formats performed till the first signs of fatigue. The trainings were finalized by the cool-down relaxation exercises focused on the key muscle groups worked out in the trainings. Given in Table 1 hereunder is the sample postural control weight training session design.

The pre- versus post-experimental tests of the Stooped group found the cervical lordosis falling by 23 mm and the lumbar lordosis growing by 13 mm on average. This means that the group was tested to go back to the norm (as provided by O.A. Aksenova) from the pre-experimental pre-pathologic condition. It should be noted that the thoracic kyphosis in the SG was tested to improve by 13% of average, with the Aksenova shoulder index tested to exceed 90%, i.e. come back to the normal range. The pre- versus post-experimental tests of the Lordotic group found the cervical and lumbar lordosis falling by 15 mm and 13 mm on average, respectively. It should be noted that the pre-experimental tests rated the thoracic kyphosis within the pre-pathologic range – versus the post-experimental tests that found the shoulder index coming back to norm (90-100%).

Conclusion. The new postural control weight training model testing experiment found the model being beneficial for the postural disorder correction and prevention purposes. The pre- versus post-experimental test data give good grounds to recommend the new postural control weight training model for application in the university health improvement, rehabilitation and physical therapeutic physical education and sports systems.

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Towards better evidence-informed physical activity interventions for loneliness: lessons learnt from implementation and delivery of physical activity intervention for loneliness (pail) in older adults

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Abstract

Study objective. The aim of this study was to examine the feasibility of a Physical Activity Intervention for Loneliness (PAIL) in community-dwelling older adults at risk of loneliness.

Methods and structure of the study. Study design was a 12-week randomised controlled feasibility trial (RCT). Participants were 25 (mean age 68.5(8.05) years, range 60-92) healthy, inactive, community-dwelling older adults at risk for loneliness. The intervention consisted of group outdoor walking sessions with health education workshops once weekly, with a wait-list control condition. Estimation of recruitment, retention and adherence were feasibility outcomes. Body mass index, blood pressure, physical activity, and psychosocial variables were secondary outcomes.

Results and conclusions. Forty-eight participants were recruited over 4 months with a recruitment rate of 52.1% (25/48); 52% (25/48) met the inclusion criteria and 100% (25/25) were randomised into the intervention (N=12) and wait-listed (WL) control groups (N=13). At 12 weeks, 10/12 (83.3%; 95% CI 55.20 to 95.30) intervention and 10/13 (76.9%; 95% CI 49.74 to 91.82) control participants completed final assessments. The average attendance rate was 69.2% for the intervention group (range 25% – 91.7%) and 55% (range 25% – 91.7%) among controls. The a priori recruitment criteria for progression was not met. The retention rate satisfied the criteria of the study. No serious adverse events occurred. Community-dwelling older adults at risk of loneliness can safely participate in physical activity intervention for loneliness. However, change in design and methodology would be required to progress into a large-scale RCT.

Keywords: *physical activity, older adults, loneliness, feasibility study.*

Background. The value of maintaining social connections through the lifespan is important for mental health and well-being of older adults [14]. Due to health decline, older adults may be prone to home-based regime and have long periods of inactivity. This can exacerbate the feeling of loneliness. Consequences of perceived or lifelong loneliness or social isolation are having detrimental effects on mental health and well-being and impact health-related quality of life, with the last having a number of outcome measurements [13]. According to statistics, one-third of older adults are feeling loneliness at least sometimes and 5% of older adults report feeling loneliness often [27]. Severe loneliness is reported less and was found below 15% in older adults in different studies [25]. Research suggests that loneliness is closely linked to the increased morbidity and mortality [7] and its negative effect on health is comparable to smoking fitness cigarettes a day [25]. The precise link of low social relationships and mortality in adults is not well understood, however, it is likely to be mediated through physical activity, diet and behavior [25] and contribute to healthy ageing [11]. On psychological level, loneliness is linked to stress and depression [7]. On the physiological level, loneliness may lead to increased inflammation in older adults (Tull et al., 2020). In reverse, social support may correspond to better immune functioning and decrease inflamma-

tion [29]. The negative health effect of loneliness is the greatest in older adults with chronic health conditions, from low social-economic background, having lower education level and those living in poorest regions [41]. Research shows that physical activity can be effective for loneliness reduction in older adults to improve psychological well-being and general health [53]. Also, social relationships correspond to promoting decreased length of hospitalisation [31] linking social promotion interventions to inform public health and clinical practice in accordance with the strategy for tackling loneliness in England [24]. In this regard, the focus of health specialists was at loneliness prevention strategies for older adults as a high-risk population group [4]. Physical activity allows decreasing sedentary activity, maintaining physical and social health and reduce the risk frailty [28], and was shown to be an effective compensatory strategy in previous research [43, 49]. General population with strong social skills are 50% less predisposed to early mortality from all-cause risk factors compared to peers with low social relations [25, p.14]. However, there is a need for developing evidence-based interventions to prevent loneliness and social isolation in older adults in programmes of physical activity. Moreover, there is a need to implement health promotion behavioural strategies to promote health behavior and overcome barriers to exercise participation [41]. In addition, there is a need for improvement of exercise adherence, which is likely to decrease over time in older population [50].

To meet the sufficient level of PA older adults must meet minimum PA recommendations. The Centers for Disease Control and Prevention has published updated Physical Activity recommendations for older adults aged 65 years and over (Physical Activity Guidelines, PAG) in November 2018 [9]. According to the recommendations, older adults should accumulate a minimum of 150 minutes of moderate intensity physical activity (MPA) weekly (2 hours and 30 minutes) performed in any bouts [1]. In addition, increase of a minimum physical activity (PA) up to 300 minutes a week without any specific contraindications is associated with better health effect [1]. For those who are already active 75 minutes of vigorous PA (VPA) or combination of moderate-to-vigorous PA (MVPA) can results in extra health benefits [1]. Additionally older adults should perform 3 times/week and 2 times/week strengthening and balancing activities respectively [34]. In this updated PA guidelines the 10-minute bout was removed and the importance of even light intensity activity was highlighted for reducing morbidity and mortality [9]. Reducing the sedentary activity (or any long bouts of inactivity) contributes to reduced risk of developing heart diseases, high blood pressure, and all-cause mortality [1]. For those not meeting the current minimum PA recommendations, greater benefits can be achieved by reducing sedentary behavior, increasing moderate-intensity physical activity, or combinations of both [1].

Systematic evidence suggests that there is a lack of available evidence regarding effects of PA on loneliness reduction particularly in community-dwelling older adults and any existing evidence is sparse [41]. Majority of existing studies are not accounting for publication bias, and do not take into account participant characteristics (e.g. age, gender, ethnicity, health condition) and differences between structural (social networks, social integration, marital status, living alone) and functional (received social support, perceptions of social support) or multifaceted assessment of social characteristics, or study characteristics (e.g. geographical location, length of follow-up). All of which can moderate relationships between PA and loneliness [25]. As a result, the interpretation of obtained data with a high heterogeneity observed in systematic studies can be partially due to unexplained variations in individual health characteristics and not to the effect of health intervention itself which was also consistent with previous research [41]. The features of effective interventions, obtained from the systematic review [41], were used to design and implement the novel feasibility randomised controlled study entitled "A Physical Activity Intervention for Loneliness (PAIL) in community-dwelling older adults" [42]. Aims of the study were to estimate:

1. Recruitment rate, attendance and retention rates (number of participants completing the study as a proportion of those randomised).
2. The acceptability of the intervention by participants, and willingness to participate.
3. The appropriateness of the statistical methods of data analysis used.
4. The required sample size for a future large-scale RCT derived from a power calculation.
5. The acceptability of measures, and the most suitable primary outcome measure for a future large-scale RCT.

Methods/design. This intervention included 12 weeks of outdoor group walking and healthy workshops once weekly [42]. Walking was chosen because it is the most feasible and cost-effective method of physical activity for older adults. Written informed consent was obtained from all participants prior to entry into the study. After randomisation, participants in the intervention group started the 12-week intervention. Participants in the WL control (delayed intervention) group started the intervention after their follow-up measures were completed, approximately 12 weeks post-randomisation.

Loneliness was assessed using the 8-item UCLA Loneliness Scale (UCLA-8) [22]. *Social support* was assessed using the 20-item Medical Outcomes Study

Social Support Survey (MOSSSS) [39]. *Social networks* were categorised using the 6-item Lubben's Social Network Scale (LSNS-6) [32]. *Depression and anxiety* were assessed using the 14-item Hospital Anxiety and Depression Scale (HADS) [54]. *Self-efficacy for exercise* was measured using the revised 9-item Self-Efficacy for Walking/Exercise Scale (SEE), using a paper-and-pencil format [36]. *Satisfaction with level of social contacts* (SSC) was measured with the question "How satisfied are you with your social contacts?" [15]. *Expected outcomes and barriers for exercise* were measured using the Expected Outcomes and Barriers for Habitual Exercise scale [46] adapted for the older adult population. Four questions related to sport competence were deleted from the expected outcomes sub-scale due to irrelevance for this population group [46].

The progression criteria to a definitive large-scale RCT were: 1) no any serious adverse events, such as hospitalisation, life-threatening condition, death and any adverse events associated with the intervention experienced by less than 5% of participants per group; 2) recruitment rate of no less than 75% by the end of the four months recruitment period; and 3) retention rate of no less than 75% in each group at 12 weeks (end-point). If all three criteria were not met, there would be insufficient evidence to justify proceeding to the definitive RCT. No targets were set for other feasibility outcomes, e.g., questionnaire completion rates or attendance at the intervention sessions.

Results and discussion. Participants were 25 (mean (SD) 68.5(8.05) years, range 60-92 years) healthy, inactive, community-dwelling older adults, 14 (56%) female, and 18 (72%) white.

Feasibility outcomes

The recruitment rate was 25% (48/195). The average attendance rate for the total of 12 sessions of the walking intervention was 58.3% for the intervention group, with attendance ranging from 33.0% to 75.0%. The average attendance rate for the wait-list control group was 42.3%, with attendance ranging from 23.1% to 69.2 %.

Secondary outcomes

There were no significant differences between the intervention and control groups at baseline in all measures except for number (n) of sit-to-stand transitions (p=0.02), which were 14.4 points lower in the intervention group (mean 43.3(11.3)) compared with controls (mean 57.6(15.8); 95% CI 2.91, 25.81). A mixed repeated between-within subjects' ANOVA showed that there were no significant between (group) or within (time) interaction effects during the study for all outcomes (Table 1).

Recommendations for future research

Findings of this trial suggest that community-dwelling older adults at risk of loneliness found the intervention and measures acceptable and could safely participate. However, a more extensive and robust strategy would be needed to support adequate recruitment of lonely older adults and adherence into a definitive RCT. Based on the progression criteria, the retention rate was satisfactory, e.g. >75% of participants at 12 weeks (end-point period). The recruitment rate of 25% by the end of the four months was somewhat lower than initially proposed at 75%. No adverse events were found. Therefore, only two out of three criteria of progression to the definitive RCT were satisfied, meaning that the study was not feasible to deliver in its present form and needs modifications. Moreover, there is a need to promote older adults' change in PA behavior as one of the health strategy to overcome inactivity linked to mortality. This article will address some limitations that were raised in PAIL study as well as discuss how this intervention can be improved in the future trial.

Attendance

One of the reasons for low adherence obtained in PAIL study [40] can be due to impaired self-regulation, which was found to be typical for lonely individuals in previous research and affected PA intervention participation [42]. Also, self-esteem and self-worth are likely to induce positive affective responses in PA interventions which was not determined in the PAIL study. Therefore, the improvement of adherence to the future intervention should be discussed based on the existing evidence. The PAIL feasibility study had a mixed-method approach utilising qualitative methods (e.g. focus group interviews) which were aimed to gather participants' feedback on the intervention, including the reasons for participation, and any suggestions for improvement. The results showed that older adults experience barriers for participation, such as transport difficulties getting to and from the location of walks and healthy workshops, seasonal preferences of summer-autumn season versus winter-spring time. Other preferences were related to a certain time and day of the intervention with preference given to at least 10 am and weekday versus weekends [40]. Focus group interviews were conducted only for participants of experimental group, therefore, future study may conduct interviews for control group participants firstly, to understand their experiences in completing assessment forms, regarding research methods, design of the intervention and other feedback. Also, as follows from focus group interviews with older adults [40] providing transport and food to PA intervention for loneliness may significantly increase adherence and reduce drop outs [45].

Promotion of PA behavior

One of the way to promote PA behavior can be the implementation of digital behavior change techniques (BCTs) such as the use of mobile apps and devices

for tracking amount of PA. In face-to-face interventions most effective were self-regulatory BCTs (e.g. goal settings (behavior), self-monitoring of behavior) [20]. Other effective techniques for promotion of PA interventions with older adults were as follows: feedback on progress, reviewing of behavior goals, engaging social support, follow-up prompts, and use of relapse management techniques [20]. Additional benefits were gained by increasing number of visits to participants by a nurse or by skateholders (who were activity leaders of local community clubs) [20]. Among effective BCTs in digital behavior change interventions (DBCIs) were self-efficacy, intention and action planning which can be effective to promote PA participation among older adults and can be acceptable in this population [47]. The systematic review of Stockwell et al (2019) demonstrated up to 52 min/per week increase in MVPA (N=22) (SMD=0.47; 95% CI 0.32, 0.62, $p < 0.001$; MD=52 min/week) and up to 58 minutes a day decrease in sedentary time (SMD=–0.45; 95%CI –0.69, –0.19; $p < 0.001$; MD=58 min/day) in web-based PA interventions for older adults. Average number of reported BCTs was 6.6 (range 2–23; median=5.5) [47]. Similarly, the systematic review of Greaves et al (2011) showed increased physical activity (30-60 mins/week of moderate activity at 12-18 months) using behavior change techniques (BCTs) (N=30) [20]. The use of step-goals or a step diary along with activity tracker increased walking behavior on about 54 minutes per week in the study of Greaves et al., 2011 [20]. Therefore, the evidence does not support the use of digital devices (e.g. activity trackers) without behavior change techniques. Not many studies assess barriers to physical activity and explore the association between motivation for physical activity and exercise behavior. Therefore, additionally intervention mapping can be implemented to identify process of change of PA behavior, as well as recommended to use for identification of any barriers and strategies of supporting behavior and overcoming these barriers [20]. Use of peer-volunteering support and increased number of contacts with the staff can be beneficial to overcome barriers and promote health behavior [20]. To provide focus on maintenance, self-monitoring of progress and providing a feedback were widely implemented in PA promotion interventions with older adults [44].

Inclusion of theoretical frameworks

One of the limitation of existing intervention studies is the absence of any theoretical frameworks [42]. However, only theory-driven interventions can explain the mechanism of social-cognitive predictors that change a health behavior and promote PA in older adults. Most effective theoretical frameworks in PA health promotion interventions for older adults obtained in the literature were socio-ecological model (i.e., individual, community, (i.e., individual, relationship, community, and societal levels) [3,9], health promotion programme [52], transtheoretical model [48], stages of change and I-Change model [5], and social-cognitive theory [2]. They are typically assessed using questionnaires at pre-to-post periods. In accordance with the social-cognitive theory [2] self-efficacy, intention and action planning mediated the change of PA behavior in older adults in the 10-week online PA interventions with the same intervention plus activity tracker in the study of Ratz et al. (2020) [35]. Based on the socio-ecological model there are interactions between all levels and variation between causal factors and preventions at each level can be measured as, for instance, using example of the loneliness framework [30]. All of the said above suggest that effectivity of loneliness reduction PA interventions for older adults can be increased by implementing one of above behavioural change strategies for promoting and increasing PA.

Recruitment difficulties

Another problem is a community-based recruitment of older adults at risk of loneliness into PA interventions, which is a challenge of health-care providers [26,40]. Identifying and recruiting older adults into loneliness reduction PA interventions is difficult due to lack of transparency in assessment of loneliness and the relative lack of it's precise definitions [41]. Such methods of recruiting as mass-media advertisement and the use of flyers and leaflets are common for research interventions due to limited resources available [40], however they are biased to particular category of participants who are willing to participate and leaving those who are most at risk not covered. Also, mass advertisements is less effective than recruitment though general practitioner (GP) which is used in minority of studies and requiring more time associated with ethical approval and resources for the study [26]. Other beneficial methods of recruitment of older adults at risk of loneliness can be referrals by recognised agencies, used either alone or together with other methods of recruitment. Previous research with older adults showed effects of a personalised invitation card in the envelope delivered to the door, use of local social community clubs for advertising intervention, a word-of-mouth and by contacting the activity leaders of community organisations [26]. Participants can also be recruited through local commercial mailing list of residents depending on the sources available for the study. In addition to self-report standardised loneliness tools to recruit participants based on loneliness, such as the UCLA Loneliness Scale [38] and the de Jong Gierveld Loneliness Scale [17], assessment of other risk factors must be assessed to include those at high risk [4]. Among factors associated with loneliness in pre-

vious research were such as poor health condition, independent living, perceived loneliness (widowhood or loss of a close friend), relocation and change in socio-cultural environment, low education level, ethnicity and other factors that often stay neglected. Victor et al (2020) for instance, used a combination of a self-report assessment of loneliness using the 3 item UCLA with a score of 6 and over for defining loneliness (from 3 = not lonely to 9 = lonely) and a question about how often people felt lonely in their area of residence (area-based; ranging from 1 = often to 7 = never, using cut off 4+ to define loneliness).

Control group condition

The wait-list control (WLC) group condition was used in the PAIL feasibility study, which is likely to generate a nocebo effect (a worsening symptom of disappointment, e.g., anxiety, worsening psychological well-being) as opposed to no treatment control group or placebo condition [16]. Those potential participants who are promised to receive an intervention later may remain inactive and not seek for further solutions to the health problem as promised the delayed intervention. This can result in worsening of depression symptoms and further impair their psychosocial well-being [16]. This WLC condition may also induce a certain frustration associated with waiting for the promised intervention and increase feelings of despair and uncertainty and, therefore, overestimate the effect size estimate [19]. On the contrary, in 'no treatment' condition approach participants who was not promised any intervention and asked not to change their lifestyle will remain motivated to seek for advice for activity in the future [16]. Also, there is a likelihood of a high drop-out rate in participants assigned to WLC condition. However, for feasibility studies the amount of time and resources can be significantly saved using the WLC condition approach. Therefore, the future study may utilise control (sedentary) group condition to account for the limitations associated with WLC design in the large-scale RCT. In addition, the limitations associated with ethical reasons of not receiving the promised interventions in no treatment control group should also be discussed.

Health education classes

Group health education classes conducted only for lonely individuals may increase "the tendency of negativity" of lonely individuals [23, p.571]. Lonely people often lack essential social skills to develop relationships with strangers and were shown to have unrealistic friendship expectations. With this intervention programmes designed to form social relationships in lonely people in specially created experimental setting (such as health education classes) may not always work. This is coincident with the results of qualitative analysis conducted in PAIL intervention [40] where participants expressed opinion to use less formal approach to health education classes and conduct them not in the class environment (preferable outdoor) and to be free from obligatory attendance (e.g. as an invitation to attend the health education classes in the free time). Therefore, inclusion of health education classes should be added as extra activity for older adults who wish to listen to the topics of their choice and freely communicate with others to share their opinions. The format of round tables can be applied instead of the structured small group conversation with a leader being a moderator of discussions between participants.

Conclusions

The existing effects of loneliness reduction PA interventions older adults both obtained from the systematic review and the feasibility trial evidence need to be improved in order to proceed to the large-scale trial. Improvements must be implemented in the research design that can be strengthened by inclusion of a theory-based approach to the stages of change and health-promotion strategies of PA, as well as the content and delivery on the walking-based intervention. These major alterations suggested above may be plausible and implementation of the feasibility study with further adaptation to the community-dwelling older adult population may result in better effect on psychosocial outcomes. Bearing in mind that psychosocial environment can have a significant effect on health behavior of older adults and their physical health, delivery of such intervention can significantly advance the existing knowledge for health and clinical professionals in healthy ageing area. Future studies should incorporate a robust methodology and contribute to the consequent high quality randomised controlled study to generate the evidence-based knowledge.

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Tomsk International Marathon: online competitions to keep up sporting motivations in crisis periods

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Abstract

Objective of the study was to analyze benefits of the traditional Tomsk International Marathon model to keep up the running community's competitive motivations in the global health crisis period.

Methods and structure of the study. Tomsk is one of the 13 largest cities in the Asian Russia that has hosted, since 2018, the Tomsk International Marathon in compliance with the AIMS (Association of International Marathons and Races) and WA (World Athletics) rules, with a special contribution from the local running community. The Tomsk International Marathon is ranked among the top five marathons in Russia, with the Tomsk International Marathon running community estimated at 7100 runners as of early 2020.

Results and discussion. Since the modern sports remain one of the key elements of the modern healthy lifestyles, we have reasons to believe that in the crisis periods (1) sports offer a powerful toolkit to encourage the human resource mobilizing, development and healthy lifestyle popularizing initiatives; (2) sports communities in their social dimensions may be highly effective in changing popular attitudes to the sporting lifestyles with their habitual training agendas; and (3) running communities may take leadership in the crisis periods to motivate people for new forms of competitions including the online ones, to successfully cope with the challenges of pandemic restrictions and lockdowns.

Keywords: *running community, COVID-19, healthy lifestyle, motivation, social institute, sports, Tomsk International Marathon, questionnaire survey.*

Background. Modern world of sports has developed a wide range of popular amateur and professional associations including sports clubs, sport schools, sports interest communities and other social tools and institutions geared to motivate people for sports, enrich their lifestyles with sporting interests and change their health agendas. The ongoing global COVID-19 pandemic since the early 2020 has forced most of the world nations to protect public health by multiple restrictions and lockdowns of many social services and businesses including fitness clubs, sports facilities, traditional tournaments and other public events, with a wide range of negative consequences for professional and amateur sports and athletic training systems and services. Sporting communities since then нaмy made attempts to respond to the crisis by special systemic service models for athletes to keep up the training process and competitions wherever possible.

Objective of the study was to analyze benefits of the traditional Tomsk International Marathon model to keep up the running community's competitive motivations in the global health crisis period.

Results and discussion. Tomsk is one of the 13 largest cities in the Asian Russia that has hosted, since 2018, the Tomsk International Marathon in compliance with the AIMS (Association of International Marathons and Races) and WA (World Athletics) rules, with a special contribution from the local running community. The Tomsk International Mara-

thon is ranked among the top five marathons in Russia, with the Tomsk International Marathon running community estimated at 7100 runners as of early 2020 – that is a great progress since 2018 when the local running community reported only 200 athletes [5, 6]: see Table 1.

Therefore, the local organized running community has clearly encouraged the popular inflow to the sport, although the progress was stalled since the early 2020 by the global pandemic and the resultant economic crisis. A questionnaire survey in March 2020 of 1000 Tomsk International Marathon running community members found 87% of the sample seriously unmotivated for habitual trainings due to the stalled competitions; and 93% reported being unfamiliar with the potential online competitive options: see Table 3.

Based the questionnaire survey data, the Tomsk International Marathon running community has taken active physical education and sports promotion initiatives with a special emphasis on the health and physical fitness benefits of the habitual trainings rather than competitions only [3, 4, 8]. As a result, a new questionnaire survey in May 2020 of 1000 running community members found only 17% still unmotivated for habitual trainings and 87% willing to compete online: see Table 4.

Therefore, the new questionnaire survey proved progress of the Tomsk International Marathon running community sport encouragement initiatives and a potential demand for an international online race. The event called Grand Prix attracted 1050 virtual competitors from all over the planet, with the actual competitors registered on the start of the event estimated at 95% of the applicant pool versus 80% typical for the offline races.

Conclusion. Since the modern sports remain one of the key elements of the modern healthy lifestyles, we have reasons to believe that in the crisis periods (1) sports offer a powerful toolkit to encourage the human resource mobilizing, development and healthy lifestyle popularizing initiatives; (2) sports communities in their social dimensions may be highly effective in changing popular attitudes to the sporting lifestyles with their habitual training agendas; and (3) running communities may take leadership in the

Table 1. *Tomsk International Marathon: 2014-17 qualification statistics*

Events	2014	2015	2016	2017
My Marathon	60	53	67	116
Cosmic Marathon	72	104	162	184

Note that since the Tomsk International Marathon running community launched its mass physical training and sports initiatives with a special priority to the running sports promotion aspects, the local running community has grown up 35 times to 7100 people [6]: see Table 2.

Table 2. *Tomsk International Marathon: 2014-19 qualification statistics*

Events	2014	2015	2016	2017	2018	2019
My Marathon plus TRC events	60	53	67	116	2098	6716
Cosmic Marathon	72	104	162	184	213	384

Table 3. *Questionnaire survey of the Tomsk International Marathon running community sample in March 2020*

	Are you still in habitual training?	Are you ready to compete online?	Are you motivated for hard trainings?	Would you compete online in 2020 if there are no public competitions?
Yes	15	7	13	10
No	85	93	87	90

Table 4. *Questionnaire survey of the Tomsk International Marathon running community sample in May 2020*

	Are you still in habitual training?	Are you ready to compete online?	Are you motivated for hard trainings?	Would you compete online in 2020 if there are no public competitions?
Yes	78	87	83	95
No	23	13	17	5

crisis periods to motivate people for new forms of competitions including the online ones, to successfully cope with the challenges of pandemic restrictions and lockdowns.

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Biologically active additives (baa) for energy generation in ice hockey

UDC 615.1

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Abstract

Objective of the study was to analyze benefits of modern biologically active additives for energy generation mechanisms in the ice hockey sport.

Methods and structure of the study. We conducted a systematic review of the scientific research on the keywords: hockey, nutrition, sports nutrition, nutraceuticals, biologically active additives in two electronic databases Elibrary.ru and Pubmed.

Results and conclusions. The review considered the biochemical features of energy supply of ice hockey players. We analyzed the process of renewal of the main sources of energy before, during, and after the game: ATP, creatine phosphate in the muscles, glycogen in the muscles and liver using biologically active additives. A review of the activities on the acceleration of metabolism of the substances that restrict energy supply in ice hockey is included.

The authors note that the combination of ATP with hydroxymethyl butyrate is the most effective way to increase the level of ATP in the muscles with a high level of evidence. It is shown that creatine has an ergonomic effect on ice hockey players. The effects of creatine are associated with its positive impact on the neuromuscular function and the increase of glycogen in the muscles due to the protein (glucose transporter GLUT4) expression of the glucose-carrying protein.

Supplementation for the purpose of emergency compensation of carbohydrates during the training and competitive activities (carb mineral drinks) gives an opportunity to replenish the energy consumption as early as in the course of the game, improves a number of performance indicators, and replenishes glycogen depot levels.

The consumption by ice hockey players of the biologically active additives containing leucine, glutamine, BCAA, magnesium, thiamine, biotin, and lipoic acid inhibits the accumulation of lactic acid in the body. The lactat acid acidosis levels can be reduced by taking such biologically active additives as beta-alanine and carnosine (beta-alanine-L-histidine). When an athlete ingests amber acid (succinate) in the form of biologically active additives, his cellular respiration is increased and aerobic glycolysis is stimulated.

Keywords: *sports, athletes, ice hockey, biologically active additives.*

Background. It is common knowledge nowadays that competitive progress in modern ice hockey may be facilitated when the coaching teams are competent in the sport-specific dieting issues, with a special role played by modern dietary supplements with biologically active additives for the physical progress and performance enhancement purposes.

Objective of the study was to analyze benefits of modern biologically active additives for energy generation mechanisms in the ice hockey sport.

Methods and structure of the study. We analyzed for the purposes of the study the relevant study reports on modern ice hockey, diets, nutraceuticals and biologically active additives including those in the Elibrary.ru and Pubmed databases.

Results and discussion. Generally the energy supply mechanisms in ice hockey are dominated by muscle ATP, muscle creatine phosphate, blood glucose and muscle/ liver glycogen. Individual performance and teamwork on the whole heavily depends

on how timely and efficient the intake or bodily synthesis of the agents with high ergogenic values is.

Muscle ATP driven energy supply mechanism normally takes a few seconds for mobilizing. It was in 2014 that R. Jager et al. [5] found the universal ergogenic effect of a 12-week high ATP intake course (400 mg/ day), with the skeletal muscle strength and power tested to grow by above 30%. In 2012-2016, a series of randomly sampled double blind, placebo-/ controlled dieting studies of the ergogenic effects of a few ATP supplements (enteric Peak ATP and ATP-Long agents) found the combination of ATP with hydroxymethyl butyrate (HMB, an organic acid produced as a result of amino acid leucine disintegration) being most beneficial for energizing purposes [1]. The combination of HMB (3 g/ day) with ATP (400 mg/ day) was tested of synergizing effect on the skeletal muscle strength growth due to the endogenous ATP synthesis going even under extreme physical stress.

Alactate energy supply mechanism is mobilized in the maximal power zone to last for 20s at most. This energy generation mechanism is secured mostly by the creatine phosphate based ATP production, with the process productivity dependent on the creatine phosphate level in muscles. Creatine was tested with an ergogenic effect on ice hockey players [6] apparently due to its benefits for neuromuscular functionality and contribution to the muscle glycogen resource by the glucose transporting protein GLUT4.

Aerobic glycolytic energy generation mechanism may be ranked number one for ice hockey. Individual glycolytic resource largely depends of the carbohydrate reserves in the form of glycogen in muscles and liver and free glucose in the blood. This is the reason why athletes are recommended high-carbohydrate diets with carbohydrates making up to up to 8-13g per kg of body mass with an emphasis on complex carbohydrates (vegetables, grains, bread, pasta, cereals, rice and legumes) to keep the glycemic index within the optimal range.

Active athletes need their glycogen depots being replenished after trainings and competitions. Thus they are recommended, within the so-called "carbohydrate window" (at most 30 minutes upon completion of a match), taking at least 1g of carbohydrates per kg of body mass with banana, baked potatoes, dried fruits, smoothies, etc.; since 60% of glycogen needs to be replenished within the first two hours after training or match, otherwise (when it takes the whole day or more), the rehabilitation sand fitness rebuilding processes may be stalled.

Instant carbohydrate compensations in trainings and competitions (by carbohydrate-rich soda drinks) make it possible to offset the energy costs on the run, improve performance and restore glycogen depots. Thus the American College of Sports Medicine recommends diets of 0.7g of carbohydrates per kg of body mass per hour when training or competing in the form of glucose-electrolyte drinks (6-8% solutions) to keep up the blood glucose levels and prevent dehydration and potential immunosuppressive effects [7].

Modern ice hockey players are known to widely use stimulants. Thus R.T. Bents and E. Marsh [2] reported 51.8% of the ice hockey sample surveyed making resort to stimulants prior to a match. J. Coso et al. [3] found 3 mg of caffeine per kg of body mass to significantly improve the ice skating speed and intensity with the relevant benefits for competitive performance.

The glycolytic energy supply mechanism is critical for the individual ability to cope with the lactic acid accumulation and the relevant adverse effects. Dietary supplements with leucine, glutamine, BCAAs, magnesium, thiamine, biotin and lipoic acid effectively prevent accumulation of lactic acid in the anaerobic glycolysis by converting pyruvate into agents with no suppression effects on the energy generation (alanine, oxaloacetic acid, acetyl CoA).

The efforts to limit the lactate accumulation shall be complemented by the initiatives to remove the produced lactate and thereby prevent lactic acidosis in trainings and competitions. These initiatives may be facilitated by such dietary supplements as beta-alanine (1.6-3.2g) and carnosine (beta-alanine-L-histidine, 4-6.5g). These biologically active additives not only mitigate acidosis, but also improve the contractility and elasticity of muscle fibers by stimulating the collagen formation and thereby delaying muscle fatigue.

Aspartic amino acid (aspartate) not only suppresses acidosis but also encourages synthesis of ATP, testosterone, somatotropin and insulin-like growth factor. This dietary supplement is recommended in precompetitive period since it increases the individual anabolic potential and contributes to the ATP synthesis. For the lactate removal purposes, 3g of this biologically active additive shall be taken 30-60 minutes prior to a match.

Aerobic glycolysis is launched only 30s after starting a physical work to peak after the 50s point. This time is needed for pyruvate to convert into Acetyl-CoA that goes through the Krebs cycle reactions to produce 38 ATP molecules. Intake of succinic acid (succinate) as a dietary supplement of 0.03g per 1 kg of body mass per day (straight after a lunch) enhances the cellular respiration and aerobic glycolysis. For prophylactics, up to 300 mg per day of the biologically active additives may be taken for 1-2 months. Coenzyme Q10 (60-100 mg) is known to have the same effect on aerobic glycolysis. It is essential for the ATP synthesis efficiency, with 95% of the whole cellular energy known to be generated with a contribution from coenzyme Q10.

Vitamin D3 is of special benefits for application in ice hockey for energy supply and performance enhancement purposes [4, 9] as has been demonstrated by the recent study reports. It was found to increase the maximal oxygen consumption and muscle strength, reduce muscle inflammation and stimulate testosterone production, with enhancement of the energy generation mechanisms in hockey players. It should be noted that 23 studies that sampled 2,313 athletes on the whole found 56% (44% to 67%) of the total sample and 40% of the ice hockey subsample having vitamin D3 deficiencies [9].

One of the studies mentions that since 2007 the Chicago Blackhawks (a professional US ice hockey club) players were taking 5,000 IU vitamin D3 per day [12]; and it took only 2 years for the club to make progress from the last place on the scoreboard to the Stanley Cup title. None of their competitors was taking vitamin D3 until 2008. Nowadays athletes are recommended 1000 IU of vitamin D3 on a daily basis [4, 9].

Conclusion. Energy supply mechanisms and performance in modern ice hockey largely depend on diets on the whole and dietary supplements in particular with the biochemical response encouragement effects of the latter.

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Russia and China national youth volleyball teams: injury data analysis on gender- and age- specific basi

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Abstract

Objective of the study was to analyze the gender- and age-specific injury statistics of the China and Russia national youth volleyball teams and develop injury prevention recommendations.

Methods and structure of the study. We run an expert questionnaire survey to mine and analyze the injury data on a sample of China (Henan province) 13-17-year-old volleyball elite (189 men and 139 women) with the sports records of 2-8 years (see Table 1 hereunder). The peer Russia volleyball elite injury data were mined in the relevant study reports. A comparative analysis of the above data could be beneficial, as we believe, for the injury prevention and progress facilitation goals.

Results and conclusions. The study found that the vulnerable parts of the Chinese male volleyball players were fingers, ankles, shoulders, elbows, waist, knees, and wrists, and in women - fingers, ankles, waist, shoulders, and knees. In addition, it was found that leg injuries were more common among the Russian volleyball players. The Russian volleyball players suffered 4 major volleyball-related injuries: ankles, fingers, knees, and shoulders. The injury data analyses give grounds to offer the following injury prevention recommendations for the physical training systems:

- A special attention will be paid to the minor/ moderate injuries of ligaments, muscle overstrain and bruises, particularly in the beginner trainings; plus prevention of injuries of the most sensitive bodily parts including fingers, ankles, knees, shoulders, waist and back in the everyday trainings;
- The youth team training and competitive systems will be prudently designed, scheduled and customized to the actual physical and technical fitness levels; and they shall never plainly mimic the adult ones. A special priority will be given to the comprehensive physical fitness and standard sport-specific motor skills building components at no risk for the natural movement biomechanics to fully prevent acute injuries in the process.

Keywords: *youth volleyball, injury rate, national volleyball team, Russia, China, gender-specific injury incidence.*

Background. Sports-related gender- and age-specific injury data analyses are commonly acknowledged as critical for the injury prevention and competitive progress facilitation initiatives. The China and Russia national volleyball teams, particularly the women's ones, have long been ranked among the world leaders. A comparative gender- and age-specific national team injury data analysis could be very beneficial for the injury prevention and theoretically grounded training system improvement projects in the both countries.

Objective of the study was to analyze the gender- and age-specific injury statistics of the China and Russia national youth volleyball teams and develop injury prevention recommendations.

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comparative analysis of the above data could be beneficial, as we believe, for the injury prevention and progress facilitation goals.

Table 1. *China and Russia national volleyball teams: injury data*

Sample, data	Men	Women
Headcount, n	189	139
Total injuries, China	82	58
Total injuries, Russia	89	59
Injury rate, %	49,2%	42,4%

Results and discussion. Note that 40.2% (n=140) of the China sample (n=328) reported individual injury histories; with 152 injury cases in total and 46.3% injury rate (computed as the injuries to the total sample ratio) – versus the 45% injury rate with a growth trend in the Russia sample.

The injury survey and examination of the China sample found [7] 112 out of 117 athletes reporting 211 injuries i.e. 1.80 cases per capita. A special survey of the China college subsample [3] found everybody of 72 players having injuries i.e. the injury rate was 100%, with the injury rate of 1.89 cases per capita.

Furthermore, the injury survey of the [China] 19-minus year-old women's volleyball subsample [4] (n=142) at the First National Youth Games found a 64% injury rate. Note that the injury rate refers only to the active competitors net of the seriously injured ones who failed to qualify for the event, that means that the injury rate was clearly underreported. On the whole, the injury rates in youth teams are lower than in professional and college volleyball teams albeit still high and, hence, deserve special attention. The relatively low injury rates may be partially attributed to the relatively low skill levels and intensity of the trainings. Longer-term studies of the China samples have found the men's teams most exposed to finger, ankle, shoulder, elbow, waist, knee and wrist injuries; and the women's teams to the finger, ankle, waist, shoulder and knee injuries. Note that the Russian samples were found more exposed to lower limb injuries.

The Russia volleyball injury statistics for the last 25 years reports the ankle, finger, knee and shoulder injuries among the top four cases, with both acute and fatigue-related habitual injuries (due to the long intensive work with micro-traumas of tissues) reported typical for modern volleyball [9]. Aagaard and Jorgensen classified 97% of the finger injuries and 86% of the ankle injuries with the acute injury class; and 90% of the shoulder injuries and 88% of the knee injuries with the fatigue-related class. They also found at least 55% of the fatigue-related injuries caused by trainings, and 74% of the acute injuries by competitions [8]. Thus the ankle injuries were found dominated by ankle sprains [12] followed by bursitis and fractures (typically hand fingers) [11] in the Russia sample, with the situation largely the same in the China sample.

It should be noted that adolescents are vulnerable to interphalangeal joint injuries due to the still underdeveloped/ weak local muscles and ligaments [6] than often fail to stand high competitive pressures and high ball speed. Ball receiving, passing and blocking moves often result in excessive tension on the fingers and, hence, acute injuries. Excessive ball striking in trainings and competitions may trigger chronic injuries of the interphalangeal joints. As reported by the interviewed coaches, the interphalangeal joint injuries are often caused by the imperfect blocking and excessively strong striking techniques. Players are never fully immune to errors in the ball reception techniques with the fingers exposed to overstrain and injuries as a result. Furthermore, the sport-specific fast jumping and landing moves expose the ankles to high tension that may cause fatigue, hypertension and landing errors with the foot being suddenly contorted and the relatively weak lateral collateral ligament sprained on the outside.

The frequent striking actions imply fast rotations in the shoulder joints with the arms intensively stretched and the tendons of the long heads of the biceps sliding in the nodal groove. High-intensity trainings and competitions with the local overstrain often cause the tendon sheath to wear off and chronically inflame, with the athletes being diagnosed with the biceps tendon tendosynovitis as a result. In the efforts to fast build up the striking speed, the athletes tend to give a special priority to the shoulder joint forward/ downward flexor strengthening trainings often at sacrifice of the scapular muscles strength. As a result, the latter may be overstressed by heavy strikes [6] – when the deltoid muscles of a young athlete are still underdeveloped. When such athlete spikes in an effort to save the ball and lands on the shoulder, he/she often injures the acromion.

It should also be emphasized that the adolescent newcomers to volleyball are still technically unskilled, their 'ball feel' is still underdeveloped and no wonder that they are highly exposed to finger injuries. Their movement controls, jumping and landing techniques are still poor as well that makes them vulnerable to ankle injuries, particularly when their enthusiastic running and jumping workloads are mismanaged. Many of them may have elbow injuries due to the technically unskilled efforts to save balls by spiking.

Conclusion. The injury data analyses give grounds to offer the following injury prevention recommendations for the physical training systems:

– A special attention will be paid to the minor/ moderate injuries of ligaments, muscle overstrain and

bruises, particularly in the beginner trainings; plus prevention of injuries of the most sensitive bodily parts including fingers, ankles, knees, shoulders, waist and back in the everyday trainings;

– The youth team training and competitive systems will be prudently designed, scheduled and customized to the actual physical and technical fitness levels; and they shall never plainly mimic the adult ones. A special priority will be given to the comprehensive physical fitness and standard sport-specific motor skills building components at no risk for the natural movement biomechanics to fully prevent acute injuries in the process.

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