



T & P P C

№ 12 December 2021

# Theory & Practice of Physical Culture

Athletic  
training

Sport  
psychology

Academic  
physical education

Sport  
physiology

***Key issues of the modern sports science for discussion*****Priorities of the school Olympiad in physical culture:  
sports talent or intelligence?**

School Olympiads began to develop rapidly. Every year, starting in September, schoolchildren from different regions of the country consistently participate in the qualifying rounds of the Olympiads – from school to municipal, regional and All-Russian stages.

2021 is the year of science and education. Many regions allocate grants and awards to expand the opportunities and status of the Olympiad movement. The successful performance of the student at the school Olympiad depends on painstaking and serious preparation, in-depth knowledge of the profile subject. The usual study of the standard of education, which is required when passing the Unified State Exam– is only the basic level of the content of the requirements and tasks of the school Olympiad. In addition, the student needs a highly competent knowledge of the subject.

The main goals and objectives of the All-Russian Olympiad of schoolchildren on the subject of "Physical Culture" are to identify and develop creative abilities and interest of schoolchildren in scientific work, improve physical qualities, and promote scientific knowledge. Mastering the subject content of this field involves the active involvement of students in the process of physical self-improvement, competitive activities, organization of independent studies and a healthy lifestyle. Each stage of the Olympiad is a competitive test of students, including theoretical and practical components. Theoretical and methodological testing consists in performing tasks differentiated by sections of theory, the level of complexity of which increases depending on the stage of the Olympiad. Practical tests include exercises based on the content of educational

programs of basic general and secondary general education of advanced level on the subject of "Physical Culture". Olympiad tasks consist of technical techniques characteristic of the sport in which the test is conducted.

The Olympiad requires students to work at a high intellectual level, involves their application of knowledge in a non-standard situation, possession of skills of analysis, synthesis, a logically constructed system of knowledge and skills on the subject of "Physical Culture".

How to choose a student who is capable of successfully participating in the school Olympiad? What are the abilities to focus on: the ability to perform motor tasks or the child's ability to think logically, analyze and form conclusions? What is more important for a successful performance: motor experience or mental development? It seems that the answer to this question is obvious: a harmonious combination of physical qualities with the intellect of the student. Practice shows that a student who is well physically prepared, but does not master theory well, is very difficult to pull up in school. At the same time, it is difficult to compete for prizes at the Olympics without a good knowledge of theory, especially at the regional and All-Russian stages.

To improve the effectiveness of classes, it is necessary to use meta-subject connections, ensure the participation of schoolchildren in competitions, use modern methods, principles and means of preparation. Psychological and emotional components are also important for the participant of the Olympiad. Preparation for the Olympiad is the creation of a team of like-minded people who are ready to fight and win! *We invite scientists to publish articles that are aimed at finding new approaches in the development of sports science.*

**Editor-in-Chief, Honored Worker of Physical Culture of the Russian Federation, Ph.D., Professor L.I. Lubysheva**

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Theory and Practice  
of Physical Culture

# Theory and Practice of Physical Culture

## Contents

### SPORTS TRAINING

|                                                                                                                                                                  |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>L.D. Nazarenko, I.N. Timoshina, O.L. Bystrova</b> – Competitive performance modeling skills training method: tests and benefit analysis .....                 | 3  |
| <b>E.R. Akhmedzyanov, O.B. Dmitriev, P.K. Petrov</b> – Tournament bracket generation for martial arts events: digital draw algorithm .....                       | 5  |
| <b>M.Kh. Khaupshev, A.Z. Bazhev, A.A. Bazhev</b> – Motor coordination, visual function and functional/ sensory vision training system for volleyball sport ..... | 8  |
| <b>A.V. Arishin, A.I. Pogrebnoy</b> – Synergized physical and technical training model for 12-13-year-old swimmers: benefits for annual training cycle .....     | 12 |
| <b>Paulina Szyszka</b> – Changes in muscle strength moments and weightlifting performance gains during two-year training cycle of young weightlifters .....      | 16 |
| <b>M. Lichota, K. Górniak, T. Sacewicz, D. Sadowska</b> – Body balance of male football players aged 7-10: pilot study .....                                     | 20 |
| <b>A.V. Voronov, P.V. Kvashuk, R.V. Malkin, N.B. Kotelevskaya</b> – Paddling machine for kayaking sport: biomechanical tests and benefit analysis .....          | 24 |
| <b>M.Y. Stepanov, M.B. Salamatov, S.A. Sharipov</b> – Interval test training model for junior martial artists .....                                              | 27 |

### SPORT PHYSIOLOGY

|                                                                                                                                                                    |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>N.I. Shlyk</b> – Standards for variation range of RR-intervals at rest and in orthostasis in training of racing skiers with different types of regulation ..... | 30 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|

### ADAPTIVE PHYSICAL EDUCATION AND SPORTS

|                                                                                                                                                   |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>V.F. Lutkov, L.L. Miller, G.I. Smirnov, D.I. Shadrin</b> – Physical overstrain in sports: modern prevention and rehabilitation procedure ..... | 35 |
| <b>I.I. Shumikhina, R.Kh. Mitrichenko</b> – Impact of adaptive physical education on health of students from various nosological groups .....     | 38 |
| <b>E.F. Nasyrova, O.Y. Muller</b> – Academic special health groups: physical education and sports motivations and values survey .....             | 41 |

### VOCATIONAL TRAINING

|                                                                                                                                              |    |
|----------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>E.Y. Mikhailova, E.V. Utisheva, N.G. Zakrevskaya, G.A. Androsova</b> – Academic physical education and sports system: gender aspect ..... | 44 |
| <b>O.B. Dmitriev</b> – Faceted classifiers and essays in new e-test system: benefit analysis .....                                           | 47 |

### PEOPLE'S MOTOR ACTIVITY

|                                                                                                                                                                                                   |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>O.V. Timofeeva, E.A. Lubyshev, N.A. Ibragimova, D.V. Vyprikov</b> – Anthropometric analysis and body sculpt improvement in application to female students from cheerleading picked teams ..... | 50 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|

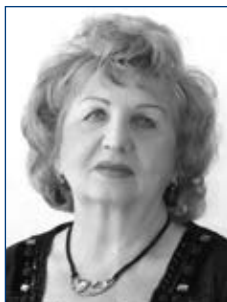
### PERSPECTIVE

|                                                                                                                                                                                                |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>A.A. Raizikh, S.S. Maksimova, A.E. Alabuzhev</b> – Theoretical and practical tests in All-Russian School Physical Education Olympiad .....                                                  | 53 |
| <b>G.V. Bogomolov, V.A. Furaev, S.A. Vorobev</b> – National physical education and sports sector progress forecast using federal statistical report forms processed by modern IT toolkit ..... | 56 |
| <b>G.V. Merzlyakova, V.V. Novokreshchenov, A.E. Alabuzhev</b> – University physical education and sports advancement program: provisions and analysis .....                                    | 59 |
| <b>P.K. Petrov</b> – Digital progress trends in national physical education and sports sector .....                                                                                            | 62 |
| <b>S.A. Alabuzhev, A.P. Knyazev</b> – Public information services of regional sports federations: demand and supply situation survey.....                                                      | 65 |



# Competitive performance modeling skills training method: tests and benefit analysis

UDC 796.32



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## Abstract

**Objective of the study** was to develop and test benefits of a new competitive performance modeling skills training method in application to the skilled 17-19-year-old volleyball players.

**Methods and structure of the study.** We sampled for the competitive performance modeling skills training method testing experiment the 17-19-year-old Class I/ II players (n=28) and split them up into Reference and Experimental Groups (RG, EG) of 14 people each. Pre-experimental physical fitness tests (including the 3/ 6m sprints (s); standing long/ high jumps (cm); and 1kg fitball jump throws – straight and left-/ right-turn ones) found insignificant intergroup differences ( $p>0.05$ ). Pre-experimental technical fitness tests (including the situation-specific response efficiency; motor skills control on the move; and situation-specific attacking skills tests) also found insignificant intergroup differences ( $p>0.05$ ). The RG training in the experiment was standard, and the EG training was complemented by the new competitive performance modeling skills training method.

The competitive performance modeling skills training method offered special training tools to excel the specific perceptions, attention control, motor memory and a range of other individual intellectual and physical qualities.

**Results and conclusion.** The new competitive performance modeling skills training method was tested beneficial for the situation specific responses and control excellence purposes as verified by a set of the group pre- versus post-experimental physical / technical fitness tests, with special improvements in a range of intellectual performance and practical aspects. The improved competitive performance modeling skills were found to contribute to the game reading, forecasting and analyzing abilities for fair analyses of the own/ opponent's technical performance of special importance for the competitive experience building aspect.

**Keywords:** volleyball, actions modeling, educational experiment.

**Background.** Motor skills excellence trainings for competitive progress in modern volleyball require persistent efforts to train the sport-specific perceptions, attention control, motor memory and a range of other individual intellectual and physical qualities; with the motor perceptions and motor skill control and excellence tools being critical for the competitive performance and progress modeling purposes.

**Objective of the study** was to develop and test benefits of a new competitive performance modeling skills training method in application to the skilled 17-19-year-old volleyball players.

**Methods and structure of the study.** We sampled for the competitive performance modeling skills training method testing experiment the 17-19-year-old Class I/ II players (n=28) and split them up into Reference and Experimental Groups (RG, EG) of 14 people each. Pre-experimental physical fitness tests (including the 3/ 6m sprints (s); standing long/ high jumps (cm); and 1kg fitball jump throws – straight and left-/ right-turn ones) found insignificant intergroup differences ( $p>0.05$ ). Pre-experimental technical fitness tests (including the situation-specific response efficiency; motor skills control on the move; and situation-specific attacking skills tests) also found insignifi-



cant intergroup differences ( $p>0.05$ ). The RG training in the experiment was standard, and the EG training was complemented by the new competitive performance modeling skills training method.

The competitive performance modeling skills training method offered special training tools to excel the specific perceptions, attention control, motor memory and a range of other individual intellectual and physical qualities. A special priority was given to the individual perceptions of every competitive game action on an inclusive/ holistic basis i.e. as a combination of interrelated specific game elements classifiable by their contributions – from the core to associating secondary ones with their specific details when necessary – to help understand their complex relationships.

The perception excellence trainings included the following practices: (1) Name a specific technical skill as soon as you see it; (2) Analyze the technical skill structure and indicate its core technical element with the associating details; (3) Explain why the element plays the core role; and describe the details and their roles for success of the technical element; etc.

Other EG members were encouraged to assess the above partner responses with clarifications when necessary. A special attention in this training was given to objectivity, accuracy, perceptive clarity and good understanding of every opponent's/ partner's action and its contribution to success – to facilitate formation of due motor memory with its two most important aspects: scope and strength.

**Results and discussion.** Upon completion of the experiment, we run post-experimental tests to rate the group physical / technical fitness progress. The tests found progress in both groups, although the EG was tested significantly better in virtually every post-experimental test.

The group pre- versus post-experimental physical fitness tests yielded the following data. The RG and EG made progress in the standing high jump test from  $58.16\pm 4.65\text{cm}$  to  $59.97\pm 3.82\text{cm}$  ( $p>0.05$ ); and from  $57.29\pm 3.85\text{cm}$  to  $61.79\pm 5.35\text{cm}$  ( $p<0.05$ ), respectively. In the fitball jump throw tests, the RG and EG made progress from  $11.63\pm 2.15\text{m}$  to  $12.33\pm 1.77\text{m}$  ( $p>0.05$ ); and  $11.71\pm 1.55\text{m}$  to  $13.18\pm 1.82\text{m}$  ( $p<0.05$ ), respectively. The same advantage of the EG versus RG was found by other physical fitness tests.

The group pre- versus post-experimental technical fitness tests yielded the following data. The RG and EG made progress in the situation-specific response efficiency test from  $2.73\pm 0.32$  to  $2.88\pm 0.39$  points

( $p>0.05$ ); and from  $2.70\pm 0.24$  to  $3.62\pm 0.27$  points ( $p<0.05$ ), respectively.

And in the motor skills control on the move test, the RG and EG made progress from  $3.05\pm 0.26$  to  $3.17\pm 0.23$  points ( $p>0.05$ ); and from  $3.08\pm 0.20$  to  $3.72\pm 0.36$  points ( $p<0.05$ ), respectively. The same advantage of the EG versus RG was found by the other technical fitness tests.

Therefore, the group pre- versus post-experimental physical / technical fitness tests demonstrated benefits of the new competitive performance modeling skills training method in every aspect including the game-specific perceptions, motor memory, attention controls, analytical skills, opponent's actions reading/ forecasting and other skills – with the method used as complementary to the physical/ technical trainings of the 17-19-year-old volleyball players. This finding gives us the grounds to recommend the competitive performance modeling skills training method for application in the training systems.

**Conclusion.** The new competitive performance modeling skills training method was tested beneficial for the situation specific responses and control excellence purposes as verified by a set of the group pre-versus post-experimental physical / technical fitness tests, with special improvements in a range of intellectual performance and practical aspects. The improved competitive performance modeling skills were found to contribute to the game reading, forecasting and analyzing abilities for fair analyses of the own/ opponent's technical performance of special importance for the competitive experience building aspect.

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# Tournament bracket generation for martial arts events: digital draw algorithm

UDC 796.85: 004



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## Abstract

**Objective of the study** was to develop an efficient digital draw algorithm to generate tournament brackets for the martial arts events.

**Methods and structure of the study.** We developed the digital draw algorithm at the Physical Education Theory and Practice, Gymnastics and Life Safety Department of the Physical Education Institute of Udmurt State University. The digital draw algorithm was developed to complement the computer software toolkit for competitive event design, management and reporting by a Martial Arts Draw section. Generally, the modern martial arts communities set the following requirements for a draw algorithm and resultant tournament brackets: (1) Teammates (of the same regional team and/ or trained by the same coach) should compete at the latest stages; (2) Top-ranking athletes should compete in the finals; and (3) The draw system should be reasonably random, with the brackets expected to never repeat.

Every of the above requirements can be met quite simply. Thus, the teammates' matches may be prevented at the early stages by the tournament brackets with a rational numbering system that secures the teammates of the same region/ coach listed in a sequential manner. Individual competitive accomplishments will be fixed in a database of core events with respect to the ratings. Such rating systems need to be formed separately as provided, for example, in study. On the whole, a competitive draw system will offer a multi-criteria optimization method.

**Results and conclusion.** The digital draw algorithm of our design has been tested beneficial in the Udmurt-Republic-hosted martial arts events, with the digital-draw-algorithm-generated tournament bracket recognized efficient in sorting athletes by their professional skills, competitive ratings, regional teams and coaches. The digital draw algorithm is recommended for application in different sports events that imply draws to group the qualifiers using specific sets of grouping criteria dominated by their professional ranks.

**Keywords:** martial arts, draw, algorithm, rating, tournament bracket, digital draw algorithm.

**Background.** Presently the martial arts communities give a high priority to new digital draw algorithms with the relevant software toolkits geared to generate high-quality tournament brackets for the competitive events.

**Objective of the study** was to develop an efficient digital draw algorithm to generate tournament brackets for the martial arts events.

**Methods and structure of the study.** We developed the digital draw algorithm at the Physical Education Theory and Practice, Gymnastics and Life Safety Department of the Physical Education Institute of Udmurt State University. The digital draw algorithm was developed to complement the computer software toolkit for competitive event design, management and reporting by a Martial Arts Draw section [2]. Generally,

the modern martial arts communities set the following requirements for a draw algorithm and resultant tournament brackets: (1) Teammates (of the same regional team and/ or trained by the same coach) should compete at the latest stages; (2) Top-ranking athletes should compete in the finals; and (3) The draw system should be reasonably random, with the brackets expected to never repeat.

Every of the above requirements can be met quite simply. Thus, the teammates' matches may be prevented at the early stages by the tournament brackets with a rational numbering system that secures the teammates of the same region/ coach listed in a sequential manner. Individual competitive accomplishments will be fixed in a database of core events with respect to the ratings.



Such rating systems need to be formed separately as provided, for example, in study [1]. On the whole, a competitive draw system will offer a multi-criteria optimization method. When the lists of competitors are short and there are no time limitations, a good tournament bracket may be made by experienced service personnel. However, modern major martial arts events that require a draw every competitive day still need modern digital draw systems for efficiency.

The digital draw algorithm needs at least the following input data: lists of qualifiers for the events with their full names, ratings, regions and coaches. An Olympic-system-based tournament bracket will be generated as a binary tree with the winner, runner-ups and so on ranked from bottom (root) to top, respectively (Figure 1, a), with every leaf representing a competitor. When the number of competitors in  $N$  class equals to a degree of two, we obtain a full binary tree with the filled-in tournament bracket, otherwise a pre-qualification is needed. We may use  $2^{n-1} < N \leq 2^n$  precondition to find the number of qualifier rounds. When  $N < 2^n$ , we should add fictitious athletes to the  $N$  class with zero ratings and non-existent regions to make a full binary tree.

Having a full binary tree in the database, we now may do without a complex data processing procedure and use only a two-dimensional data array of  $n=1$  lines and

$2^n$  columns; with each element (tree node) in the array giving the relevant list of competitors (Figure 1, b). Each  $i$  line corresponds to  $2^{i-1}$  columns. Actual competitive practices show that the numbers of competitors in every class never exceed 64, although even a higher limit is acceptable for the memory claimed by the data storage capacity, with the data accessibility highly simplified.

Our digital draw algorithm includes the following sequential steps:

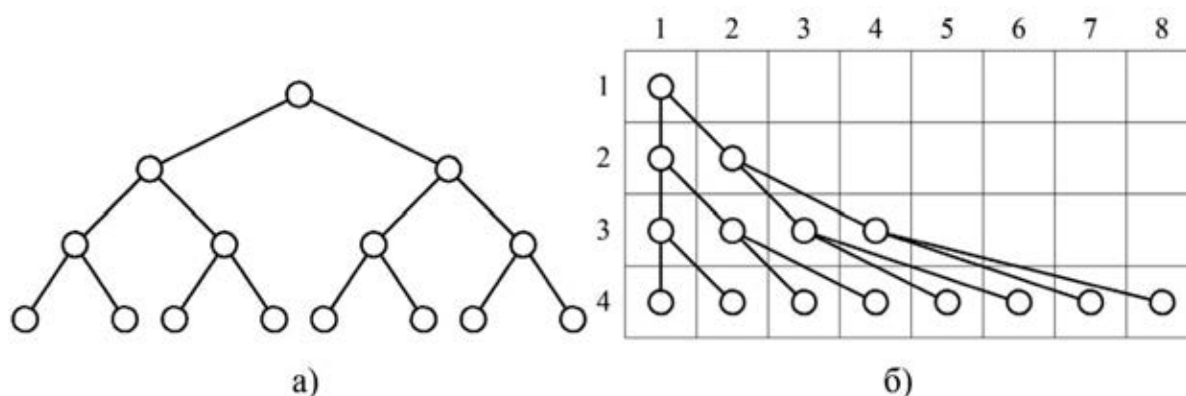
1. Make a full list of class  $N$  competitors for the relevant tree level ( $i=1$  line,  $j=1$  column).

2. Consider, in a cyclic manner, elements of the array for  $i$  line ( $i=1 \dots n$ ) and  $j$  column ( $j=1 \dots 2^{i-1}$ ). Group the competitors into two groups stored in the next line ( $i+1$ ) in the columns numbered  $(2j-1)$  and  $(2j)$ . The grouping will be made as follows:

(a) Put in the  $N$  class the individual ratings in a descending order;

(b) Select 50% of the leaders – at most two from every region/ coach;

(c) Add leaders to the groups using the "serpent" pattern [3], with the top rated athlete listed with the first group; second and third with the second group; fourth and fifth again with the first group, etc. When an athlete is grouped with his teammate, substitute him by a peer from another group of the same serpent lev-

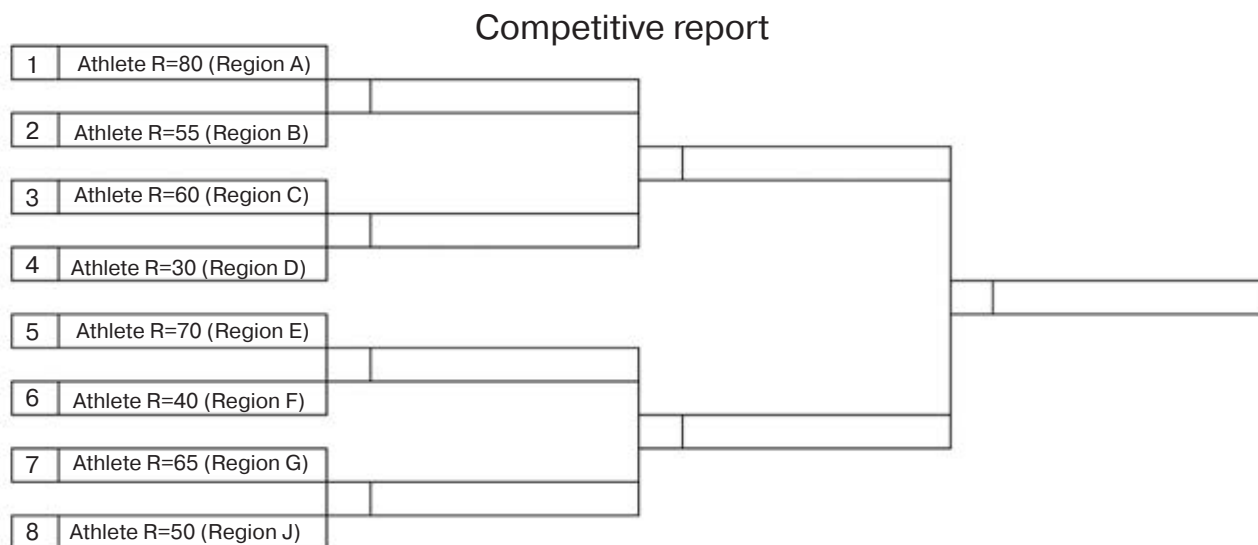


**Figure 1.** Binary-tree-shaped tournament bracket (a) and the relevant data array (b)

The tournament bracket is generated as follows: (1) Form a binary tree in parallel with the DD; and (2) Develop a digital draw algorithm for the binary tree.

**Fig. 2.** Excerpt from the Registration Form

| Draw | Sex | Last name | First name | Patronymic | Date of birth | Age | Title           | Region | Coach |
|------|-----|-----------|------------|------------|---------------|-----|-----------------|--------|-------|
| 1    | M   | Athlete   | R=80       |            | 15.10.2015    |     | Oriental Combat | A      | A     |
| 2    | M   | Athlete   | R=55       |            | 19.08.2015    |     | Oriental Combat | V      | V     |
| 3    | M   | Athlete   | R=60       |            | 07.07.2014    |     | Oriental Combat | B      | B     |
| 4    | M   | Athlete   | R=30       |            | 18.12.2015    |     | Oriental Combat | A      | A     |
| 5    | M   | Athlete   | R=70       |            | 09.10.2015    |     | Oriental Combat | B      | B     |
| 6    | M   | Athlete   | R=40       |            | 20.09.2014    |     | Oriental Combat | V      | V     |
| 7    | M   | Athlete   | R=65       |            | 25.11.2015    |     | Oriental Combat | G      | G     |
| 8    | M   | Athlete   | R=50       |            | 12.10.2015    |     | Oriental Combat | A      | A     |



**Figure 3.** Digital-draw-algorithm-generated tournament bracket

el. This procedure generates virtually the same group rating structures and prevents the teammates' matches at the early stages;

(d) Form teams of the remaining competitors by the regions/ coaches and rearrange the team members randomly; and

e) Add athletes from the randomly selected teams to the groups using the serpent pattern, to ensure that every region/ coach is equally represented in both groups.

3. Form the class N protocol by moving the competitors' data from  $i=n+1$  lines and  $j=1...2^n$  columns into a Microsoft Excel spreadsheet, with the tournament bracket formed by automatic references, and with the fictitious athletes' entries left empty in the tournament bracket.

**Results and discussion.** Given in Figures 2 and 3 hereunder are the sample digital draw algorithm for a tournament bracket of eight competitors. The digital draw algorithm has been successfully tested in the computerized tournament bracket and reporting system during the municipal/ regional/ federal multi-disciplinary karate and combat sports events hosted by the Udmurt Republic. Quality of the tournament brackets generated by the digital draw algorithm of our design was recognized by the event organizers and coaching teams.

**Conclusion.** The digital draw algorithm of our design has been tested beneficial in the Udmurt-Republic-hosted martial arts events, with the digital-draw-algorithm-generated tournament bracket recognized efficient in sorting athletes by their professional skills, competitive ratings, regional teams and coaches. The digital draw algorithm is recommended for application in different sports events that imply draws to group the

qualifiers using specific sets of grouping criteria dominated by their professional ranks.

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# Motor coordination, visual function and functional/ sensory vision training system for volleyball sport

UDC 797.212.4

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## Abstract

**Objective of the study** was to test and analyze benefits of a new visual function / motor coordination training system for volleyball players.

**Methods and structure of the study.** We run a yearly test of the visual function / motor coordination training equipment at volleyball sports schools of Kabardino-Balkarian State University and Kabardino-Balkarian State Agrarian University. We sampled for the tests the 9-10 to 19-20 year-old volleyball players (n=208) split up into six Reference Groups (RG) and six Experimental Groups (EG). The sample progress was tested by the direct/ feedback visual function and technical and tactical action accuracy tests.

**Results and conclusion.** Special trainings have proved to contribute up to 30-50% in the visual function / functional vision progress, although the traditional training systems never offer training equipment with a feedback capacity for the data flow accuracy control.

The experimental visual function / motor coordination training system for volleyball players was tested highly beneficial for harmonized motor coordination / visual function progress in the Experimental group versus the traditional training system. The new training technology effectively facilitated the visual function / technical and tactical action progress as verified by the individual progress profiles and databases. We recommend the new visual function / motor coordination training system and test data for application in volleyball training service.

**Keywords:** volleyball practices, visual function, motor coordination, training complex, health agenda.

**Background.** The visual function and motor coordination training elements in modern volleyball are always relevant for the players' game control and responses that need to be accurate, timely and highly efficient. Volleyball trainings give a special priority to visual function and functional vision i.e. controlled responses in the 'eye-hand, eye-ball, eye-partner' systems. Every action will start from the target being visually fixed in the premotor phase when the response is planned. Special accuracy trainings will develop movement phasing skills starting from the premotor phase for the motor skill stability and success. The visual function is undoubtedly critical for the sport-specific accurate movement controls and, therefore, need to be in special priority in the motor coordination training service elements [1-6, 11].

Motor coordination in the context of the special technical and tactical skills has been studied by many researchers. Volleyball is known to improve the visual function and functional vision in trainings due to the heavy flows of the game data need to be processed by the visual analyzer in rapidly changing game situations. Volleyball players would develop special functional vision with the feel of the court, partner, ball, net, distance, opponent, etc. These sensations tend to excel with trainings and competitions and sag in the idle periods [2, 4, 7, 9, 10, 12].

The visual function - functional vision excelling elements are relatively challenging for the traditional training systems, with the best alternative provided by the training equipment compliant with the K.K. Platonov's training simulator theory [8] and

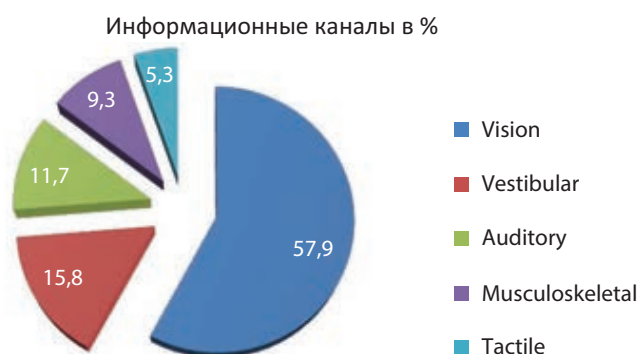


I.P. Ratov's training machine assisted sports motor skill theory [9], and the V.S. Farfel's instant data flow processing principles [10].

Objective of the study was to test and analyze benefits of a new visual function / motor coordination training system for volleyball players.

Methods and structure of the study. We run a yearly test of the visual function / motor coordination training equipment at volleyball sports schools of Kabardino-Balkarian State University and Kabardino-Balkarian State Agrarian University. We sampled for the tests the 9-10 to 19-20 year-old volleyball players ( $n=208$ ) split up into six Reference Groups (RG) and six Experimental Groups (EG). The sample progress was tested by the direct/ feedback visual function and technical and tactical action accuracy tests.

Results and discussion. Modern volleyball training systems give a special priority to sensory systems dominated by the visual function / functional vision excellence elements, with the motor skill known to be 50-70% dependent on the visual function / functional vision. Special trainings have proved to contribute up to 30-50% in the visual function / functional vision progress, although the traditional training systems never offer training equipment with a feedback capacity for the data flow accuracy control. For visual function / motor coordination progress, the volleyball training systems need to offer combined special signals to train perceptions, motor skill biomechanics, speed and accuracy on a harmonic basis. Such trainings will be focused on the visual signal perception, processing and response i.e. choice of the right 'action program' to attain the goal by special coordinated motor skill. Figures 1 and 2 hereunder give the data flow processing channels for the traditional and experimental motor coordination training models.



**Figure 1.** Data flow processing channels (%): traditional volleyball training system



**Figure 2.** Data flow processing channels (%): experimental volleyball training system

We tested the group progress by the Response to Moving Object (RMO) test; electronic reflexometer; peripheral (external, upper, lower) visual function by ophthalmic perimeter; binocular (in depth) visual function by the horizontal and linear perimeter visual function tests; and the technical and tactical action accuracy by UMV-2 system using the wall and floor targets. The test tools, methods and rating criteria have proved reliable and objective. The group pre-experimental tests found no significant EG/ RG differences ( $p_1 > 0.05$ ). The progress tests found insignificant ( $p_2 < 0.05$ ) progress in the RG and significant ( $p_2 < 0.01$ ) progress in the EG. The post-experimental tests found significant ( $p_3 < 0.05$ ) progress in the EG versus RG: see Table 1.

The motor skill / technical and tactical action accuracy showed little progress in the RG ( $p_2 < 0.05$ ), versus significant progress in the EG ( $p_2 < 0.01$ ). The post-experimental tests found significant ( $p_3 < 0.05$ ) progress in the EG versus RG. The yearly experimental model resulted in significant progress in the EG ( $p_2 < 0.01$ ) see Table 2.

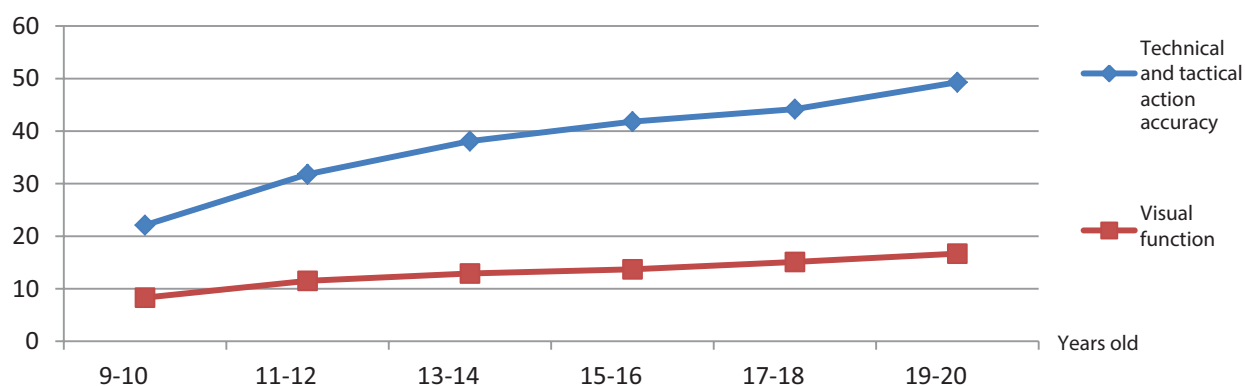
The group progress in the visual function components and motor coordination showed high effectiveness of the tests, with  $r_{tk} = 0.3 > 0.6$  that meets recommendations of well-known scientists. The tests made it possible for us to profile the age group progress. Figure 3 gives the visual function progress test data ( $p < 0.05$ ) and technical and tactical action accuracy test data for the EG ( $p < 0.01$ ). Note the direct high correlation ( $r=0.531 > 0.786$ ) of the visual function and technical and tactical action accuracy test rates – indicative of the high visual function contribution to the technical and tactical action accuracy.

**Table 1.** Group visual function test data

| Tests                      | Group | Age subgroups, years           |                                |                                |                                |                                |                                |                |
|----------------------------|-------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|----------------|
|                            |       | 9-10                           |                                | 11-12                          |                                | 13-14                          |                                | p <sub>2</sub> |
|                            |       | M <sub>1</sub> ±m <sub>1</sub> | M <sub>2</sub> ±m <sub>2</sub> | M <sub>1</sub> ±m <sub>1</sub> | M <sub>2</sub> ±m <sub>2</sub> | M <sub>1</sub> ±m <sub>1</sub> | M <sub>2</sub> ±m <sub>2</sub> |                |
| Target shooting accuracy   | RG    | 41,4±1,6                       | 45,7±1,6                       | 53,2±1,6                       | 59,4±1,6                       | 57,4±1,6                       | 60,7±1,6                       | <0,05          |
|                            | EG    | 42,2±1,6                       | 51,3±1,6                       | 53,6±1,6                       | 67,2±1,6                       | 58,3±1,6                       | 68,3±1,6                       | <0,01          |
| RMO                        | RG    | 43,3±3,7                       | 45,4±3,7                       | 48,6±3,7                       | 54,3±3,7                       | 52,1±3,7                       | 56,4±3,7                       | <0,05          |
|                            | EG    | 42,3±3,7                       | 49,9±3,7                       | 50,2±3,7                       | 61,1±3,7                       | 53,0±3,7                       | 61,4±3,7                       | <0,01          |
| Peripheral visual function | RG    | 44,3±1,2                       | 46,5±1,1                       | 49,1±1,2                       | 53,1±1,2                       | 52,1±1,2                       | 55,1±1,2                       | <0,05          |
|                            | EG    | 44,1±1,2                       | 51,8±1,2                       | 50,1±1,2                       | 60,3±1,2                       | 52,3±1,1                       | 61,2±1,2                       | <0,01          |
| Binocular visual function  | RG    | 46,3±1,3                       | 48,4±1,3                       | 49,1±1,2                       | 54,9±1,3                       | 51,2±1,2                       | 55,8±1,3                       | <0,05          |
|                            | EG    | 46,6±1,2                       | 52,4±1,3                       | 49,2±1,2                       | 60,7±1,3                       | 52,3±1,3                       | 61,8±1,2                       | <0,01          |
|                            |       | 15-16                          |                                | 17-18                          |                                | 19-20                          |                                | p <sub>2</sub> |
| Target shooting accuracy   | RG    | 62,2±1,6                       | 66,0±1,6                       | 66,1±1,6                       | 70,9±1,6                       | 69,4±1,6                       | 73,2±1,6                       | <0,05          |
|                            | EG    | 62,6±1,6                       | 71,9±1,6                       | 67,4±1,6                       | 75,8±1,6                       | 70,6±1,6                       | 78,4±1,6                       | <0,01          |
| RMO                        | RG    | 54,2±3,7                       | 58,3±3,7                       | 57,3±3,7                       | 61,2±3,7                       | 60,6±3,7                       | 66,4±3,7                       | <0,05          |
|                            | EG    | 55,4±3,7                       | 64,0±3,7                       | 58,2±3,7                       | 63,8±3,7                       | 62,3±3,7                       | 71,4±3,7                       | <0,01          |
| Peripheral visual function | RG    | 54,9±1,2                       | 58,3±1,3                       | 57,6±1,2                       | 64,2±1,2                       | 60,5±1,3                       | 64,6±1,3                       | <0,05          |
|                            | EG    | 54,9±1,2                       | 63,5±1,3                       | 58,1±1,3                       | 65,2±1,3                       | 60,7±1,3                       | 70,5±1,3                       | <0,01          |
| Binocular visual function  | RG    | 53,7±1,3                       | 58,8±1,2                       | 58,3±1,3                       | 63,4±1,2                       | 62,0±1,3                       | 67,2±1,3                       | <0,05          |
|                            | EG    | 54,9±1,2                       | 63,9±1,2                       | 59,4±1,2                       | 68,9±1,3                       | 63,0±1,3                       | 73,7±1,3                       | <0,01          |
| Significance rate          |       | p1>0,05                        | p3<0,05                        | p1>0,05                        | p3<0,05                        | p1>0,05                        | p3<0,05                        |                |

**Table 2.** Group technical and tactical action accuracy test data

| Tests             | Group | Age subgroups, years           |                                |                                |                                |                                |                                |                |
|-------------------|-------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|----------------|
|                   |       | 9-10                           |                                | 11-12                          |                                | 13-14                          |                                | p <sub>2</sub> |
|                   |       | M <sub>1</sub> ±m <sub>1</sub> | M <sub>2</sub> ±m <sub>2</sub> | M <sub>1</sub> ±m <sub>1</sub> | M <sub>2</sub> ±m <sub>2</sub> | M <sub>1</sub> ±m <sub>1</sub> | M <sub>2</sub> ±m <sub>2</sub> |                |
| Attack            | RG    | 22,0±4,4                       | 27,7±3,9                       | 25,8±3,9                       | 33,5±3,4                       | 28,6±3,8                       | 34,3±3,0                       | <0,05          |
|                   | EG    | 22,1±4,3                       | 31,8±3,2                       | 23,8±3,9                       | 40,0±2,9                       | 28,9±3,8                       | 37,8±3,1                       | <0,01          |
| Defense           | RG    | 18,4±3,7                       | 22,7±5,4                       | 20,8±3,2                       | 27,6±3,8                       | 23,2±3,3                       | 29,1±3,8                       | <0,05          |
|                   |       | 17,8±3,9                       | 26,8±5,4                       | 20,5±3,2                       | 32,9±3,6                       | 23,0±3,3                       | 34,0±3,9                       | <0,01          |
|                   |       | 15-16                          |                                | 17-18                          |                                | 19-20                          |                                | p2             |
| Attack            | RG    | 31,2±3,5                       | 37,3±3,8                       | 34,3±3,1                       | 40,6±2,9                       | 38,2±3,1                       | 43,9±2,9                       | <0,05          |
|                   | EG    | 31,7±3,5                       | 42,2±3,2                       | 35,2±3,1                       | 47,3±2,9                       | 38,5±3,1                       | 50,2±2,9                       | <0,01          |
| Defense           | RG    | 26,0±3,0                       | 31,1±3,9                       | 28,6±2,8                       | 34,8±3,8                       | 31,7±3,3                       | 37,3±3,8                       | <0,05          |
|                   |       | 25,6±3,2                       | 34,4±3,9                       | 28,1±2,8                       | 39,9±3,9                       | 31,0±3,1                       | 41,5±3,6                       | <0,01          |
| Significance rate |       | p1>0.05                        | p3<0.05                        | p1>0.05                        | p3<0.05                        | p1>0.05                        | p3<0.05                        |                |

**Figure 3.** Age-specific progresses in the visual function and technical and tactical action accuracy for the EG



**Conclusion.** The experimental visual function / motor coordination training system for volleyball players was tested highly beneficial for harmonized motor coordination / visual function progress in the EG versus the traditional training system. The new training technology effectively facilitated the visual function / technical and tactical action progress as verified by the individual progress profiles and databases. We recommend the new visual function / motor coordination training system and test data for application in volleyball training service.

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# Synergized physical and technical training model for 12-13-year-old swimmers: benefits for annual training cycle

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## Abstract

**Objective of the study** was to test benefits of the new synergized physical and technical training service model for the 12-13-year-old swimmers within their annual training cycle.

**Methods and structure of the study.** We used in the study video replays to analyze the individual swimming techniques; dynamometry using a SwimForceTest system; and standard mathematical statistics toolkit for the test data processing. We sampled for a yearly training experiment the 12-13-year-old Class I swimmers (n=57) trained for the third year, and split them up into Reference Group (RG, n=38) and Experimental Group (EG, n=19). The RG was trained as required by the traditional system, and the EG trainings were complemented by the synergized physical and technical fitness model with controlled movement biomechanics in the gym/ aquatic practices, and special excellence workouts in every motor skill training.

**Results and conclusion.** The new synergized physical and technical training service model for the 12-13-year-old swimmers was found beneficial as verified by the significant progress of the EG versus RG in the strength, technical fitness and top swimming speed tests. The priority to the strength training elements in the new model helped develop more efficient stroke dynamics in the EG versus the RG. Special excellence elements geared to improve the movement kinematics and dynamics in the further practices are expected to yield further benefits for the synergized training service and competitive fitness of the trainees.

**Keywords:** *physical and technical training, junior swimmer, synergy, harmony, training tools, annual training cycle.*

**Background.** Competitive progress of the modern swimmers is known to largely depend on their physical and technical fitness [3, 4], and no wonder that most of the studies analyze the relevant training elements, although these analyses tend to be rather specific/ differentiated that means that they tend to select and develop special knowledge fields. On the other hand, it is the integrative and inclusive approaches that make it possible to address the issue or problem in a multisided manner to find new priorities for progress in every field on the whole and athletic training systems in particular [1].

The 12-13-year-olds entering pubertal development stage are considered by many specialists [2, 5] particularly sensitive to the strength training elements. We assumed in this context that efficiently synergized physical and technical training

service with a special emphasis on specific training elements could be beneficial for competitive progress of junior swimmers.

**Objective of the study** was to test benefits of a new synergized physical and technical training service model for the 12-13-year-old swimmers within their annual training cycle.

**Methods and structure of the study.** We used in the study video replays to analyze the individual swimming techniques; dynamometry using a SwimForceTest system; and standard mathematical statistics toolkit for the test data processing. We sampled for a yearly training experiment the 12-13-year-old Class I swimmers (n=57) trained for the third year, and split them up into Reference Group (RG, n=38) and Experimental Group (EG, n=19). The RG was trained as required by the traditional system, and



the EG trainings were complemented by the synergized physical and technical fitness model with controlled movement biomechanics in the gym/ aquatic practices, and special excellence workouts in every motor skill training.

**Results and discussion.** To prioritize the key physical qualities, we first made a regression analysis of the physical and technical fitness indices to find the priority/ dominant (accounting for above 90% of the total) strength and speed qualities critical for an individual technical fitness. Furthermore, having analyzed many parameters of the modern swimming techniques using a statistical ROC-analysis, we found the key/ dominant kinematic and dynamic swimming techniques criteria including: pull-phase hand movement speed (HMSp); pull-phase hand movement strength (HMSt); hand movement pace; and the vertical hand reach (maximal depth). We used the top swimming speed as a benchmark (“gold standard”) in the ROC analysis.

The EG training was designed to prudently combine aerobic, aerobic-anaerobic, strength, speed and speed-strength elements; with the swimming techniques progress secured by and tested in the stepped-up workouts. The pre-experimental tests in the annual training cycle found the groups virtually the same in the successive cycle timings (with the time variations rated at 44% and 46% in the EG and RG, respectively) – indicative of the unstable swimming techniques i.e. excessive variations of the propulsive elements in the movement cycles. Based on these test data, we designed the EG spring-summer trainings so as to step up the training elements on threshold of anaerobic metabolism combined with the controlled glycolytic elements; with the both

workouts rated at no more than 4% of the monthly totals.

The pre-experimental tests, therefore, gave us a bifurcation point for revising the EG training system so as to complement it with special gym/ aquatic practices including those with VASA training machines to excel the stroke in every element, particularly in the high-speed swimming practices. The training exercises were selected and customized based on findings of the ROC analysis.

The post-experimental (post-annual training cycle) physical and technical fitness tests included digital swimming techniques video analyses with the swimming techniques dynamics ratings and repeated successive cycle timing tests for every swimming speed level (slow, threshold of anaerobic metabolism level and top). The post-experimental tests found that the EG made progress in the successive cycle timings versus the RG (with the successive cycle time variations rated at 4% and 40% in the EG and RG, respectively). Tables 1 and 2 hereunder give the group pre- versus post-experimental swimming techniques test data variations.

The synergized physical and technical fitness tools were tested beneficial as verified by the significant ( $p < 0.001$ ) progress of the EG versus RG in the dynamic swimming technique tests (particularly in the pull-phase strength and power and ground move strength): see Table 1. The tests showed high progresses in the propulsive elements of the stroke due to the EG trainings being complemented with special controlled strength workouts in gyms and water. It should be emphasized that the tests found no significant intergroup differences in the entry-phase strength and power – in disagreement with

**Table 1.** Pre- versus post-experimental dynamic swimming technique test data variations ( )

| Dynamic test            | Pre-experimental        |             | Post-experimental       |              |
|-------------------------|-------------------------|-------------|-------------------------|--------------|
|                         | EG (n=19)               | RG (n=38)   | EG (n=19)               | RG (n=38)    |
| Entry-phase strength, N | 144.92±4.00             | 143.84±3.71 | 158.68±5.21             | 157.90±5.73  |
|                         | $U_{kp}=399.0; p>0.05$  |             | $U_{kp}=312.0; p>0.05$  |              |
| Entry-phase power, W    | 63.48±18.10             | 63.11±16.41 | 80.82±12.47             | 80.42±10.88  |
|                         | $U_{kp}=344.0; p>0.05$  |             | $U_{kp}=388.5; p>0.05$  |              |
| Pull-phase strength, N  | 143.26±10.45            | 142.47±7.60 | 180.79±5.77             | 163.24±5.24  |
|                         | $U_{kp}=378.5; p>0.05$  |             | $U_{kp}=15.0; p<0.001$  |              |
| Pull-phase power, W     | 38.912±10.26            | 36.59±7.71  | 84.27±8.97              | 74.82±10.54  |
|                         | $U_{kpm}=423.5; p>0.05$ |             | $U_{kp}=551.0; p<0.001$ |              |
| Push-phase strength, N  | 136.11±4.76             | 136.26±4.33 | 172.95±8.47             | 156.82±8.25  |
|                         | $U_{kp}=367.0; p>0.05$  |             | $U_{kp}=64.0; p<0.001$  |              |
| Push-phase power, W     | 83.72±20.39             | 82.93±15.42 | 187.63±18.58            | 156.65±21.46 |
|                         | $U_{kp}=372.0; p>0.05$  |             | $U_{kp}=93.5; p<0.001$  |              |
| Ground move strength, W | 100.39±2.95             | 99.98±1.92  | 102.54±3.38             | 99.93±3.25   |
|                         | $U_{kp}=395.5; p>0.05$  |             | $U_{kp}=143.0; p<0.001$ |              |

**Table 2.** Pre- versus post-experimental kinematic swimming techniques test data variations ( )

| Dynamic test                                     | Pre-experimental                |            | Post-experimental                |             |
|--------------------------------------------------|---------------------------------|------------|----------------------------------|-------------|
|                                                  | EG (n=19)                       | RG (n=38)  | EG (n=19)                        | RG (n=38)   |
| Entry-phase hand speed, m/s                      | 0.44±0.12                       | 0.44±0.11  | 0.51±0.07                        | 0.51±0.06   |
|                                                  | U <sub>kp</sub> = 338.5; p>0.05 |            | U <sub>kp</sub> = 379.5; p>0.05  |             |
| Pull-phase hand speed, m/s                       | 0.27±0.06                       | 0.27±0.05  | 0.41±0.05                        | 0.52±0.064  |
|                                                  | U <sub>kp</sub> = 375.5; p>0.05 |            | U <sub>kp</sub> = 655.5; p<0.001 |             |
| Push-phase hand speed, m/s                       | 0.64±0.13                       | 0.63±0.17  | 1.09±0.10                        | 1.00±0.12   |
|                                                  | U <sub>kp</sub> = 365.5; p>0.05 |            | U <sub>kp</sub> = 215.5; p<0.05  |             |
| Water pace, moves/ min                           | 78.71±3.16                      | 80.37±2.80 | 77.03±2.03                       | 79.269±1.54 |
|                                                  | U <sub>kp</sub> = 255.5; p>0.05 |            | U <sub>kp</sub> = 613.5; p<0.001 |             |
| Ground pace, moves/ min                          | 79.32±3.08                      | 80.20±2.92 | 76.90±1.66                       | 80.00±1.68  |
|                                                  | U <sub>kp</sub> = 311.0; p>0.05 |            | U <sub>kp</sub> = 651.5; p<0.001 |             |
| Cycle time, s                                    | 0.61±0.05                       | 0.61±0.07  | 0.80±0.03                        | 0.75±0.03   |
|                                                  | U <sub>kp</sub> = 376.5; p>0.05 |            | U <sub>kp</sub> = 63.5; p<0.001  |             |
| Stroke, time, s                                  | 0.4±0.05                        | 0.40±0.07  | 0.67±0.057                       | 0.61±0.05   |
|                                                  | U <sub>kp</sub> = 376.5; p>0.05 |            | U <sub>kp</sub> = 129.5; p<0.001 |             |
| Vertical hand reach, cm                          | 39.04±2.13                      | 38.80±1.55 | 41.12±1.29                       | 42.41±1.58  |
|                                                  | U <sub>kp</sub> = 380.5; p>0.05 |            | U <sub>kp</sub> = 533.0 p<0.01   |             |
| Entry-phase trajectory, m                        | 0.23±0.05                       | 0.23±0.05  | 0.27±0.03                        | 0.30±0.03   |
|                                                  | U <sub>kp</sub> = 355.0; p>0.05 |            | U <sub>kp</sub> = 561.5 p<0.001  |             |
| Pull-phase trajectory, m                         | 0.53±0.07                       | 0.51±0.08  | 0.72±0.02                        | 0.67±0.03   |
|                                                  | U <sub>kp</sub> = 406.0; p>0.05 |            | U <sub>kp</sub> = 55.5 p<0.001   |             |
| Push-phase trajectory, m                         | 0.24±0.17                       | 0.26±0.09  | 0.33±0.02                        | 0.22±0.05   |
|                                                  | U <sub>kp</sub> = 251.0; p>0.05 |            | U <sub>kp</sub> = 36.5 p<0.001   |             |
| Stroke length, m                                 | 1.26±0.07                       | 1.26±0.09  | 1.39±0.02                        | 1.3±0.03    |
|                                                  | U <sub>kp</sub> = 396.0; p>0.05 |            | U <sub>kp</sub> = 24.5 p<0.001   |             |
| Entry-phase hand acceleration, m /s <sup>2</sup> | 0.10±0.11                       | 0.11±0.11  | -0.39±0.17                       | -0.38±0.16  |
|                                                  | U <sub>kp</sub> = 325.0; p>0.05 |            | U <sub>kp</sub> = 394.5 p>0.05   |             |
| Pull-phase hand acceleration, m /s <sup>2</sup>  | 0.14±0.82                       | 0.12±0.64  | 0.21±0.48                        | 0.20±0.36   |
|                                                  | U <sub>kp</sub> = 305.0; p>0.05 |            | U <sub>kp</sub> = 335.5 p>0.05   |             |
| Push-phase hand acceleration, m /s <sup>2</sup>  | 0.71±0.52                       | 0.73±0.09  | 2.56±0.09                        | 1.23±0.68   |
|                                                  | U <sub>kp</sub> = 277.0; p>0.05 |            | U <sub>kp</sub> = 37.5 p<0.001   |             |
| Top swimming speed, m/s                          | 1.36±0.04                       | 1.35±0.04  | 1.62±0.08                        | 1.52±0.03   |
|                                                  | U <sub>kp</sub> = 443.5; p>0.05 |            | U <sub>kp</sub> = 51.0 p<0.001   |             |

Daiki Koga et al. [6] who ranked this movement phase with the propulsive ones. We also found a few significant intergroup differences in the kinematic swimming technique test data: see Table 2.

The spatial performance tests found intergroup differences in the pull- and push-phase hand trajectories and strokes (p<0.001). The phase timing analysis found intergroup differences in the cycle times and stroke times (p<0.001) in favor of the EG, with the ground/ water movement paces tested significantly lower (p<0.001) in the EG. The hand speed tests found significant intergroup differences only in the pull and push phases. Despite the insignificant intergroup differences in the pull-phase accelerations, the pull-phase hand speed was tested significantly lower in the EG (p<0.001) that is indicative of the higher stroking efficiency. The top swimming speed is known to be indicative of the general individual physical and technical fit-

ness. Note that the EG swimming speed was tested significantly above the RG in the post-experimental tests – that may be interpreted as indicative of the new synergized physical and technical training service model for the 12-13 year-old swimmers being beneficial.

**Conclusion.** The new synergized physical and technical training service model for the 12-13-year-old swimmers was found beneficial as verified by the significant progress of the EG versus RG in the strength, technical fitness and top swimming speed tests. The priority to the strength training elements in the new model helped develop more efficient stroke dynamics in the EG versus the RG. Special excellence elements geared to improve the movement kinematics and dynamics in the further practices are expected to yield further benefits for the synergized training service and competitive fitness of the trainees.



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# Changes in muscle strength moments and weightlifting performance gains during two-year training cycle of young weightlifters

UDC 796.012.1

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## Abstract

**Objective of the study** of the research was to evaluate changes in muscle strength moments as well as to compare these changes with the performance gains in weightlifting results during a 2-year training cycle of young weightlifters.

**Methods and structure of the study.** The study was conducted in a group of 20 athletes training weightlifting with at least one year of training experience and 2nd sport class. Peak torque values of the muscles of the upper and lower limbs and the trunk were measured under isometric conditions. The measurements were carried out on properly prepared LR2-P test stands (JBA Zb. Staniak, Poland).

**Results and conclusions.** The results achieved in individual weightlifting exercises were recalculated according to Sinclair's scores in order to eliminate the influence of the competitors' body mass change on the achieved results. Among the studied group of athletes, statistically significant ( $p < 0.05$ ) gains in the value of moments of the analysed muscle groups were confirmed. The greatest gains among the analysed muscle groups occurred in the case of trunk extensors. The literature provides evidence that strength training of the trunk extensors in sport is important in the prevention of low back pain (LBP). Furthermore, it translates into the high performance in many sports. Therefore, these muscle unit strength gain confirmed in this study may translate into a lack of pain and the ability to continue specialised training for two years among young athletes. Gains in trunk extensors correlate significantly with gains in snatch performance, which may directly translate into performance in weightlifting, as this is an exercise performed during competitions.

**Keywords:** *weightlifting, long-term research, young athletes, strength.*

**Introduction.** Scientific research conducted in sport allows optimisation of training loads by providing coaches with information about the adaptation of the body to a given training [6]. Research concerns different time intervals, often measurements are performed at intervals of 6-8 weeks [1, 3, 8] covering the preparatory period [2], less often observations of changes in various parameters are conducted over longer periods [4]. In weightlifting, the improvement of sports performance is influenced by appropriate technical and fitness preparation [10]. Many authors researched the influence of weightlifting training on various parameters. The available literature confirms the significant effect of Olympic Weightlifting exercises on the height of the vertical jump [3] as well as the results of barbell squats [8]. You can also find stud-

ies on the strength preparation of weightlifters [9] as well as those comparing their muscle strength with athletes of other sports. In weightlifting training, the primary focus is on the trunk strength [7], as well as the knee and ankle extensors, which is associated with the so-called triple extension [1] which is important in the context of exercise technique. The development of the sport of weightlifting requires athletes to start their sport career early which becomes a big challenge for coaches in the context of optimizing training loads as well as forecasting the development path of young athletes [6]. The assessment of the level of strength preparation and the correlation with the achieved results in weightlifting can be a hint for coaches on what to focus when working with young weightlifters. Therefore, the aim of the research was



to evaluate changes in muscle strength moments as well as to compare these changes with the performance gains in weightlifting results during a 2-year training cycle of young weightlifters.

**Methods and structure.** The study was conducted in a group of 20 athletes training weightlifting (Table 1) with at least one year of training experience and 2nd sport class.

**Table 1. Age and body mass of subjects**

|      | Age [years] | Body mass I [kg]<br>2019 | Body mass II [kg]<br>2021 |
|------|-------------|--------------------------|---------------------------|
| mean | 18.1        | 74.55                    | 78.55                     |
| SD   | 3.93        | 17.05                    | 17.02                     |

The study was conducted in a two-year training cycle, the first measurement was conducted in January 2019 and the second one in January 2021. During the analysed period the athletes were following specialized weightlifting training 6 times a week, they were preparing for competitions of the National Championship rank, where 10 of the subjects won medals in their age groups and 5 of them were preparing for international competitions. Peak torque values of the muscles of the upper and lower limbs and the trunk were measured under isometric conditions [9]. The measurements were carried out on properly prepared LR2-P test stands (JBA Zb. Stan-  
iak, Poland) [9]. The results achieved in individual weightlifting exercises were recalculated according to Sinclair's scores in order to eliminate the influence of the competitors' body mass change on the achieved results.

#### Results and discussion RESULTS OF STUDIES

The differences in relative muscle strength moments under static conditions of weightlifters training in a 2-year cycle are shown in Table 2.

Among the studied group of athletes, statistically significant ( $p < 0.05$ ) gains in the value of moments of the analysed muscle groups were confirmed. The greatest gains among the analysed muscle groups occurred in the case of trunk extensors. The average increase in a two-year training cycle was  $3.54 \text{ N}\cdot\text{m/kg}$ .

Gains in the value of muscle strength moments were compared with the results achieved in individual exercises used in weightlifting training after conversion into Sinclair points. The strongest correlations for the results achieved in the weightlifting exercises and the increase of muscle strength moments were confirmed between the performance gains in the squat clean and gains in the moments of strength in the extensor muscles of the knee joint ( $R^2 = 0.7849$ ,  $p < 0.001$ ) (Figure 1).

Statistically significant correlations were also confirmed for gains in maximal muscle strength moments under static conditions for the trunk extensor muscles and gains in barbell snatch ( $R^2 = 0.656$ ,  $p < 0.01$ ), power snatch from knee ( $R^2 = 0.755$ ,  $p < 0.001$ ) and squat clean from knee ( $R^2 = 0.697$ ,  $p < 0.001$ ). Statistically significant correlations were also confirmed for gains in knee joint flexor and extensor strength moments and performance gains in the front squat (Flexors  $R^2 = 0.713$ ,  $p < 0.001$ , Extensors  $R^2 = 0.677$ ,  $p < 0.001$ ) and back squat (Flexors  $R^2 = 0.746$ ,  $p < 0.001$  and Extensors  $R^2 = 0.703$ ,  $p < 0.001$ ).

**Summary and conclusions.** The aim of this study was to determine the relationship between gains in strength moments under static conditions and changes in performance in weightlifting exercises. In weightlifting training, the main focus is on trunk strength, which is important because all movements originate in or are assisted by the trunk [7].

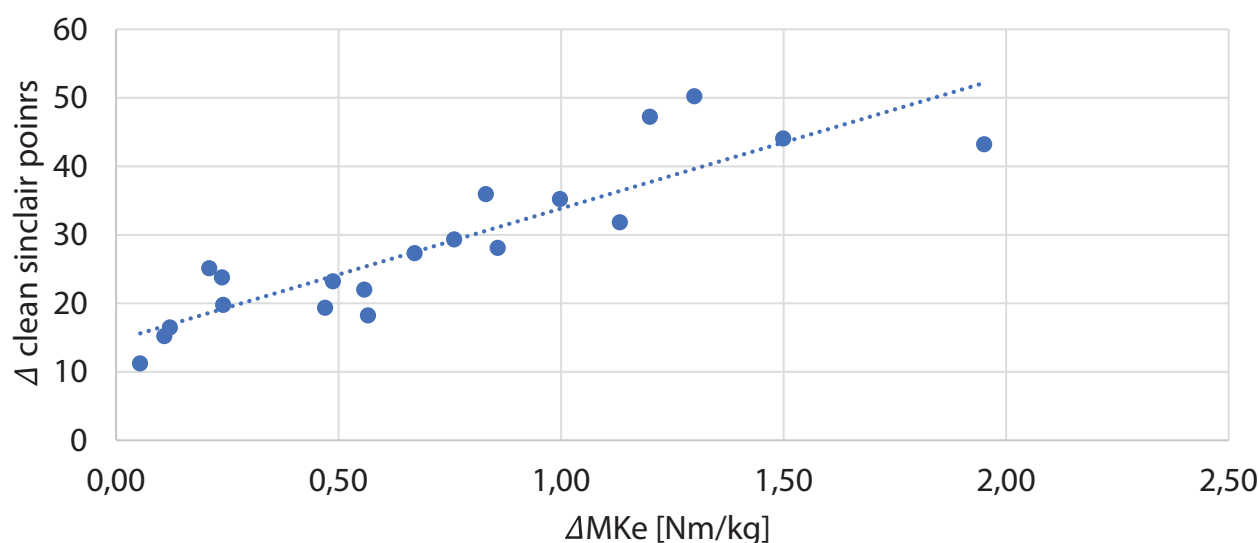
The two-year training in weightlifting resulted in a significant increase in the relative values of strength moments for all analysed muscle groups. The greatest gains in strength, as well as the strongest correlations with performance gains in weightlifting exercises, were confirmed for the muscle groups of knee extensors and trunk extensors. This is in accordance with the data presented by many authors suggesting that in the weightlifting technique an important role is played by the muscles of extensors of the ankle and knee joints and trunk extensors responsible for the so-called triple extension [1].

In many sports, the structure of an athlete's movement during a movement activity is related to the tri-

**Table 2. Changes in relative moments of muscle strength under static conditions of weightlifters during a 2-year training cycle**

|              | Knee joint |      | Trunk |      | Elbow joint |      | Shoulder joint |      |
|--------------|------------|------|-------|------|-------------|------|----------------|------|
|              | F          | E    | F     | E    | F           | E    | F              | E    |
| Mean [Nm/kg] | 0.62       | 0.56 | 0.92  | 3.54 | 0.57        | 0.33 | 0.24           | 0.39 |
| SD           | 0.39       | 0.65 | 0.59  | 1.79 | 0.30        | 0.18 | 0.15           | 0.18 |

F- flexors E- extensors



**Figure 1.** Relationship between the Sinclair scores in the clean and gains in knee extensor strength moments of weightlifters

ple extension, so it seems reasonable to use weightlifting exercises in other sports to improve strength parameters affecting this triple extension [1]. These sports often use power snatch from knee, because the movement technique in this exercise is easier to master [4, 10]. As confirmed by the conducted analyses, the gains in this variant of the exercise correlate with gains in maximal moments of trunk extensor muscles.

The literature provides evidence that strength training of the trunk extensors in sport is important in the prevention of low back pain (LBP). Furthermore, it translates into the high performance in many sports [5]. Therefore, these muscle unit strength gain confirmed in this study may translate into a lack of pain and the ability to continue specialised training for two years among young athletes. Gains in trunk extensors correlate significantly with gains in snatch performance, which may directly translate into performance in weightlifting, as this is an exercise performed during competitions.

#### SUMMARY

The aim of the research was to evaluate changes in muscle strength moments as well as to compare these changes with the performance gains in weightlifting results during a 2-year training cycle of young weightlifters. The study was conducted in a group of 20 athletes training weightlifting with at least one year of training experience and 2nd sport class. Peak torque values of the muscles of the upper and lower limbs and the trunk were measured under isometric conditions. The measure-

ments were carried out on properly prepared LR2-P test stands (JBA Zb. Staniak, Poland). The results achieved in individual weightlifting exercises were recalculated according to Sinclair's scores in order to eliminate the influence of the competitors' body mass change on the achieved results. Among the studied group of athletes, statistically significant ( $p < 0.05$ ) gains in the value of moments of the analysed muscle groups were confirmed. The greatest gains among the analysed muscle groups occurred in the case of trunk extensors. The literature provides evidence that strength training of the trunk extensors in sport is important in the prevention of low back pain (LBP). Furthermore, it translates into the high performance in many sports. Therefore, these muscle unit strength gain confirmed in this study may translate into a lack of pain and the ability to continue specialised training for two years among young athletes. Gains in trunk extensors correlate significantly with gains in snatch performance, which may directly translate into performance in weightlifting, as this is an exercise performed during competitions.

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# Body balance of male football players aged 7-10: pilot study

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## Abstract

**Objective of the study** – body balance is an element needed to perform activities of daily living and do sports. The aim of this study was to evaluate and compare body balance of male football players aged 7-10.

**Methods and structure of the study.** The study involved 92 football players aged 7-10 (7 years n = 21; 8 years n = 26; 9 years n = 29; 10 years n = 16), members of TOP-54 Football Academy in Biala Podlaska, Poland. Postural balance was tested using ZEBRIS FDM-2 (Force Distribution Measurement) measuring system with WinFDM software during free barefoot standing with eyes open.

**Results and conclusions.** In the majority of the analysed parameters, significantly higher values of posturographic parameters were found in younger players (7 years) compared to their older peers (10 years). The observed differences probably stemmed from the immaturity of the postural control system in younger boys. It may be related to the lack of ability to fully utilize sensory information. Football training contributes to proper physical and motor development of children and positively influences the formation of the balance control system. An important aspect is a proper selection of loads to ensure that training is beneficial and supports natural ontogenetic development of players at each stage of training

**Keywords:** *balance, children, football players.*

**Introduction.** Body balance is motor potential of a human being. It is defined as assuming a desired body position (e.g. standing) and maintaining it in every static and dynamic situation. The conditions for its maintenance are complex. They mainly concern the locomotor system efficiency, speed of reaction and decision making, and the ability to correctly analyse information regarding the current state of the body, the position of its segments and their speed and acceleration. Body balance, as one of the components of coordination abilities, co-occurs with spatial orientation, speed of reaction and movement differentiation [13].

Body balance control includes the ability to anticipate and cope with instability. It occurs based on sensory signals coming from the vestibular system, visual organ and proprioceptors [1, 11, 15].

In each individual, the degree of development of the ability to maintain body balance depends on many factors such as individual genetic and environmental conditions, sports activity, health state or age [5, 6].

The achievement of sports mastery requires proper training planning, appropriately selected methods and forms of work and training loads at all stages of the athlete's development. In this context, body balance is extremely important in many sports, such as gymnastics [10] or handball [14], and in some sports, such as pentathlon or biathlon, it can even determine the final result of an athlete [7, 8] or a biathlete [9]. Body balance also has a significant impact on the quality of performance of technical elements in football, including dribbling [2].



**Objective of the study.** The aim of this study was to evaluate and compare body balance of male football players aged 7-10.

### Participants

The study involved 92 players aged 7-10 (7 years  $n = 21$ ; 8 years  $n = 26$ ; 9 years  $n = 29$ ; 10 years  $n = 16$ ), members of TOP-54 Football Academy in Biala Podlaska, whose parents gave written consent to participate in it.

Postural balance testing was conducted in March and April 2021 in the Posture Laboratory of the Regional Research and Development Centre at the Faculty of Physical Education and Health in Biala Podlaska, Poland.

The study protocol followed the recommendations of the Declaration of Helsinki. It was approved and received a positive opinion from the Senate Committee on Research Ethics of J zef Pi sudski University of Physical Education in Warsaw (SKE 01-04/2020).

### Procedure

Body balance was examined using ZEBRIS FDM-2 (Force Distribution Measurement, 212x60.5x2.1 cm, 120 Hz, System Medical GMBH, Germany) measuring system that recorded the centre of pressure (COP) signal. The platform was connected to WinFDM software for body sway analysis and calibrated before each measurement.

Body balance was assessed under the following conditions: standing barefoot on both feet with eyes open. During the recording of each measurement, the participant remained motionless on the platform in a standing bipedal position. Each body balance measurement lasted 40 seconds. The first and the last five seconds of each measurement were excluded from the analysis, and the 30-second COP displacement records were further analysed.

The following basic parameters were analysed in the body balance assessment:

AoE [mm<sup>2</sup>] – area of the centre of pressure (calculated from COP displacements in such a way that

95% of the data was within the ellipsoid and 5% was outside the ellipsoid);

SP [mm] – path length of COP; V [mm/s] – average velocity of COP;

WoE [mm] – width of the ellipse (length of the ellipse in the medial-lateral direction); HoE [mm] – height of the ellipse (length in the anterior-posterior direction).

### Statistical analysis

The results were analysed using one-way ANOVA with four levels of the group factor (7 years, 8 years, 9 years, 10 years). Before proceeding with the analysis, the conformity of the distributions to the normal distribution was checked. Statistical significance was set at  $p < 0.05$ .

**Results and discussion.** The test of keeping body balance in a standing position with eyes open revealed the highest values and the highest variation of all the analysed parameters in the group of 7-year-old boys, while the lowest values were observed in 10-year-old players (Table 1).

The conducted intergroup statistical analysis showed significant differences between the studied groups of young football players in the path of COP (SP) and its derivative, i.e. mean COP velocity (V). In the case of both parameters, post hoc analysis showed that the values of these indices in the group of 7-year-old football players were significantly higher than in the other age groups. However, there was no difference in the analysed parameters between the other age groups of boys (Figures 1a and 1b).

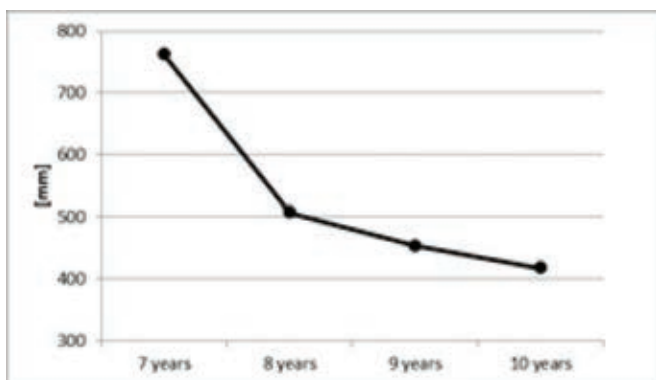
Statistically significant differences were also noted in the case of the width of the ellipse of the sway area (WoE). WoE values in the group of 7-year-olds were significantly higher than in the group of 10-year-olds (Figure 1c). In the case of the other two parameters, i.e. the size of the COP displacement ellipse area (AoE) and its length (HoE), no significant differences were observed between the studied age groups.

**Table 1.** Mean arithmetic values, standard deviations and intergroup significance of differences in body balance parameters in measurements with eyes open

|                               | 7 years       | 8 years       | 9 years       | 10 years      | p             |
|-------------------------------|---------------|---------------|---------------|---------------|---------------|
| <b>AoE</b> [mm <sup>2</sup> ] | 714.1 ± 674.5 | 511.1 ± 260.6 | 529.4 ± 412.5 | 316.6 ± 145.4 | 0.0778        |
| <b>SP</b> [mm]                | 762.6 ± 399.4 | 507.7 ± 171.4 | 454.1 ± 193.2 | 418.9 ± 117.0 | <b>0.0002</b> |
| <b>V</b> [mm/sec]             | 25.4 ± 12.9   | 17.2 ± 6.0    | 15.3 ± 6.6    | 14.1 ± 3.8    | <b>0.0002</b> |
| <b>WoE</b> [mm]               | 21.8 ± 8.6    | 18.3 ± 6.7    | 18.4 ± 7.1    | 13.4 ± 4.6    | <b>0.0145</b> |
| <b>HoE</b> [mm]               | 36.2 ± 18.9   | 33.8 ± 9.7    | 33.3 ± 13.0   | 29.5 ± 7.2    | 0.5474        |

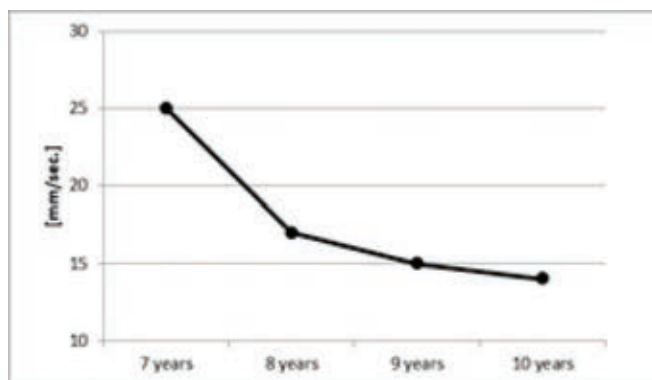


a) SP - Path length of COP



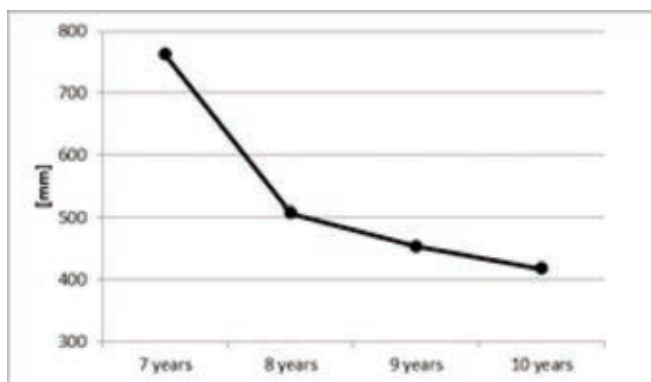
7 years vs 8 years \*\*  
7 years vs 9 years \*\*\*  
7 years vs 10 years \*\*\*

b) V - Average velocity of COP



7 years vs 8 years \*  
7 years vs 9 years \*\*\*  
7 years vs 10 years \*\*\*

c) WoE - Width of the ellipse COP



7 years vs 10 years \*\*

**Figure 1.** Values of posturographic parameters significantly different for the studied groups

It is worth noting that in the case of all the studied parameters, a considerable decrease in their value in the subsequent age groups can be seen, which probably indicates an improvement in body balance with age.

Football is a sport that requires excellent coordination and divided attention. Players must concentrate not only on the ball, but also on the position of their teammates as well as opponents on the pitch and, simultaneously, they control their body position. At the same time, the level of technical and tactical preparation influences the quality of balance control and motor strategies undertaken.

The findings of our study indicate that the maturity of balance reactions improves with age, which is manifested by a decrease in the values of the analysed posturographic parameters (the distance

of COP displacement, the average speed of COP displacement, and the width of the ellipse of COP displacement).

Our study showed that 10-year-old football players were more stable compared to players from younger age groups. Our results are consistent with the findings of Triangali et al. [12], who noted better control of body balance in children between 8 and 10 years of age than in younger age groups. However, Peterson et al. [4] emphasise that full maturity of body balance control using vestibular and visual stimuli is achieved by humans around 12 years of age.

### Conclusions

Higher values of body balance parameters in younger football players may indicate immaturity of their postural control system. This may be related to the lack of ability to use sensory information.



Properly planned football training supports proper physical and motor development of children and has a positive effect on the development of the body balance control. An important aspect of training is the selection of loads in such a way that they benefit and support natural ontogenetic development of players at each stage of training.

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# Paddling machine for kayaking sport: biomechanical tests and benefit analysis

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## Abstract

**Objective of the study** was to find to most beneficial individual paddling machine settings for the special strength training.

**Methods and structure of the study.** We used the G.M. Efremov Paddling Machine with a sliding seat and varied counterweights simulating the water resistance [3]; with the muscle electromyographic (EMG) activity fixed by a computerized Sportlab Test System (made in Russia) that includes an eight-channel telemetric electromyography, video camera, synchronizer and accelerometer [1]. We profiled the 1000Hz skin EMG of the following right-side muscles: m. triceps brachii\_R, m. latissimus dorsi\_R, m. vastus lateralis\_R and m. gastrocnemius medialis\_R. The EMG curves were inverted and smoothed by a moving average with a 50ms window; with the test process videos shot at 25 frames per second. We sampled for the tests 3 elite (Candidate Masters and Masters of Sport) kayakers.

The paddling machine test pace and resistant counterweight were varied in the ranges of 42 to 130 paddles/ min and 5 to 14 kg respectively.

The paddling cycle efficiency was rated by the EMG amplitude versus the competitive performance benchmarks.

**Results and conclusion.** Traditional strength trainings with squats with a barbell, bench presses etc. have proved ineffective or even harmful for the kayaking sports due to differences in the movement biomechanics. The Efremov Paddling Machine offers customizable strength training modes for the key paddling muscle groups, with the workouts managed so as to keep the average EMG amplitudes in the paddling machine workouts as close as possible to the actual water kayaking ones, otherwise arbitrary paddling machine settings may distort the individual competitive water kayaking stereotypes. As demonstrated by our study, the paddling pace and water resistance simulating counterweights of the paddling machine should be customized to the individual physical and technical fitness using the test data and analyses generated by modern biomechanical test systems.

**Keywords:** kayaking techniques, paddling machine, biomechanics, EMG, benefit analysis, special strength, paddling cycle, paddling pace, water kayaking.

**Background.** Since the rowing and paddling sports have always been seasonal, athletes have to widely use training machines in midseason times [4-6]. Modern paddling machines make it possible to closely mimic the actual competitive water kayaking techniques by customized workloads on the upper / lower limb and trunk muscles. Muscle-group-specific strength trainings need to be customized for the water resistance and paddling pace. The modern paddling machine settings may be individualized by varying the paddling pace and weight so as to keep the optimal strength training profile.

**Objective of the study** was to find to most beneficial individual paddling machine settings for the special strength training.

**Methods and structure of the study.** We used the G.M. Efremov Paddling Machine with a sliding seat and varied counterweights simulating the water resistance [3]; with the muscle electromyographic (EMG) activity fixed by a computerized Sportlab Test System (made in Russia) that includes an eight-channel telemetric electromyography, video camera, synchronizer and accelerometer [1]. We profiled the 1000Hz skin EMG of the following right-



side muscles: m. triceps brachii\_R, m. latissimus dorsi\_R, m. vastus lateralis\_R and m. gastrocnemius medialis\_R. The EMG curves were inverted and smoothed by a moving average with a 50ms window; with the test process videos shot at 25 frames per second. We sampled for the tests 3 elite (Candidate Masters and Masters of Sport) kayakers.

The paddling machine test pace and resistant counterweight were varied in the ranges of 42 to 130 paddles/ min and 5 to 14 kg respectively. The paddling pace variations were computed using the formula:

$$\Delta T_{\text{EMG}_i} = \left( \frac{T_{\text{EMG}_i} - T_{\text{EMG}_0}}{T_{\text{EMG}_0}} \right) * 100\% \quad (1)$$

$\Delta T_{\text{EMG}_i}$  pace increment as % to the minimal;  $\Delta T_{\text{EMG}_i}$  paddling pace; and  $\Delta T_{\text{EMG}_0}$  minimal individual paddling pace. For example, when the pace grows from 66 to 132 p/ min, the pace increment ( $\Delta T_{\text{EMG}_i}$ ) is 100%. We rated the muscle mиеlectric activity to the paddle time to find the average EMG amplitude ( $C_{\text{EMG}_i}^K$ ) of every paddling cycle as follows:

$$C_{\text{EMG}_i}^K = \frac{\sum_{j=1}^N \left( \frac{\int_{t=0}^{t=T_j} C_{\text{EMG}_i}^{j,K} dt}{T_j} \right)}{N} \quad (2)$$

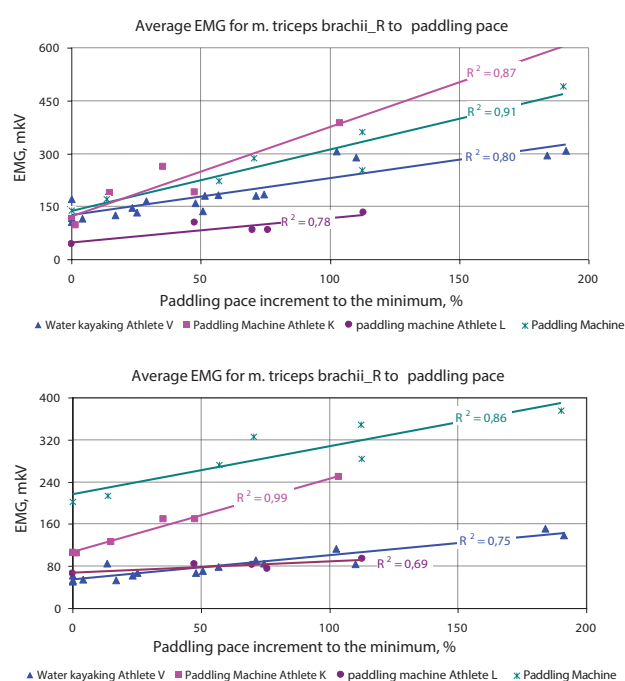
$C_{\text{EMG}_i}^{j,K}$  smoothed paddling cycle EMG amplitude, mkV; i – muscle; K – kayaking; j – paddling cycle; N –

number of paddles;  $T_j$  – paddle time, s; N – number of paddling cycle.

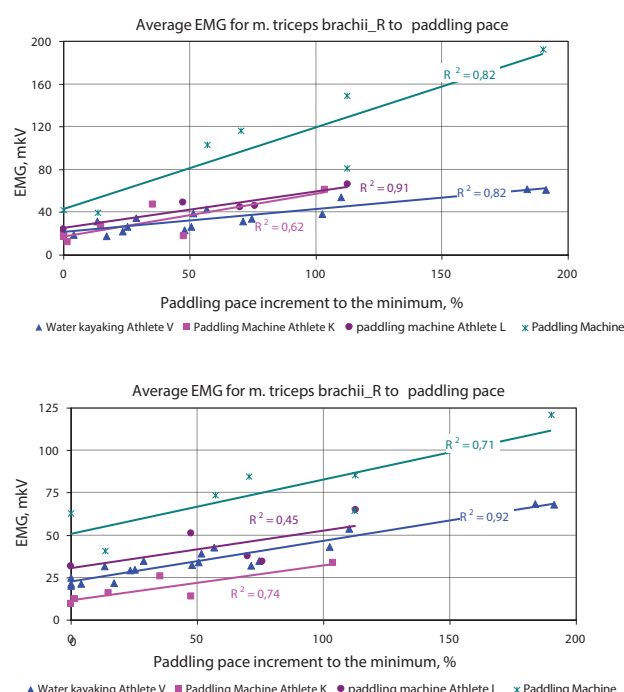
The paddling cycle efficiency was rated by the EMG amplitude versus the competitive performance benchmarks, i.e. matched with the  $C_{\text{EMG}_i}^K$  paddling cycle amplitudes in the paddling machine tests with the water (competitive) kayaking ones (see Figures 1, 2); with the actual competitive EMG curves of an elite MS used as benchmarks. An individual minimal pace was fixed on the abscissa axis; and the average EMG amplitude (HZ) calculated by formula 2 fixed on the ordinate axis.

**Results and discussion.** The paddling machine workout efficiency is considered the highest when the muscle EMG amplitudes match with those for the competitive kayaking. For example, athlete V (with the individual paddling minimum of 65 paddles/ min) who tackled the special strength training of m. triceps brachii\_R on the paddling machine, the machine was set at 86-96 paddles/ min (that means about 50% increment to the minimal pace) and the weight at 10-plus kg (Fig. 1 upper). Such paddling machine workout was tested to secure the m. triceps brachii\_R average EMG amplitude in the paddling cycle almost the same as for the actual water kayaking.

When the paddling machine pace grows to 133 p/ m (104% increment to the minimum) and the paddling machine weight grows to 12kg, the EMG amplitude of the elbow extensor was tested to grow 2.5 times, with



**Figure 1.** Right-side limb/ trunk muscles EMG versus paddling pace for paddling machine and water kayaking



**Figure 2.** Right lower limb muscles EMG versus paddling pace for paddling machine and water kayaking



the workout getting unfocused i.e. the special strength transformed to hard strength training detrimental for paddling motor stereotype. Thus Athlete V in the paddling machine training was tested with excessive strain of m. latissimus dorsi\_R.

Furthermore, the high-pace paddling machine workout (100-120 paddles /min, with 100% increment to the minimum) was tested to increase the EMG amplitude three times versus the water kayaking – with a meaningful change in the muscular effort profile. When the paddling pace was relatively low at 75 p/ min (increment of 15% to the minimum) with the weight of 8kg (Fig. 1, bottom), the m. latissimus dorsi\_R performance profile (athlete V) was tested close to the water kayaking profile. However, the low-pace workout often fails to closely mimic the actual competitive motor stereotype.

In case of athlete L (with the paddling pace minimum of 43 p/ min), the paddling machine paddling pace of 90 p/ min (with 10-14 kg weight) and water kayaking training was found to increase the m. triceps brachii\_R EMG amplitude to 250-360 mkV (Fig. 1 upper). This paddling pace appears to be a threshold in transition from the rational m. triceps brachii\_R workout to an overstress. We recommended for athlete L the relatively low-pace (75-80 p/ min, with up to 86% increment to the minimum) workout with 10-minus kg weights as the most beneficial paddling machine workout scenario. The athlete L's paddling machine technique was tested with an excessive contribution of the widest dorsal muscle in contrast to the optimal water kayaking technique (Fig. 1 lower). For m. latissimus dorsi special strength training, therefore,, athlete L is not recommended to use such paddling machine settings.

In case of women athlete K (paddling pace minimum of 48 p/ min), the paddling machine pace was found matching with the competitive water kayaking profile, unless the excessive 8-14kg weights are applied – since they were tested to activate Golgi complexes in the muscle tendon [6]. As a result, the m. triceps brachii\_R EMG amplitude was tested twice as little as that in the water kayaking workout (Fig. 1 upper). To maintain the paddling pace, athlete K has to add the m. latissimus dorsi\_R efforts (Fig. 1 lower).

The paddling machine and water kayaking lower-limb muscle EMG profiles of athletes V and K were found to match (Fig. 2). Athlete L in the paddling machine with 72-120 p/ min pace (70-180% increment to the minimum) was tested with the m. vastus lateralis\_R and m. gastrocnemius medialis\_R EMG amplitudes significantly different from the water kayaking ones (Fig. 2). This was the reason for us to recommend him the paddling machine special strength trainings with

6-minus kg counterweights being kept within the relatively low paddling pace range. It is not unlikely that athlete L was still adapting to the paddling machine workouts in the test time.

**Conclusion.** Traditional strength trainings with squats with a barbell, bench presses etc. have proved ineffective or even harmful for the kayaking sports due to differences in the movement biomechanics. The Efremov Paddling Machine offers customizable strength training modes for the key paddling muscle groups, with the workouts managed so as to keep the average EMG amplitudes in the paddling machine workouts as close as possible to the actual water kayaking ones, otherwise arbitrary paddling machine settings may distort the individual competitive water kayaking stereotypes. As demonstrated by our study, the paddling pace and water resistance simulating counterweights of the paddling machine should be customized to the individual physical and technical fitness using the test data and analyses generated by modern biomechanical test systems.

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# Interval test training model for junior martial artists

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## Abstract

**Objective of the study** was to develop and test benefits of a new interval test training method with a progress test scale.

**Methods and structure of the study.** We were governed by the conceptual ideas of Gershler and Tabat in the new interval test training design. Generally the interval test training time depends on the amplitude and frequency of the pulse wave, with amplitude interpreted as the number of pulse zones with a preset frequency. The key formula is 6 interval test training = 8:52, where 6 is the number intervals in an interval test training cycle; amplitude of the pulse zones; and 8:52 is the interval test training time.

The study was run in the period of 09/01/2020 to 04/16/2021 at Tchaikovsky State Academy of Physical Culture where we sampled the 11-12-year-olds from the kickboxing and Thai boxing teams (n=30). We used Polar-10 heart rate monitors with Polar-Team software in the tests. In September we rated the individual heart rate maximums to find that the common formula 220-minus-age applies not to every athlete. The pulse zones were computed by the Polar-Team software automatically for every athlete based on the input heart rate maximums. The interval test training was designed using the following five pulse zones: Zone 1 (gray): 50-59%; Zone 2 (blue): 60-69%; Zone 3 (green): 70-79%; Zone 4 (yellow): 80-89%; and Zone 5 (red): 90-100% of the individual heart rate maximums.

Then we selected the most beneficial formulae for the Thai boxers' training depending on the training stages.

**Results and conclusion.** The new interval test training model was tested beneficial as it gives the means to control the load versus the actual individual fitness to prevent health risks. The training formats with application of the Polar-Team heart rate monitors were found to provide special progress motivations since every athlete could track own progress. Practical tests of the new interval test training model showed its benefits for competitive progress as verified, among other things, by the actual competitive accomplishments of the sample in the 2021 Ural-Volga Zone Kickboxing and Thai boxing Championship with the Tchaikovsky State Academy of Physical Culture teams ranked the first and second on the event scoreboard.

**Keywords:** interval training, interval test training, Hyksos tracker, high-intensity training, Tabata protocol workout, Polar H-10 heart monitor, Kicktest-100 dynamic bag, Polar-Team software.

**Background.** The interval training format is presently ranked among the most popular physical training methods and is known to include repeated workouts with the rest breaks customizable by distance, training time, repetitions, and heart rate variation range. Today interval training methods are traditional for virtually every sport discipline, with their alternating high- and low-intensity physical workouts with the distance and time controls. The commonly known linear correlation of the heart rate with the training intensity is widely used by the interval training control and management heart rate monitoring systems. It was in the early 1930s that German coach Waldemar Gershler made the first

attempts to control and manage interval training using the heart rate tests. His trainees alternated the 100-400m sprints with the heart rate up to 180 beats/ min with the rest breaks to let it drop to 120 beats/ min, followed by new sprints till the heart rate recovery time exceeded 90s to urge the training being stopped. This new format made it possible for the athletes to make world records in the 400m and 800m events.

A new interval training model was offered by Professor Izumi Tabata (Japan) in 1996 [5, 6]. He proved benefits of a 4-minute high-intensity workout four times a week prior to the regular 1-hour trainings five times a week. Every such workout included eight

**Table 1.** Individual performance rating scale applied in the interval test training

| №  | Interval test training formula | Scores, points |              |              |          |
|----|--------------------------------|----------------|--------------|--------------|----------|
|    |                                | 5              | 4            | 3            | 2        |
| 1  | 1 ITT <sub>[1-5]</sub>         | 1-1:30min      | 1:30-2:30min | 2:30-3:30min | 3:30+min |
|    | Hykso (strikes)                | 200+           | 150-200      | 120-150      | 120-     |
| 2  | 1 ITT <sub>[5]</sub>           | 24+min         | 11-24min     | 6-11min      | 6-min    |
|    | Hykso (strikes)                | 2000+          | 1500-2000    | 1000-1500    | 1000-    |
| 3  | 6 ITT <sub>[3-5]</sub>         | 4-min          | 4-5min       | 5-8min       | 8+min    |
|    | Hykso (strikes)                | 900+           | 850-900      | 750-850      | 750-     |
| 4  | 6 ITT <sub>[2-5]</sub>         | 7-min          | 7-8min       | 8-9min       | 9+min    |
|    | Hykso (strikes)                | 1100+          | 800-1100     | 500-800      | 500-     |
| 5  | 12 ITT <sub>[4-5]</sub>        | 5-min          | 5-6min       | 6-8min       | 8+min    |
|    | Hykso (strikes)                | 1000+          | 850-1000     | 600-850      | 600-     |
| 6  | 12 ITT <sub>[3-5]</sub>        | 10-min         | 10-15min     | 15-18min     | 18+min   |
|    | Hykso (strikes)                | 2000+          | 1500-2000    | 1000-1500    | 1000-    |
| 7  | 12 ITT <sub>[2-5]</sub>        | 14-min         | 14-18min     | 18-20min     | 20+min   |
|    | Hykso (strikes)                | 2500+          | 2000-2500    | 1500-2000    | 1500-    |
| 8  | Burpee, count                  | 80+            | 70-80        | 60-70        | 60-      |
| 9  | Hykso (1-min strikes)          | 500+           | 400-500      | 300-400      | 300-     |
| 10 | 1-min striking power test      | 10+ tons       | 6-10 tons    | 3-6 tons     | 3- tons  |

20-second rounds with 10-second rest breaks jointly referred to as the Tabata Protocol. The keyword 'protocol' has become common since every workout is designed to attain an individual maximum and fix it in an individual progress record for the performance tracking, analyzing and improvement purposes.

**Objective of the study** was to develop and test benefits of a new interval test training method with a progress test scale.

**Methods and structure of the study.** We were governed by the conceptual ideas of Gershler and Tabat in the new interval test training design. Generally, the interval test training time depends on the amplitude and frequency of the pulse wave, with amplitude interpreted as the number of pulse zones with a preset frequency. The key formula is 6 interval test training [3-5]=8:52, where 6 is the number intervals in an interval test training cycle; [3-5] amplitude of the pulse zones; and 8:52 is the interval test training time: see Figures 1-2.

The study was run in the period of 09/01/2020 to 04/16/2021 at Tchaikovsky State Academy of Physical Culture where we sampled the 11-12 year-olds from the kickboxing and Thai boxing teams (n=30). We used Polar-10 heart rate monitors with Polar-Team software in the tests. In September we rated the individual heart rate maximums to find that the common formula 220-minus-age applies not to every athlete [1]. The pulse zones were computed by the Polar-Team software automatically for every athlete based on the input heart

rate maximums. The interval test training was designed using the following five pulse zones: Zone 1 (gray): 50-59%; Zone 2 (blue): 60-69%; Zone 3 (green): 70-79%; Zone 4 (yellow): 80-89%; and Zone 5 (red): 90-100% of the individual heart rate maximums.

Then we selected the most beneficial formulae for the Thai boxers' training (see Table 1) depending on the training stages. The interval test training formula in the Table refers to the punching bag trainings with Hykso trackers [2-4] with counts of strikes used as the key index for the performance rating scale. Furthermore we used 1 interval training [1-5] formula for the pre-training warm-up to rate the individual athletic fitness for the special core training on a 5-point scale. In case of a low rate in the 1 interval training [1-5] test, the athlete was either released of the training or offered an eased training scenario.

We used the interval test training 1 [5] formula for the shock test micro-cycles at the precompetitive stage to rate an individual competitive fitness. The interval test training (ITT) 6 [3-5], ITT 6 [2-5], ITT 12 [4-5], ITT 12 [3-5], and ITT 12 [2-5] formulae were used in different combinations in the core training stage with the punching bags and other training equipment, with the pulse curves applied as the key performance control tool (Fig. 1-2). The intervals were varied in numbers and times based on the pulse curve analyses. We also rated the individual performances using Burpee exercise from the Tabata Interval Training Protocol, with controlled repetitions and 1-min punching



bag (dynamic Kicktest-100) test to rate the individual performances in tons.



**Figure 1.** Individual ITT 1 [1-5], ITT 12 [2-5] and ITT 12 [3-5] tracks



**Figure 2.** Individual ITT 1 [1-5] and ITT 6 [3-5] tracks

**Results and discussion.** The new interval test training model piloting experiment with the training process controlled by the pulse zones and the interval frequencies found the individual performances depending on the actual fitness; with an interval test training formula selected for every athlete depending on the fitness level and the pulse curve analysis. The interval test training time was used as the key workload and current performance control index, whilst the Burpee test and 1-min dynamic bag tests used to rate the individual precompetitive fitness.

**Conclusion.** The new interval test training model was tested beneficial as it gives the means to control the workload versus the actual individual fitness to prevent health risks. The training formats with application of the Polar-Team heart rate monitors were found to provide special progress motivations since every athlete could track the own progress. Practical tests of the new interval test training model showed its benefits for competitive progress as verified, among other things, by the actual competitive accomplishments of the sample in the 2021 Ural-Volga Zone Kickboxing and Thai boxing Championship with the Tchaikovsky State Academy of Physical Culture teams ranked the first and second on the event scoreboard.

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# Standards for variation range of rr-intervals at rest and in orthostasis in training of racing skiers with different types of regulation

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## Abstract

**Objective of the study** was to identify standards for the variation range of RR-intervals at rest and in orthostasis in training of racing skiers with different types of regulation

**Methods and structure of the study.** During the study, we conducted 559 dynamic HRV tests at rest and in orthostasis at different stages of the training cycle. Subject to the study were 34 racing skiers aged 17-22 years, having the sports qualifications of I adult category, CMS, and MS. The subjects were tested in the morning after the previous training day before the first training using the Varikard 2.51 hardware-software complex and Varikard MP program (Ryazan, Russia). The predominant type of autonomic regulation was defined by the classification proposed by N.I. Shlyk. Prior to each HRV test, the racing skiers were interviewed about the physical loads performed on the previous training day, their load tolerance, quality of sleep, well-being, and participation in competitions.

**Results and conclusion.** The study found that the predominant type of regulation at rest in each athlete defines the bounds of the MxDMn range, divisions of the autonomic nervous system, and level of the body's functioning as a whole. Therefore, racing skiers with different MxDMn values and vegetative balances should be subjected to different training loads, which would help timely prevent overstrain and overtraining.

The lack of clarity over the bounds of the optimal MxDMn range, or disregard of this indicator in the HRV analysis of racing skiers cannot provide researchers with true information on the level of tolerance to physical loads.

**Keywords:** heart rate variability, variation range of RR-intervals, types of regulation, racing skiers, individual approach.

**Background.** When analyzing the heart rate variability (HRV) data, the basic information on the regulatory mechanisms of cardiac activity was taken from the duration and range of RR-intervals [1]. The amplitude of the heart rate oscillations and functional features of the sinoatrial node determine the variation range of RR-intervals (MxDMn). Any functional changes in the body are immediately reflected in HRV MxDMn of the heart rate variability [2, 3]. Many researchers who use the HRV analysis are dismissive of MxDMn, which is a serious gap in the sinus node and cardio-regulatory system functionality rating. In a series of studies, the authors have not reached a consensus on the standards for this indicator. Such an approach to the HRV analysis does not give a true picture of the level of functioning of the sinus node and the way each of its regulatory links influences it [3, 4].

**Objective of the study** was to identify standards for the variation range of RR-intervals at rest and in orthostasis in training of racing skiers with different types of regulation.

**Methods and structure of the study.** During the study, we conducted 559 dynamic HRV tests at rest and in orthostasis at different stages of the training cycle. Subject to the study were 34 racing skiers aged 17-22 years, having the sports qualifications of I adult category, CMS, and MS. The subjects were tested in the morning after the previous training day before the first training using the Varikard 2.51 hardware-software complex and Varikard MP program (Ryazan, Russia). The predominant type of autonomic regulation was defined by the classification proposed by N.I. Shlyk [3, 4]. Prior to each HRV test, the racing skiers were interviewed about the physical loads performed



on the previous training day, their load tolerance, quality of sleep, well-being, and participation in competitions.

**Results and discussion.** The analysis of the HRV data in the racing skiers during the training cycle revealed 7 MxDMn at rest: <150, 151-250, 251-350, 351-450, 451-550, 551-650, and >650 ms, which correspond to different levels of functioning of the si-

nus node, type of autonomic regulation, and recovery processes.

The data given in Tables 1 and 3 indicate that the increase in the resting MxDMn values from <150 to >650 ms leads to the increase in the HRV parameters: TP, HF, LF, VLF, ULF, as well as to the decrease in SI. It was found that at the same ranges of the MxDMn values, it is the respiratory (HF ms<sup>2</sup>) or vasomotor (LF

**Table 1.** Standards for HRV in racing skiers with dominating HF-waves at rest and optimal responses to orthostasis at different variation ranges of RR-intervals (MxDMn)

| № of tests | MxDMn range, ms | HR, bpm |          | MxDMn, ms |          | SI, c.u. |          | TP, ms <sup>2</sup> |          | HF, ms <sup>2</sup> |          | LF, ms <sup>2</sup> |          | VLF, ms <sup>2</sup> |          | ULF, ms <sup>2</sup> |          |
|------------|-----------------|---------|----------|-----------|----------|----------|----------|---------------------|----------|---------------------|----------|---------------------|----------|----------------------|----------|----------------------|----------|
|            |                 | lying   | standing | lying     | standing | lying    | standing | lying               | standing | lying               | standing | lying               | standing | lying                | standing | lying                | standing |
| 29         | MxDMn 151-250   | 65      | 89       | 205       | 151      | 149      | 410      | 1515                | 842      | 824                 | 79       | 326                 | 360      | 149                  | 200      | 216                  | 203      |
|            | M±m             | 6       | 8        | 27        | 33       | 58       | 199      | 450                 | 415      | 363                 | 52       | 151                 | 192      | 60                   | 145      | 161                  | 215      |
| 80         | MxDMn 251-350   | 59      | 83       | 303       | 201      | 54       | 235      | 3425                | 1569     | 1880                | 236      | 782                 | 783      | 293                  | 263      | 469                  | 287      |
|            | M±m             | 6       | 10       | 27        | 57       | 14       | 155      | 768                 | 942      | 621                 | 266      | 288                 | 607      | 122                  | 159      | 307                  | 242      |
| 108        | MxDMn 351-450   | 54      | 79       | 397       | 238      | 29       | 188      | 5602                | 2126     | 2889                | 302      | 1205                | 1034     | 562                  | 386      | 945                  | 404      |
|            | M±m             | 7       | 11       | 26        | 68       | 7        | 194      | 1153                | 1244     | 1046                | 326      | 427                 | 746      | 301                  | 278      | 683                  | 345      |
| 43         | MxDMn 451-550   | 54      | 79       | 492       | 275      | 19       | 139      | 7273                | 2712     | 3641                | 428      | 1511                | 1246     | 605                  | 519      | 1516                 | 519      |
|            | M±m             | 7       | 12       | 33        | 85       | 5        | 121      | 1456                | 1584     | 1077                | 588      | 498                 | 721      | 223                  | 407      | 913                  | 472      |
| 18         | MxDMn 551-650   | 52      | 76       | 591       | 259      | 12       | 123      | 11492               | 2315     | 3927                | 309      | 2336                | 976      | 1388                 | 566      | 3841                 | 465      |
|            | M±m             | 5       | 10       | 28        | 71       | 4        | 66       | 3312                | 1208     | 1184                | 272      | 547                 | 701      | 354                  | 439      | 3308                 | 293      |
| 4          | MxDMn >650      | 54      | 70       | 711       | 403      | 10       | 50       | 12456               | 6497     | 4066                | 767      | 2204                | 1752     | 1152                 | 882      | 5034                 | 3097     |
|            | M±m             | 3       | 14       | 80        | 121      | 1        | 35       | 6955                | 3323     | 735                 | 520      | 779                 | 710      | 409                  | 408      | 6107                 | 2467     |

**Table 2.** Standards for HRV in racing skiers with dominating HF-waves at rest and paradoxical responses to orthostasis at different variation ranges of RR-intervals (MxDMn)

| № of tests | MxDMn range, Ms | HR, bpm |          | MxDMn, ms |          | SI, c.u. |          | TP, ms <sup>2</sup> |          | HF, ms <sup>2</sup> |          | LF, ms <sup>2</sup> |          | VLF, ms <sup>2</sup> |          | ULF, ms <sup>2</sup> |          |
|------------|-----------------|---------|----------|-----------|----------|----------|----------|---------------------|----------|---------------------|----------|---------------------|----------|----------------------|----------|----------------------|----------|
|            |                 | lying   | standing | lying     | standing | lying    | standing | lying               | standing | lying               | standing | lying               | standing | lying                | standing | lying                | standing |
| 41         | MxDMn<150       | 57      | 78       | 84        | 212      | 1047     | 216      | 239                 | 1550     | 94                  | 283      | 42                  | 676      | 34                   | 302      | 69                   | 289      |
|            | M±m             | 4       | 8        | 29        | 85       | 675      | 145      | 155                 | 1674     | 80                  | 421      | 37                  | 600      | 24                   | 542      | 53                   | 346      |
| 29         | MxDMn 151-250   | 58      | 74       | 205       | 283      | 121      | 97       | 1616                | 2831     | 852                 | 306      | 334                 | 1685     | 160                  | 488      | 270                  | 351      |
|            | M±m             | 9       | 7        | 26        | 65       | 35       | 45       | 424                 | 1741     | 339                 | 256      | 184                 | 1591     | 71                   | 311      | 182                  | 238      |
| 6          | MxDMn 251-350   | 47      | 66       | 307       | 363      | 48       | 57       | 3886                | 3060     | 1811                | 447      | 891                 | 1132     | 332                  | 618      | 853                  | 862      |
|            | M±m             | 8       | 14       | 35        | 88       | 24       | 37       | 709                 | 1397     | 417                 | 433      | 370                 | 1022     | 100                  | 278      | 399                  | 631      |
| 4          | MxDMn 351-450   | 49      | 73       | 400       | 455      | 23       | 41       | 6165                | 4912     | 3728                | 489      | 998                 | 2900     | 621                  | 809      | 816                  | 714      |
|            | M±m             | 7       | 8        | 30        | 72       | 9        | 5        | 1347                | 1479     | 1412                | 287      | 256                 | 1507     | 206                  | 335      | 203                  | 181      |
| 3          | MxDMn 451-550   | 45      | 65       | 495       | 621      | 18       | 19       | 7831                | 12612    | 3362                | 1177     | 2457                | 6962     | 865                  | 3221     | 1148                 | 1252     |
|            | M±m             | 4       | 15       | 46        | 52       | 6        | 9        | 1552                | 8461     | 1529                | 555      | 1564                | 5249     | 282                  | 2872     | 305                  | 504      |

\* The marked HRV rates at rest and in orthostasis indicate a deviation from the norm.

**Table 3.** Standards for HRV in racing skiers with dominating LF-waves at rest and optimal responses to orthostasis at different variation ranges of RR-intervals (MxDMn)

| № of tests | MxDMn range, ms | HR, bpm |          | MxDMn, ms |          | SI, c.u. |          | TP, ms <sup>2</sup> |          | HF, ms <sup>2</sup> |          | LF, ms <sup>2</sup> |          | VLF, ms <sup>2</sup> |          | ULF, ms <sup>2</sup> |          |
|------------|-----------------|---------|----------|-----------|----------|----------|----------|---------------------|----------|---------------------|----------|---------------------|----------|----------------------|----------|----------------------|----------|
|            |                 | Lying   | standing | lying     | standing | lying    | standing | lying               | standing | lying               | standing | lying               | standing | lying                | standing | lying                | standing |
| 14         | MxDMn 151-250   | 60      | 83       | 217       | 153      | 122      | 410      | 1576                | 1222     | 417                 | 77       | 574                 | 618      | 200                  | 268      | 385                  | 259      |
|            | M±m             | 11      | 15       | 23        | 44       | 36       | 308      | 359                 | 904      | 208                 | 89       | 198                 | 584      | 50                   | 187      | 281                  | 199      |
| 33         | MxDMn 251-350   | 61      | 85       | 303       | 197      | 65       | 295      | 3171                | 1708     | 836                 | 141      | 1392                | 1035     | 361                  | 264      | 584                  | 269      |
|            | M±m             | 10      | 13       | 25        | 57       | 20       | 341      | 713                 | 1108     | 400                 | 134      | 615                 | 804      | 194                  | 219      | 402                  | 207      |
| 9          | MxDMn 351-450   | 57      | 79       | 413       | 263      | 31       | 145      | 6331                | 2556     | 1739                | 248      | 2380                | 1249     | 814                  | 568      | 1399                 | 491      |
|            | M±m             | 6       | 12       | 25        | 88       | 6        | 119      | 779                 | 1959     | 368                 | 168      | 402                 | 835      | 174                  | 550      | 877                  | 654      |
| 41         | MxDMn 451-550   | 55      | 78       | 496       | 291      | 24       | 133      | 9148                | 3892     | 2193                | 614      | 4461                | 2114     | 1192                 | 667      | 1302                 | 496      |
|            | M±m             | 7       | 11       | 26        | 100      | 10       | 147      | 2612                | 3400     | 733                 | 909      | 1849                | 2044     | 651                  | 669      | 866                  | 563      |
| 24         | MxDMn 551-650   | 53      | 79       | 596       | 266      | 15       | 167      | 13952               | 3094     | 2848                | 413      | 5671                | 1255     | 2286                 | 790      | 3146                 | 636      |
|            | M±m             | 6       | 10       | 29        | 112      | 5        | 142      | 3267                | 2259     | 857                 | 779      | 2127                | 919      | 1143                 | 754      | 2617                 | 530      |
| 6          | MxDMn >650      | 49      | 79       | 702       | 256      | 9        | 133      | 14486               | 2867     | 2566                | 383      | 5171                | 1313     | 2592                 | 568      | 4157                 | 603      |
|            | M±m             | 7       | 12       | 72        | 85       | 4        | 96       | 2968                | 2182     | 815                 | 307      | 1824                | 715      | 1072                 | 659      | 2474                 | 705      |

**Table 4.** Standards for HRV in racing skiers with dominating LF-waves at rest and paradoxical responses to orthostasis at different variation ranges of RR-intervals (MxDMn)

| № of tests | MxDMn range, ms | HR, bpm |          | MxDMn, ms |          | SI, c.u. |          | TP, ms <sup>2</sup> |          | HF, ms <sup>2</sup> |          | LF, ms <sup>2</sup> |          | VLF, ms <sup>2</sup> |          | ULF, ms <sup>2</sup> |          |
|------------|-----------------|---------|----------|-----------|----------|----------|----------|---------------------|----------|---------------------|----------|---------------------|----------|----------------------|----------|----------------------|----------|
|            |                 | lying   | standing | lying     | standing | lying    | standing | lying               | standing | lying               | standing | lying               | standing | lying                | standing | lying                | standing |
| 22         | MxDMn<150       | 55      | 74       | 121       | 237      | 352      | 131      | 566                 | 2346     | 115                 | 403      | 194                 | 1118     | 126                  | 435      | 131                  | 390      |
|            | M±m             | 4       | 8        | 15        | 64       | 104      | 74       | 175                 | 1812     | 59                  | 719      | 71                  | 1010     | 48                   | 289      | 75                   | 277      |
| 21         | MxDMn 151-250   | 58      | 79       | 201       | 265      | 136      | 115      | 1503                | 2776     | 341                 | 244      | 579                 | 1553     | 227                  | 524      | 356                  | 455      |
|            | M±m             | 14      | 13       | 22        | 56       | 49       | 48       | 369                 | 1440     | 143                 | 192      | 282                 | 1108     | 112                  | 289      | 269                  | 283      |
| 17         | MxDMn 251-350   | 58      | 75       | 294       | 386      | 71       | 53       | 3004                | 5858     | 609                 | 592      | 1230                | 3615     | 426                  | 824      | 740                  | 828      |
|            | M±m             | 16      | 13       | 26        | 65       | 23       | 25       | 726                 | 3132     | 300                 | 317      | 448                 | 2570     | 180                  | 371      | 532                  | 656      |
| 3          | MxDMn 351-450   | 47      | 68       | 394       | 492      | 32       | 38       | 6426                | 10867    | 1471                | 1604     | 2936                | 6101     | 896                  | 1752     | 1122                 | 1410     |
|            | M±m             | 9       | 15       | 33        | 141      | 10       | 32       | 4981                | 4828     | 1844                | 1409     | 2942                | 131      | 741                  | 1971     | 536                  | 1446     |
| 1          | MxDMn 551-650   | 42      | 68       | 559       | 577      | 8        | 17       | 22757               | 14991    | 3802                | 3967     | 12231               | 6444     | 3698                 | 3027     | 3025                 | 1554     |
|            | M±m             | -       | -        | -         | -        | -        | -        | -                   | -        | -                   | -        | -                   | -        | -                    | -        | -                    | -        |

\* The marked HRV rates at rest and in orthostasis indicate a deviation from the norm.

ms<sup>2</sup>) waves that may predominate, indicating different autonomic balance types and the need to take this into account when designing individual training loads for racing skiers.

The predominance of the HF component in the HRV power spectrum was found in 365 cases (Table 1), of which 22.7% had a paradoxical response to orthosta-

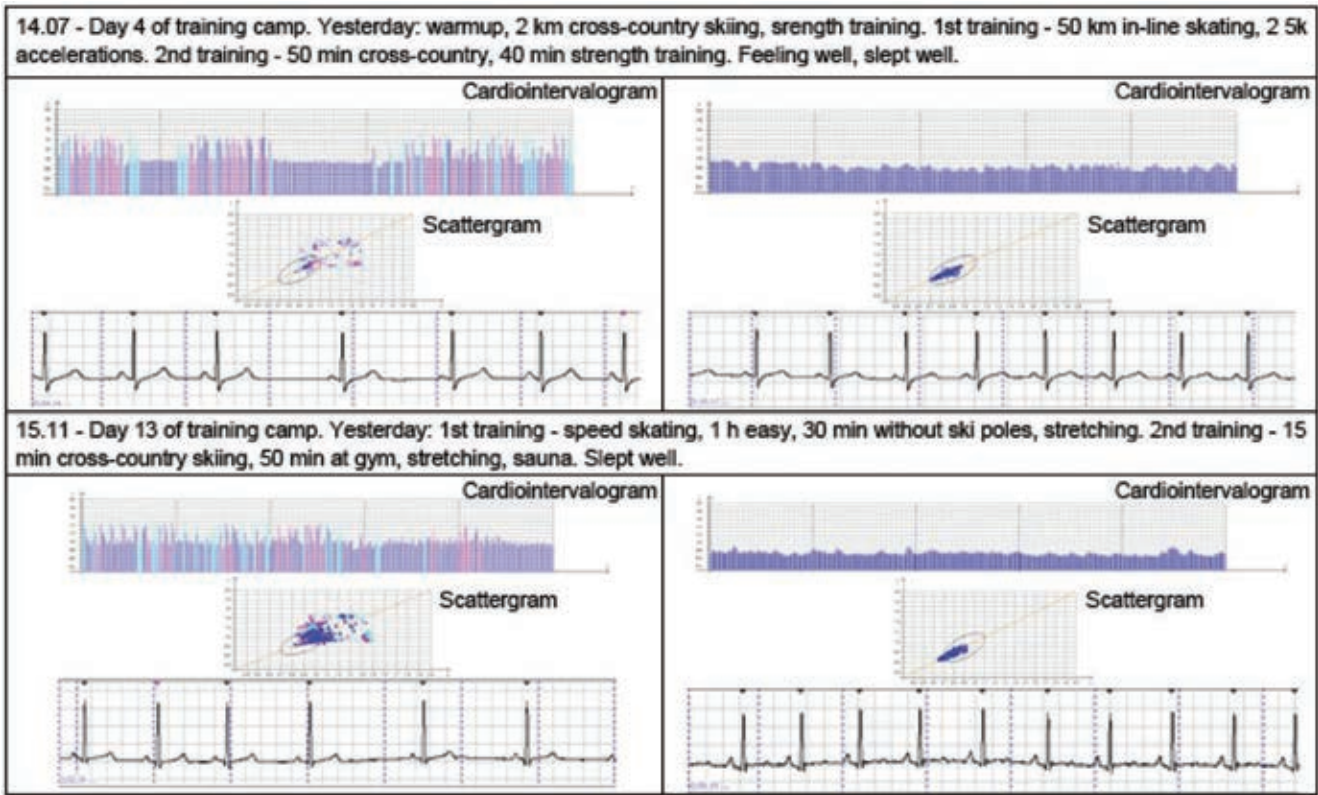
sis mainly within the low MxDMn ranges - <150 and 151-250 ms (Table 2).

The predominance of the LF component was found in 193 cases at rest, of which 32% had adverse response to the orthostasis mainly within the following MxDMn ranges: <150, 151-250, and 251-350 ms (Table 4).

**Table 5.** HRV rates in overtrained racing skier K. at rest and in orthostasis with high MxDMn values in training and competitive periods

| Date  | HR, bpm |          | MxDMn, ms |          | SI, c.u. |          | TP, ms <sup>2</sup> |          | HF, ms <sup>2</sup> |          | LF, ms <sup>2</sup> |          | VLF, ms <sup>2</sup> |          | ULF, ms <sup>2</sup> |          |
|-------|---------|----------|-----------|----------|----------|----------|---------------------|----------|---------------------|----------|---------------------|----------|----------------------|----------|----------------------|----------|
|       | lying   | Standing | Lying     | standing | lying    | standing | lying               | standing | lying               | Standing | lying               | standing | lying                | standing | Lying                | standing |
| 14.07 | 55      | 72       | 618       | 261      | 19       | 81       | 29467               | 2265     | 1655                | 486      | 9343                | 1058     | 3895                 | 365      | 14574                | 355      |
| 15.11 | 57      | 81       | 606       | 223      | 16       | 131      | 19060               | 2106     | 3550                | 223      | 7783                | 1029     | 5027                 | 540      | 2700                 | 314      |

\* The marked HRV rates at rest and in orthostasis indicate a deviation from the norm.



Cardiointervalograms, HRV scattergrams and ECG at rest and in orthostasis at high MxDMn values in over-trained racing skier K.

The MxDMn data given in Tables 1-3 indicate the predominant type of autonomic regulation. At MxDMn <150 ms, the highest SI values and low HF-, LF- and especially VLF- and ULF-waves of the HRV power spectrum were observed. At the same time, 100% of the examined racing skiers had paradoxical responses to orthostasis (Tables 2 and 4).

The paradoxical response to orthostasis is an indicator of an unfavorable prognosis both in the athlete's state of health and his sports results [3, 4].

The moderate influence of the central regulatory mechanisms on the heart rhythm corresponds to the MxDMn range of 151-250 ms (I type of regulation), where 51.0% of racing skiers were also found to have an impaired autonomic reactivity to orthostasis and slow recovery (Tables 2 and 4).

The MxDMn range of 251-350 ms represents the lower boundary of the state between the I and III types of regulation, 351-450 ms - the in-between state, and 451-550 ms - the upper boundary of the optimal state of the autonomous regulation circuit (III type of regulation). These racing skiers are characterized by good adaptability to training loads, absence of paradoxical responses to orthostasis, and fast recovery. In case of unfavorable responses to orthostasis at the III type of regulation, but in the absence of heart rhythm disorders on ECG, racing skiers need rest and correction of their training mode.

The expressed predominance of the autonomous regulation circuit is characterized by MxDMn ranging within 551-650 ms (IV type of regulation). An increase of MxDMn to >651 ms may indicate both various heart



rhythm disorders and their absence. In this case, visual monitoring of cardiointervalograms, HRV scattergrams, and ECG at rest and in orthostasis is mandatory.

Table 5 and Figure 1 illustrate the results of the HRV analysis of the overtrained racing skier K. with the expressed MxDMn values - >600 ms.

Most of the examined racing skiers were found to have multiple changes in the MxDMn values - from favorable to unfavorable - due to the sinus node malfunction, insufficient or paradoxical adaptive-regulatory processes, and primarily due to physical overloads. Moreover, at rest, several racing skiers (Tables 2 and 4) had pronounced bradycardia, which cannot be considered a positive change, as there were negative reactions to orthostasis. This confirms once again that HR does not provide true information on the functional state of the cardiovascular system, without taking into account its regulation according to the HRV analysis.

**Conclusion.** The study found that the predominant type of regulation at rest in each athlete defines the bounds of the MxDMn range, divisions of the autonomic nervous system, and level of the body's functioning as a whole. Therefore, racing skiers with different MxDMn values and vegetative balances should be

subjected to different training loads, which would help timely prevent overstrain and overtraining.

The lack of clarity over the bounds of the optimal MxDMn range, or disregard of this indicator in the HRV analysis of racing skiers cannot provide researchers with true information on the level of tolerance to physical loads.

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# Physical overstrain in sports: modern prevention and rehabilitation procedure

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## Abstract

**Objective of the study** was to analyze exposures to the microtraumatic disease risks and benefits of Traumel-C for treatment of the microtraumatic-disease-associated impaired local circulation in gorodki players, to facilitate trainings and special fitness improvement efforts.

**Methods and structure of the study.** We sampled for the study Masters of Sport in gorodki (n=12) [national game similar to skittles, with pins knocked out by throwing a bat]. The sample was tested for microcirculation disorders in the upper limbs by an infrared thermometric DT-639 system, with the pain syndrome self-rated on a visual-analog scale. The detected microcirculation disorders were treated by Traumel-C antihomotoxic medication (made by Heel Co.) with taping.

**Results and conclusion.** To identify the injury risk factors for gorodki players, we first surveyed their coaches (n= 24). They reported the following common risk factors: idle periods in trainings followed by excessive physical workouts (21%) and mismanagements in combining the training elements (11%); and the following sport-specific risk factors: elbow joint overextensions (32%), and too heavy bats favored by the sport elite (29%).

The surveys identified the core musculoskeletal system chronic overstrain risk factors for the gorodki sport sample and showed benefits of the biological regulation service using the Traumel-C antihomotoxic medication for the upper-limb microcirculation protection, improvement and post-training rehabilitation purposes. We recommend Traumel-C with taping for application in the gorodki training systems for the upper-limb musculoskeletal system overstrain prevention and sport-specific fitness improvement purposes.

**Keywords:** *chronic overstrain, risk factors, antihomotoxic medications, prevention, microcirculation.*

**Background.** Adaptive overstrains in sports are known to trigger disorders and diseases in different systems and organs [4, 7, 11] dominated by chronic overstrain of the musculoskeletal system often resulting in a microtraumatic disease [2]. Repetitive microtraumas are explained by excessive and intensive training/ competitive stresses on the one hand and ineffectiveness of the applied strain prevention and rehabilitation remedies offered by the traditional and or allopathic medicine on the other hand [3]. Such remedies are expected to suppress the inflammatory process and pain syndrome acting as symptomatic in fact and, therefore, often spur up transformations from the acute to chronic process associated with

systemic allergic reactions and barriers for the endogenous inflammation-counteracting mechanisms [10]. Modern biological medicine offers multipurpose toolkits to mitigate inflammations in overstrained tissues. Such toolkits will be customized to the natural individual needs and resources in the regulation, regeneration, adaptation and sanogenetic aspects. Modern biological therapy includes antihomotoxic therapy as one of its components with special benefits for these purposes.

The concept of homotoxicology by H.H. Reckeweg [8, 9] was developed in compliance with the key provisions of the modern connective tissue medicine [1, 6]. The musculoskeletal system overstrain at the in-



flammatory stage is effectively treated by Traumel-C antihomotoxic medication [5] that facilitates the natural protective and counter-inflammatory responses in the connective tissue of the musculoskeletal system to reduce homotoxicosis and activate cytokine regulation with the inflammation suppression and tissue detoxification effects. These combined effects facilitate rehabilitation of microcirculation and temperature homeostasis, with pain reductions [12].

**Objective of the study** was to analyze exposures to the microtraumatic disease risks and benefits of Traumel-C for treatment of the microtraumatic-disease-associated impaired local circulation in gorodki players, to facilitate trainings and special fitness improvement efforts.

**Methods and structure of the study.** We sampled for the study Masters of Sport in gorodki ( $n=12$ ) [*national game similar to skittles, with pins knocked out by throwing a bat*]. The sample was tested for microcirculation disorders in the upper limbs by an infrared thermometric DT-639 system, with the pain syndrome self-rated on a visual-analog scale. The detected microcirculation disorders were treated by Traumel-C antihomotoxic medication (made by Heel Co.) with taping.

**Results and discussion.** To identify the injury risk factors for gorodki players, we first surveyed their coaches ( $n=24$ ). They reported the following common risk factors: idle periods in trainings followed by excessive physical workouts (21%) and mismanagements in combining the training elements (11%); and the following sport-specific risk factors: elbow joint overextensions (32%), and too heavy bats favored by the sport elite (29%).

Furthermore, we profiled the pain syndrome by tests of the gorodki sportsmen ( $n=44$ ). The tests found the pains mostly in the elbow (70.5%) and shoulder joints (29.5%). We also tested effects of trainings with the heavy competitive bats on the upper-limb microcirculation using the infrared thermometric DT-639 system. The tests were run after the standard 135-min training sessions, with every player making 100-130 bat throws.

Instant adaptation patterns were ranked by the following body temperature variations: good response when the body temperature grows in the tested zone; satisfactory response when it stands virtually the same; and unsatisfactory response when it falls after training. Every such body temperature fall may be indicative of the upper-limb musculoskeletal system

**Table 1.** Post-training upper-limb microcirculation/ body temperature test data of the elite sample ( $n=12$ )

| Body temperature test zone  | People tested with:        |                        |                       |
|-----------------------------|----------------------------|------------------------|-----------------------|
|                             | Unchanged body temperature | Body temperature falls | Body temperature rise |
| Elbow: internal condyle     | 2                          | 10                     | -                     |
| Brachioradialis muscle      | 6                          | 6                      | -                     |
| Round pronator              | 2                          | 9                      | 1                     |
| Deltoid muscle: medial zone | 1                          | 1                      | 1                     |

**Table 2.** Post-training upper-limb body temperature test data in the Traumel-C application period

| Body temperature test zone  | People tested with:        |                       |                       |
|-----------------------------|----------------------------|-----------------------|-----------------------|
|                             | Unchanged body temperature | Body temperature fall | Body temperature rise |
| Elbow: internal condyle     | 8                          | 4                     | -                     |
| Brachioradialis muscle      | 7                          | 4                     | 1                     |
| Round pronator              | 8                          | 3                     | 1                     |
| Deltoid muscle: medial zone | 4                          | 3                     | 5                     |

**Table 3.** Post-training elbow body temperature test data with and without tapes ( $n=12$ )

| Body temperature test zone | People tested with:        |                       |                       |
|----------------------------|----------------------------|-----------------------|-----------------------|
|                            | Unchanged body temperature | Body temperature fall | Body temperature rise |
| Non-taped round pronator   | 1                          | 9                     | 2                     |
| Taped round pronator       | 5                          | 5                     | 2                     |



**Table 4.** Post-training pain syndrome test data in the taping experiment (n=12)

| Pain rate | People tested after: |                     |
|-----------|----------------------|---------------------|
|           | Training session 1   | Training session 10 |
| No pain   | -                    | -                   |
| Slight    | 3                    | 6                   |
| Medium    | 6                    | 5                   |
| Strong    | 3                    | 1                   |

dysfunction and potential disorder. Given in Table 1 hereunder are the post-training upper-limb microcirculation test data; with the body temperature falls indicative of potential mismanagements in the individual training systems and accumulated backlog in post-training rehabs.

We used the Traumel-C for 14 training days to prevent fatigue-related musculoskeletal system disorders, with the ointment applied 30 minutes prior to every training session by rubbing into the elbow and deltoid muscle. The sample used heavy bats in the trainings. Individual responses to the therapy were as follows: 8 people were tested with satisfactory responses; and 5 people were tested with good responses in the medial fibers of the deltoid muscle: see Table 2.

Later on, we additionally used taping to mitigate/prevent the potential training overstrains, with the tapes fixed so as to limit the elbow extension amplitude. The tape-free subsample (n=9) was tested with the body temperature fall in the round pronator zone – indicative of dysfunctions and poor microcirculation in the test zone as a result of mismanagements in the training systems. The taped subsample was tested with progresses in responses, as only five people were tested with body temperature fall and another five tested with the body temperature standing unchanged; plus four athletes were tested with satisfactory responses due to the antihomotoxic medication and taping procedure: see Table 3.

The pain syndrome in the elbow was rated on a subjective rating scale. The pain syndrome profiling survey found the taping procedure being beneficial for pain syndrome mitigation: see Table 4.

The above pain syndrome tests showed significant pain reductions in the sample for 10 training sessions as a result of the taping procedure.

**Conclusion.** The surveys identified the core musculoskeletal system chronic overstrain risk factors for the gorodki sport sample and showed benefits of the biological regulation service using the Traumel-C antihomotoxic medication for the upper-limb microcircu-

lation protection, improvement and post-training rehabilitation purposes. We recommend Traumel-C with taping for application in the gorodki training systems for the upper-limb musculoskeletal system overstrain prevention and sport-specific fitness improvement purposes.

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# Impact of adaptive physical education on health of students from various nosological groups

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## Abstract

**Objective of the study** was to identify the impact of adaptive physical education on the health of students from various nosological groups.

**Methods and structure of the study.** In the postoperative period, the students with disabilities, chronic diseases, and injuries were transferred to the adaptive physical education groups for health reasons. They attended adaptive physical education lessons twice a week, just as the main and preparatory groups. The lessons were disease-driven. The groups were formed of 8-10 students with due regard to their nosology, including 2-3 students with disabilities – with the same degree of the motor defect; students with different defects attended one-on-one training sessions.

The physical loads for corrective purposes – to expand the motor sphere of the disabled students – were designed based on the knowledge of the specifics of functioning of the cardio-respiratory, nervous and locomotor systems. At the beginning and at the end of the academic year, 32 students with special needs (19 girls and 13 boys) and 137 students attributed to the special health group (108 girls and 29 boys) were subjected to the health express-tests (as provided by G.L. Apanasenko's health rating method) [1], including the calculation of the Quetelet body mass index (QI), strength index (SI), birth-death ratio (BDR), and Robinson index (RI). The adaptive capabilities of the cardiovascular system in the recovery period were also evaluated by the Martine Probe (20 squats for 30 s).

**Results and conclusions.** Adaptive physical education classes designed for physically disabled students from various nosological groups were proved to facilitate the improvement of their adaptive capabilities and physical working capacity.

**Keywords:** *students, adaptive physical education, morbidity, health level.*

**Background.** In the Russian Federation, the number of persons with health disorders who need special conditions to be provided for their normal physical, mental and social development is increasing from year to year. In most of higher educational institutions, students with special needs are excused from attending physical education lessons and get a credit/exam on the basis of a medical fitness certificate, academic attendance, and essay grades. However, these students need physical education and sports activities that would contribute to the ultimate subsistence and self-realization in society [2, 3].

**Objective of the study** was to identify the impact of adaptive physical education on the health of students from various nosological groups.

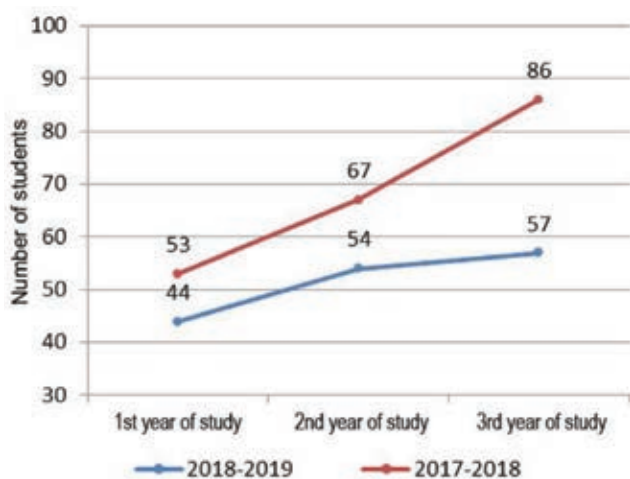
**Methods and structure of the study.** In the postoperative period, the students with disabilities, chronic diseases, and injuries were transferred to the adaptive physical education groups for health reasons. They attended adaptive physical education lessons twice a week, just as the main and preparatory groups. The lessons were disease-driven. The groups were formed of 8-10 students with due regard to their nosology, including 2-3 students with disabilities – with the same degree of the motor defect; students with different defects attended one-on-one training sessions.

The physical loads for corrective purposes – to expand the motor sphere of the disabled students – were designed based on the knowledge of the specifics



of the cardio-respiratory, nervous and locomotor system functionality. At the beginning and at the end of the academic year, 32 students with special needs (19 girls and 13 boys) and 137 students attributed to the special health group (108 girls and 29 boys) were subjected to the health express-tests (as provided by G.L. Apanasenko's health rating method) [1], including the calculation of the Quetelet body mass index (QI), strength index (SI), birth-death ratio (BDR), and Robinson index (RI). The adaptive capabilities of the cardiovascular system in the recovery period were also evaluated by the Martine Probe (20 squats for 30 s).

**Results and discussion.** The analysis revealed that in 2017-2018, 155 students from Udmurt State University attended the adaptive physical education lessons, while in 2018-2019 it was 206 students already, which is 41.7% higher, compared to the previous year. It should also be noted that both in 2017-2018 and 2018-2019 academic years, the number of students excused from attending physical education lessons and transferred to the adaptive physical education groups increased from the 1st to the 3rd years of study.



**Fig. 1.** Number of 1st-3rd-year students involved in the adaptive physical education groups

Based on the nosological characteristics, the students were divided into four groups. The majority of the students (37.5%) were diagnosed with cardio-respiratory disorders, 32.9% - with locomotor disorders, 15.9% - with gastrointestinal and excretory disorders, and 13.7% - with nervous disorders. It should be emphasized that the number of students with disabilities in the 2017-2018 and 2018-2019 academic years was 20.5% of the number of students attending adaptive physical education lessons.

The G.L. Apanasenko's health rating method was used to assess the health level of students transferred to the adaptive physical education groups at the beginning and at the end of the semester to evaluate their somatic health and energy biopotential of each student.

The analysis of the health level revealed low Quetelet index values for both girls and boys at the beginning of the semester, showing poorly developed skeletal muscles or overweight, as well as obesity. Both girls and boys were found to have reduced respiratory function as evidenced by the birth-death ratio.

The analysis of the Robinson index rates also revealed a low cardiovascular functionality in the students exempted from physical education lessons for health reasons, indicating dysregulation of the cardiovascular system. The strength index in this student population was also rated as low, indicating their low strength fitness level.

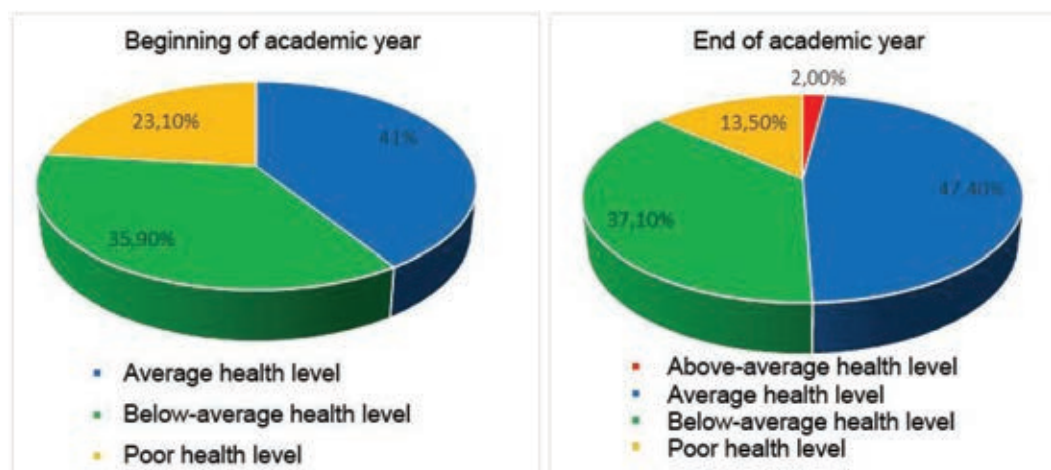
The recovery period after 20 squats indicated the reserve capacity of the cardiovascular system. Thus, it took the students quite long to recover, proving the low cardiovascular system functionality.

The analysis of the health indicators in the students exempted from physical education lessons and transferred to the adaptive physical education groups showed that 41% of the students had an average health level, while 35.9% and 23.1% - below average and low health levels respectively. The above

**Table 1.** Health rates in students involved in adaptive physical education groups

| Sex   | Period                | Quetelet index, gm/cm | Birth-death ratio, ml/kg | Strength index, kg*100% | Robinson index, bpm*mmHg/100 | Recovery time, s | Health level, points |
|-------|-----------------------|-----------------------|--------------------------|-------------------------|------------------------------|------------------|----------------------|
| Girls | Beginning of semester | 385.6±4.7             | 43.6±1.2                 | 41.2±0.9                | 100.4±3.8                    | 106.3 ±4.2       | 4.8±0.7              |
|       | End of semester       | 350.4± 3.3*           | 47.2±1.6*                | 43.7±1.1                | 92.6±4.7                     | 98.5±3.8*        | 6.4±0.9              |
| Boys  | Beginning of semester | 423.3 ±5.4            | 41.1±2.1                 | 55.1 ±3.7               | 108.3± 2.8                   | 124.1 ±3.6       | 4.4±0.8              |
|       | End of semester       | 411.82±4.6*           | 48.5±2.8*                | 57.3±4.1                | 92.4±2.9*                    | 112.7±3.2*       | 8.2±1.2*             |

\* – significance of differences between the indices at  $p \leq 0.05$



**Fig. 2.** Health rates in students involved in adaptive physical education activities at the beginning and end of the academic year

average and high health levels were not detected, which indicated that this category of students had reduced adaptive capabilities and functional state of the body. Therefore, by exempting such students from physical education lessons, we condemn them to develop serious pathologies at young age.

At the end of the academic year a shift in the health level of both girls and boys at  $p \leq 0.05$  was detected. For example, a significant increase was observed in the Quetelet index, which indicated a weight reduction and a risk of developing overweight-related diseases. The birth-death ratio and Robinson index rates increased, showing an increase in the body's reserve capacity, improvement of economization and regulation of cardiovascular activity. There was also a positive tendency in the students' hand strength, and the strength index increased slightly in both boys and girls.

These small shifts may indicate that physical loads are insufficient to develop strength in this category of students, which should be brought to the teachers' attention, who should correct physical loads by including dosed strength and resistance exercises. The overall health level of the students

transferred to the adaptive physical education groups improved, with the physical development level being above average in 2% of the students, average level – in 47.4%, below average – in 37.1%, and low – in 13.5% of the students.

**Conclusion.** Adaptive physical education classes designed for physically disabled students from various nosological groups were proved to facilitate the improvement of their adaptive capabilities and physical working capacity.

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# Academic special health groups: physical education and sports motivations and values survey

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## Abstract

**Objective of the study** was to survey and analyze the physical education and sport motivations and values of the special health group students.

**Methods and structure of the study.** We surveyed the physical education and sport motivations and values of the special health group students using the A.V. Shaboltas Sports Motivations Survey method. We sampled for the survey the Surgut Polytechnic College's special health group students (n=40) and provisionally grouped them into Hearing Impaired Group and Somatic Diseases Group.

**Results and conclusion.** The physical education and sport motivations and values of the special health group students may be grouped into general cultural, socio-psychological and specific ones. The general cultural motivations and values refer to the group conceptions of the ongoing socio-cultural processes in the key communities and their own potential contributions to the social life and cultures. The socio-psychological motivations and values refer to the public priorities, public opinions, motives, interests, values and priorities of the relevant social groups, plus the physical education-and-sport-specific social relationships. And the specific motivations and values refer to the personality progress agendas of the special health group students with the self-fulfillment, socialization, health improvement and social role/ image/ status building aspects. The above grouped motivations and values altogether constitute the physical education and sport motivations and values of the special health group students.

The survey data and analysis give us the grounds to conclude that the hearing impaired group prioritizes their physical education and sports interests for individual physical education and sports progress, whilst the somatic diseases group is much more focused on the team sports with the teamwork related motivations and values. Generally physical education and sport service to special health group is recommended being sensitive to the relevant individual motivations and values and progress agendas to attain the health improvement goals.

**Keywords:** *motivations and values, sports, physical education, special health group students.*

**Background.** Modern social and high education policies and practices give a high priority to the students' physical progress needs, with a special attention to the special health group needs. Surveys and analyses of the group determinations for sports have found the relevant sporting motivations and values, cognitive and operational/ progress motivations and values components. The physical education and sport motivations and values were found dominant as they are indicative of an individual genuine interest and drivers, and this is the reason why the academic physical education and sport system takes special efforts to form and

encourage the physical education and sport motivations and values. These efforts and service for the special health group students will be designed to: improve their physical and mental/ emotional health standards; facilitate their intellectual and creative progress; improve the spiritual and moral education service; develop good stress tolerance and endurance under external pressures; offer special therapeutic service for functional rehabilitation; facilitate their socializing and communicative progresses; help their health-specific adaptation; and advance their self-realization/ personality progress agendas [1, 2].



**Objective of the study** was to survey and analyze the physical education and sport motivations and values of the special health group students.

**Methods and structure of the study.** We surveyed the physical education and sport motivations and values of the special health group students using the A.V. Shaboltas Sports Motivations Survey method. We sampled for the survey the Surgut Polytechnic College's special health group students (n=40) and provisionally grouped them into Hearing Impaired Group and Somatic Diseases Group.

**Results and discussion.** The physical education and sport motivations and values of the special health group students may be grouped into general cultural, socio-psychological and specific ones. The general cultural motivations and values refer to the group conceptions of the ongoing socio-cultural processes in the key communities and their own potential contributions to the social life and cultures [4]. The socio-psychological motivations and values refer to the public priorities, public opinions, motives, interests, values and priorities of the relevant social groups, plus the physical education-and-sport-specific social relationships. And the specific motivations and values refer to the personality progress agendas of the special health group students with the self-fulfillment, socialization, health improvement and social role/ image/ status building aspects [3]. The above grouped motivations and values altogether constitute the physical education and sport motivations and values of the special health group students. The special health group physical education and sport motivations and values survey data we obtained are given hereunder in Table 1.

The survey data showed that the Hearing Impaired Group tends to prioritize the social self-assertion, socio-emotional and success motives

– that means that the group is focused on the physical education and sports progress and prepared to take significant efforts to attain the progress goals on the way to success. These students strive to assert themselves in their communities in the physical education and sports domain by demonstrating their accomplishments and skills being determined to take leading positions in the teams or groups. Therefore, the Hearing Impaired Group was found mostly driven by the individual success motivations and striving to mobilize the own motivations and values resource as dictated by the individual progress agendas. This means that the Hearing Impaired Group students may be highly successful in the academic physical education and sports when their progress is duly encouraged.

The Somatic Diseases Group students were tested to prioritize the emotional uplift and socio-moral motives, with a special focus on the emotional return from the physical education and sports classes on the whole and from the teammates in particular. This means that they strive to establish emotional contacts with the teammates for joint progress in the physical education and sports domain. Their socio-moral motives are dominated by the team success related ones, with every Somatic Diseases Group student prepared for self-sacrificing contribution to the collective physical education and sports progress. This high commitment for constructive and emotional teamwork make the Somatic Diseases Group highly determined in academic team sports as they facilitate their motivations and values resource being fully mobilized for progress and success. It should be also emphasized that both the Hearing Impaired and Somatic Diseases Group were tested with high rational-volitional/ recreational motives and needs in physical education and sports.

**Table 1.** *Physical education and sport motivations and values of the Hearing Impaired and Somatic Diseases Groups (Hearing Impaired Group, Somatic Diseases Group) Groups, points*

| Elementary motivations and values                       | Hearing Impaired Group | Somatic Diseases Group |
|---------------------------------------------------------|------------------------|------------------------|
| Emotional uplift                                        | 13                     | 14                     |
| Social self-assertion                                   | 14                     | 13                     |
| Physical progress                                       | 13                     | 13                     |
| Socio-emotional motives                                 | 15                     | 11                     |
| Socio-moral motives                                     | 12                     | 15                     |
| Success motives                                         | 15                     | 10                     |
| Physical education and sport specific cognitive motives | 14                     | 14                     |
| Rational volitional/ recreational motives               | <b>18</b>              | <b>18</b>              |
| Professional progress motives                           | 2                      | 1                      |
| Civil/ patriotic motives                                | 4                      | 2                      |



**Conclusion.** The survey data and analysis give us the grounds to conclude that the hearing impaired group prioritize their physical education and sports interests for individual physical education and sports progress, whilst the somatic diseases group is much more focused on the team sports with the teamwork related motivations and values. Generally physical education and sport service to special health group is recommended being sensitive to the relevant individual motivations and values and progress agendas to attain the health improvement goals.

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# Academic physical education and sports system: gender aspect

UDC 796.077.5

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## Abstract

**Objective of the study** was to survey and analyze the gender split situation in the national academic physical education and sports system.

**Methods and structure of the study.** We sampled the students (n=2524 including 1298 men and 1226 women) of Lesgaft National State University of Physical Education, Sport and Health for the gender split analysis.

**Results and conclusion.** We believe that the modern sports communities are virtually free of any gender biases that are still alive in the non-sporting population groups as myths and gender stereotypes – albeit they also tend to fade with time. A good case in point is provided by the latest progress of the men's rhythmic and artistic gymnastics and synchronized swimming disciplines. It should be mentioned in this context that some gender inequality is still traditional for the national educational system management groups including the academic physical education and sports management which is still dominated by men like quite a few other sectors.

The national physical education and sport sector shaping historical and socio-cultural contexts and factors have been virtually free of expressed and specific gender inequalities or biases. Gender split in the national physical education and sports universities is traditionally and virtually equal, with women having a free access to every natural scientific education domain. Modern education system reforms tend to prioritize multidisciplinary integrative education models free of gender biases in every sector including the academic physical education and sport service.

**Keywords:** *higher education in physical education and sports, professional gender split, gender stereotypes.*

**Background.** For the last two decades, gender issues have been increasingly relevant for the Russian society on the whole and physical education and sport system in particular. The academic physical education and sport system has always ranked the social/gender equality among its key values, along with the Soviet sports progress with their institutional building aspects. Gender equality policies and practices have always been advanced in the national communities and physical education and sport system. Thus Peter Lesgaft Institute of Physical Education since the Soviet times trained students of both sexes on an equal basis – in the context of the traditional gender statuses and roles deeply rooted in the national culture. The concept of sexual dimorphism refers to the

natural differences of both sexes to give rise to many popular biases and myths on the men's sports being inaccessible for women since they are unable to compete with men. Ridiculously enough, the gender rivalry found new forms nowadays when transgender men are qualified in some countries for the women's sport competitions.

It is also beyond doubt that female athletes in many sports have come fairly close to the best men's accomplishments. Modern sports are increasingly women-friendly i.e. offer growing and greater opportunities for their progress in many aspects. This is the reason why the modern physical education and sports theory, practice and research are increasingly interested in studies of the women's individual and



specific resources, functionality specifics and other potential contributors to their competitive successes. It should be mentioned in this context that the modern physical education and sports knowledge is increasingly integrative. Having emerged in natural sciences, it has rapidly advanced to the social and humanitarian knowledge domains to acquire an expressed interdisciplinary character. On the whole, the physical education and sports progress within the historical, socio-cultural and research contexts have largely leveled down the traditional gender inequality in the vocational identifications and motivations of the young human resource flowing in the physical education and sport sector.

**Objective of the study** was to survey and analyze the gender split situation in the national academic physical education and sports system.

**Methods and structure of the study.** We sampled the students (n=2524 including 1298 men and 1226 women) of Lesgaft National State University of Physical Education, Sport and Health for the gender split analysis.

**Results and discussion,** Given in Table 1 are the gender split data of the 48.6% female 51.4% male sample.

About the same gender split was found in the full-time and correspondence course masters majoring in 49.04.01 Physical Education and 49.04.03 Sports disciplines, with some sport-specific gender variations across the Departments. Thus the Summer Olympic Sports Department and Martial Arts and Non-Olympic Sports Department were found favored by women and men, respectively, albeit the gender differences are offset by the total numbers and percentages. Provisionally the departmental sports may be grouped into:

– Traditionally preferred by women “aesthetic” sports: rhythmic gymnastics, aesthetic gymnastics, sports aerobics, sport dances, acrobatic rock-n-roll, figure skating, etc.;

– Strength-intensive/ power contact sports preferred by men: football, ice hockey, wrestling; and

– Mass popular gender-unspecific sports: athletics, swimming, cross-country skiing, etc.

The above gender split is apparently dictated by mostly motivations and sport specifics, plus the growing commercialization trends of influence on the social and gender student groups – as demonstrated, among other things, by the figure skating discipline that reports recent growth in the paid demand for positions in the groups.

We believe that the modern sports communities are virtually free of any gender biases that are still alive in the non-sporting population groups as myths and gender stereotypes – albeit they also tend to fade with time. A good case in point is provided by the latest progress of the men’s rhythmic and artistic gymnastics and synchronized swimming disciplines. It should be mentioned in this context that some gender inequality is still traditional for the national educational system management groups including the academic physical education and sports management (see Table 2) which is still dominated by men like quite a few other sectors.

As demonstrated by Table 2, the physical education and sports management structure is still gender unequal/ discriminative – due to the national socio-cultural traditions rather than some formal preferences. This situation may be explained by repercussions of the Soviet ‘gender contracting’ requirements, although the gender equality issues in Russia appear

**Table 1.** Full-time bachelors majoring in 49.03.01 Physical Education discipline in the academic year 2020-2021 (n=2524): gender split

| Academic unit                                     | Total, n | Women, n/ % | Men, n/ % |
|---------------------------------------------------|----------|-------------|-----------|
| Health and Rehab Dept                             | 182      | 114/62,6    | 68/37,4   |
| Winter Olympic Sports Dept                        | 347      | 146/42,1    | 201/57,9  |
| Management and Social Technologies Institute      | 84       | 43/51,2     | 41/48,8   |
| Summer Olympic Sports Dept                        | 1045     | 613/58,7    | 432/41,3  |
| Martial Arts and Non-Olympic Sports Dept          | 419      | 119/28,4    | 300/71,6  |
| Individual Education and Sports Technologies Dept | 447      | 191/42,7    | 256/57,3  |
| TOTAL                                             | 2524     | 1226/48,6   | 1298/51,4 |

**Table 2.** Academic physical education and sports management personnel: gender split ( $n=316$ )

| Position        | Total | Men | %    | Women | %    |
|-----------------|-------|-----|------|-------|------|
| Rector          | 14    | 13  | 92,9 | 1     | 7,1  |
| Vice-Rector     | 65    | 40  | 61,5 | 25    | 38,5 |
| Department Head | 237   | 130 | 54,9 | 107   | 45,1 |
| Total           | 316   | 183 | 57,9 | 133   | 42,1 |

less topical and sensitive than in the US, for example, and this is undoubtedly a subject to a special academic interest.

It was since the 1970s that the US expert community has been busy with analysis of the implicit and explicit sexist contents in the textbooks and manuals – and successful in detecting violations of the gender equality standards in lectures and other materials. These findings were followed by stringent censorship and revisions. Generally, they found that “men on the whole and white men in particular dominate as a standard” in the textbooks and, hence, schoolchildren develop a belief that this situation is normal and should be considered a social standard. It should be mentioned, however, that the school teaching population is traditionally dominated by women both in Russia and the US. However, it is the characters of success stories that dominate as role models for the youth – which are predominantly male, appealing, determined, active and successful in the social domains

viewed as most prestigious [2]. However, the relevant studies in Russia are relatively new and seldom at this juncture.

**Conclusion.** The national physical education and sport sector shaping historical and socio-cultural contexts and factors have been virtually free of expressed and specific gender inequalities or biases. Gender split in the national physical education and sports universities is traditionally and virtually equal, with women having a free access to every natural scientific education domain. Modern education system reforms tend to prioritize multidisciplinary integrative education models free of gender biases in every sector including the academic physical education and sport service.

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# Faceted classifiers and essays in new e-test system: benefit analysis

UDC 378:004.9



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## Abstract

**Objective of the study** was to analyze benefits of the faceted classifiers and essay test technologies applicable in the Moodle electronic test toolkit.

**Methods and structure of the study.** We piloted the electronic test system on the Moodle e-learning platform of Institute of Physical Culture and Sports of Udmurt State University. Moodle is a multifunctional educational platform with the educational and test content design toolkit. We used the faceted classifier technologies and essays to develop test questions and problems for the knowledge and skills tests in the Martial Arts and Physical Education and Sports Information Technology disciplines. The test system was developed using the topics faceting approach.

**Results and conclusion.** The test system distracter analysis by V.S. Avanesov showed high quality of the classifier questions. The essay questions and problems were found as effective as in a traditional verbal examination as they require the student to thoroughly analyze the question, formulate and explain the choice rather than just choose or guess. It is also important that the difficulty and timeframe of the e-test is increased insignificantly. The new faceted classifier and essay questions test technologies were found beneficial for the test procedure fairness and quality, with special benefits for the discipline-specific question banks and the electronic test procedure on the whole.

**Keywords:** *electronic test, test questions, classifier questions, essay questions, parallel faceted questions, physical education, Moodle platform.*

**Background.** Presently the national higher education system gives a special priority to new electronic educational resources persistently developed as complementary to the traditional education service [7]. Electronic test is increasingly popular in the theoretical knowledge and practical skills tests [1, 3, 6, 8]. Benefits of the electronic test systems generally depend on the quality of the test sets and tools. Basic logics and classifications of the test systems were developed long ago (by V.S. Avanesov, A.N. Mayorov, et al.) as reported in a few studies [2, 5, 6, etc.], although the continued research in testology expands and perfects this taxonomy; with the hierarchical classification of the test questions apparently transforming into a network structure.

**Objective of the study** was to analyze benefits of the faceted classifiers and essay test technologies applicable in the Moodle electronic test toolkit.

**Methods and structure of the study.** We piloted the electronic test system on the Moodle e-learning platform of Institute of Physical Culture and Sports of Udmurt State University. Moodle is a multifunctional educational platform with the educational and test content design toolkit. We used the faceted classifier technologies and essays to develop test questions and problems for the knowledge and skills tests in the Martial Arts and Physical Education and Sports Information Technology disciplines. The test system was developed using the topics faceting approach.

## Results and discussion

### *Faceted classifier questions*

We analyzed the whole range of electronic test questions to form a group of classifier questions. It is standard for virtually every theoretical and practical knowledge field to classify its objects, processes



and phenomena, with the classifications applicable in the TQ system designs and templates that require a choice (check one or few) or a match in response.

In this particular case, we designed the TQ set to test knowledge of the karate-do stances based on their classification (Figure 1), with every element of the classification offered as an optional answer. Note that every answer in the test is correct, free of fictional or abstract aspects, with the classification elements used as distracters.

We use distracters in the test system in the direct meaning of the word, i.e. as diverting rather than wrong options, unlike many traditional systems. The tested subject should categorize the problems (objects, processes) in response to the test question (Fig. 1) using the classification of the karate-do stances. It was difficult for the test system designers to offer a fair range of seemingly true distracters since the traditional systems offer only four options. Classification elements/distracters in the faceted classifier go far beyond four options, and this freedom allows accurately formulate a question and increase its difficulty level. It should be mentioned that a due difficulty level is critical for the TQ and problems and ranked among the key benefits of a test system [1, 2, 3, 5, 8].

Facet means herein the presentation cell that gives a few options for the textual element presentation. Facet may be also interpreted as the presentation format for a few parallel test tasks [1, 3, 4, 5]. Given on Figure 1 hereunder is the faceted classifier that makes it possible to form an array of parallel faceted ques-

tions for every karate-do stance. The facets are used to build a topics faceting category in the TQ bank; and the test algorithm randomly selects some question from the latter – that means that every time the question is different.

### Essay-requiring tests and problems

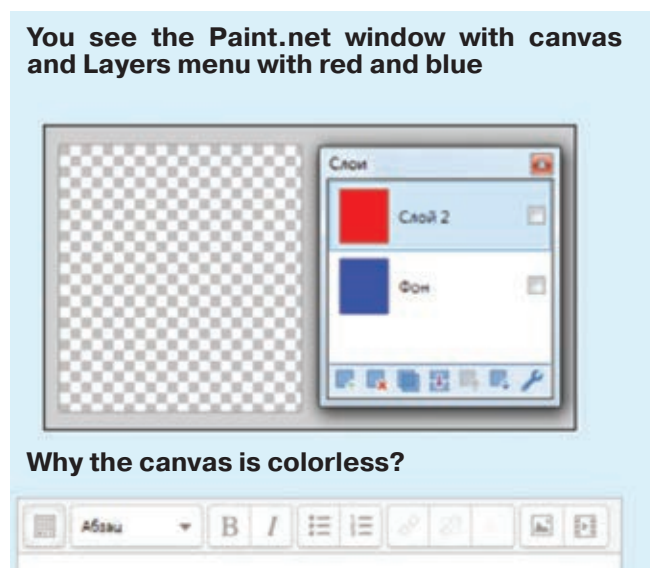
Essay questions may be defined as the open-end questions that require detailed explanatory answers – much as the traditional verbal examinations. The A.N. Mayorov's testology [5] implies the following two versions of answers: (1) full answer formulated by the subject; or (2) finisher answer, i.e. finalizing one of a few unfinished options. A.N. Mayorov distinguishes practical problems as a separate test option and emphasizes their benefits for a test system on the one hand and the high difficulties for their practical application on the other hand.

The Moodle platform offers an essay template with great technological benefits for the efforts to formulate any range of the open-end theoretical knowledge and practical skills test questions. The essay questions template offers a window for the response essay formulated by the student independently in any form. The teacher would score the answer within 0 to 1 range, and the Moodle would immediately fix the test score in the automatic test database.

The essay questions should be standardized as follows: (1) They should not be too long and intricate; (2) They should be clear, unambiguous and limited by the study material; (3) The teacher should emphasize in the lectures and practices the key points and key-



**Figure 1.** Faceted classifier to test knowledge of the key karate-do stances in a 'check one of many' format, for tests in the Martial Arts discipline



**Figure 2.** Essay-requiring problem in the PES IT discipline



**You see a karate punch**



Name the (1) punch; (2) rank; (3) stance; and (4) equipment used

| Answers:                         |   |
|----------------------------------|---|
| 1) Удар рукой - гяку дзуки;      | ✓ |
| 2) Верхний уровень - дзёдан;     | ✓ |
| 3) Стойка - "фудо дати";         | X |
| 4) Спортивный снаряд - макивара. | ✓ |

**Figure 3.** Structured essay question in the Martial Arts discipline, with the sub-questions and response options

words in ever definition, statement and concept since these key notions are factored in the test scores; and (4) The test question may be clarified by a few sub-questions/problems to help the student.

Given of Figure 2 is the example of an essay question, with the student expected to solve the problem in an explanatory format. Figure 3 gives a structured essay questions with a few sub-questions to clarify the problem on a more specific basis.

#### Scoring system

The Moodle toolkit offers a few test scoring scales: a dichotomous test score, as demonstrated by Fig. 1 and Fig. 2, with the right and wrong answers scored by 0 and 1 points, respectively; and a polytomic test score (Fig. 3) that varies within 0...1 range, being convertible into a 100-point or traditional 5-point scoring system.

**Conclusion.** The test system distracter analysis by V.S. Avanesov showed a high quality of the classifier questions. The essay questions and problems were found as effective as in a traditional verbal examination as they require the student to thoroughly analyze the question, formulate and explain the choice rather than just choose or guess. It is also important that the difficulty and timeframe of the e-test is increased insignificantly. The new faceted classifier and essay questions test technologies were found beneficial for the test procedure fairness and quality, with special benefits for the discipline-specific question banks and the electronic test procedure on the whole.

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# Anthropometric analysis and body sculpt improvement in application to female students from cheerleading picked teams

UDC 796.413.418



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## Abstract

**Objective of the study** was to develop and experimentally substantiate a customized strength training block to improve body sculpt.

**Methods and structure of the study.** An anthropometric analysis reliably reveals a correlation between the height to body-weight ratio, circumferential dimensions, skin-fat thickness, and body proportionality, and is, therefore, an integral indicator of the female body shape.

Given that female students from picked teams perform at sports events in the presence of a large number of spectators, a customized strength training block aimed to improve body sculpt was included in the training sessions and used three times a week for 40 minutes. More strength exercises were used on the torso muscles (abs, oblique muscles), legs (lateral, inner, back and front of the thigh) and glutes. These exercises were performed at a rapid pace, for 1 minute per area, at HR of 140-150 bpm. The study was carried out at two Moscow higher educational establishments – Peoples' Friendship University of Russia and Plekhanov Russian University of Economics - in the conditions of training activities 3 times a week and lasted 1 academic year.

Subject to the study were the female students (n=40) of the 1st-2nd years of study from different faculties who had been previously engaged in dance sport or gymnastics.

**Results and conclusion.** The anthropometric analysis of the body shape made it possible to develop a customized strength training block aimed to improve the body sculpt of the female students from the cheerleading picked teams. It was proved to contribute to statistically significant changes in the anthropometric indices, improvement of female students' physical fitness and body correction, and thus, beneficial for their physical appeal.

**Keywords:** *anthropometric analysis, body sculpt improvement, female students, cheerleading.*

**Background.** Cheerleading is a mass, much-in-demand, and popular sport among student youth [2].

At non-sports universities, cheerleading picked teams are made up of female students who have been previously engaged in gymnastics or dance sport. Performing in the sports arena, it is not only physical and functional fitness levels that matter, but also the athletes' appearance and well set-up figure with good muscle definition that undoubtedly boost their self-confidence. The authors of numerous studies in various sports argue that aesthetic perception of own body largely depends on a person's self-esteem and business success [1]. Therefore, it is not only physical and technical fitness levels that are important for female students of the picked teams but also a

beautiful aesthetic appearance, in which the athletes feel confident and comfortable, which enable them to successfully perform at sports events, revealing all their strengths [1].

**Objective of the study** was to develop and experimentally substantiate a customized strength training block to improve body sculpt.

**Methods and structure of the study.** An anthropometric analysis reliably reveals a correlation between the height to body-weight ratio, circumferential dimensions, skin-fat thickness, and body proportionality, and is, therefore, an integral indicator of the female body shape.

Given that female students from picked teams perform at sports events in the presence of a large



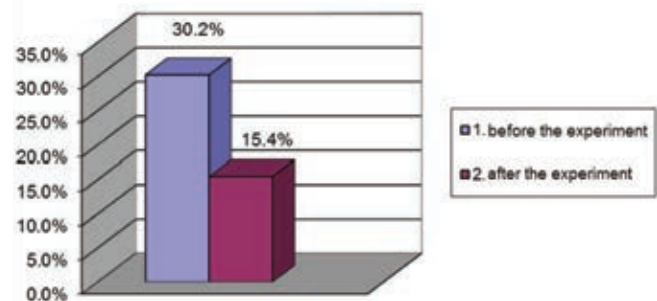
number of spectators, a customized strength training block aimed to improve body sculpt was included in the training sessions and used three times a week for 40 minutes. More strength exercises were used on the torso muscles (abs, oblique muscles), legs (lateral, inner, back and front of the thigh) and glutes. These exercises were performed at a rapid pace, for 1 minute per area, at heart rate of 140-150 bpm. The study was carried out at two Moscow higher educational establishments – Peoples' Friendship University of Russia and Plekhanov Russian University of Economics - in the conditions of training activities 3 times a week and lasted 1 academic year.

Subject to the study were the female students (n=40) of the 1st-2nd years of study from different faculties who had been previously engaged in dance sport or gymnastics.

**Results and discussion.** At the initial stage of the experiment, the anthropometric rates of the female students from the picked teams of the Peoples' Friendship University of Russia and Plekhanov Russian University of Economics corresponded to the very high to below average levels (Table 2). The measurement of the skin-fat thickness showed that the fat mass percentage exceeded the normal level in 48% (n=19) of the female students of the picked teams, while 52% (n=21) had a normal level, and only a slight correction of their external shape was required.

It should be noted that the muscle mass percentage in 86% (n=34) of the female students from the picked teams was within the normal range, while in the remaining 14% (n=6) it exceeded the normal level. This fact is indicative of the good level of the subjects' muscular development, which is a result of their sports activities. The repeat examination revealed significant improvements in the anthropometric indices

of the female students' - from a very high to an average level. We also found a reduction in the fat mass percentage by 14.8% ( $p < 0.01$ ), which proved the effectiveness of the customized strength training block aimed to improve body sculpt (Fig. 1).



**Fig. 1.** Fat mass percentage

The subjects' body mass rates after the experiment significantly decreased by 8.3% ( $p < 0.05$ ) (Table 1). The comparison of the values of the body-weight index by Kettle's formula before and after the experiment showed that there was a statistically significant increase of 5%. The reduction of the waist, hip and thigh circumferences contributed to the weight loss (Table 1).

The dynamics of changes in the waist circumference indicated a significant decrease of 6.4% ( $p < 0.01$ ). A similar pattern was observed in the hip circumference – a decrease of 4%, which corresponded to a statistically significant change ( $p < 0.05$ ). The dynamics of changes in the thigh circumference throughout the experiment also showed a statistically significant change of 5% ( $p < 0.01$ ).

After a year of trainings, the anthropometric indices in the female students of the cheerleading picked teams improved from the very high to the average lev-

**Table 1.** Changes in anthropometric indices in female students from cheerleading picked teams (Performance Cheer) throughout the study

| Indicator                          | $X \pm m$ (n = 40) | $X \pm m$ (n = 40) | $P_0$    |
|------------------------------------|--------------------|--------------------|----------|
|                                    | 1                  | 2                  |          |
| Body mass, kg                      | $61.1 \pm 1.2$     | $56.2 \pm 1.1$     | $< 0.05$ |
| Body length, cm                    | $168 \pm 2.7$      | $168 \pm 2.7$      | $> 0.05$ |
| Height to body-weight ratio, kg/cm | $371.7 \pm 6.2$    | $353.1 \pm 5.4$    | $< 0.05$ |
| <b>Circumferences, cm</b>          |                    |                    |          |
| Upper arm circumference, cm        | $24.2 \pm 0.8$     | $23.5 \pm 0.2$     | $> 0.05$ |
| Chest circumference, cm            | $88.6 \pm 1.6$     | $86.5 \pm 1.2$     | $> 0.05$ |
| Waist circumference, cm            | $65.2 \pm 1.3$     | $61.1 \pm 0.7$     | $< 0.01$ |
| Hip circumference, cm              | $93.3 \pm 1.2$     | $89.6 \pm 0.8$     | $< 0.05$ |
| Thigh circumference, cm            | $54.1 \pm 0.7$     | $51.4 \pm 0.2$     | $< 0.01$ |
| Lower leg circumference, cm        | $35.3 \pm 0.4$     | $34.7 \pm 0.4$     | $> 0.05$ |

Notes: 1 – indices before the experiment; 2 – indices after the experiment; n – sample size;  $X \pm m$  – arithmetic mean and error of arithmetic mean;  $P_0$  – significance of differences between the end values.



**Table 2.** *Changes in body shapes throughout the study*

| Ranking, % | Body shape class | Body shape perfection level | EG (n=40) |       |
|------------|------------------|-----------------------------|-----------|-------|
|            |                  |                             | before    | after |
|            | 1                | very high                   | 5         | 7     |
| Below 72.5 | 2                | above average               | 13        | 17    |
| 60-72      | 3                | average                     | 14        | 16    |
| 40-59      | 4                | below average               | 8         | 0     |
| Below 39   | 5                | poor                        | 0         | 0     |

el, and there were no female students with the below average and poor levels (Table 2).

**Conclusion.** The anthropometric analysis of the body shape made it possible to develop a customized strength training block aimed to improve the body sculpt of the female students from the cheerleading picked teams. It was proved to contribute to statistically significant changes in the anthropometric indices, improvement of female students' physical fitness and body correction, and thus, beneficial for their physical appeal.

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# Theoretical and practical tests in all-russian school physical education olympiad

UDC 796.011.3



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## Abstract

**Objective of the study** was to analyze progress of the theoretical and practical test system for the school and municipal qualifiers for the All-Russian School Physical Education Olympiad.

**Methods and structure of the study.** The School Physical Education Olympiad theoretical and practical tests structure and contents are designed to test the competitors' theoretical competency and skills by combinations of highly challenging tests. The winners need to demonstrate excellent physical fitness standards and skills supported by a profound knowledge of the modern physical education theory within the school syllabus. The theoretical and practical tests are updated in contents and difficulty levels on an annual basis as provided by the guidelines of the Central School Education Methodology Commission. The competitors are tested by responses to a set of standard questions that test their knowledge and skills in the most difficult domains of the primary and secondary school Physical Education materials [2, 4].

**Results and conclusion.** The School Physical Education Olympiads in the Udmurt Republic have accumulated vast organizational and management experience and knowledge to effectively vary the theoretical and practical tests contents and focuses, plus fair scoring, ranking and winner nomination systems. The Udmurt Republic School Physical Education Olympiad Organizing Committee recommended the School Physical Education Olympiad related training elements for broader inclusion in the school Physical Education curricula. Since the School Physical Education Olympiad was first run back in 2001, the event with its theoretical and practical test system has made a great progress and now offers nine theoretical and practical test formats.

**Keywords:** *Physical Education Olympiad, development of theoretical and practical tests.*

**Background.** National education system ranks the School Physical Education Olympiad events among the most promising innovative methods for the school Physical Education promotion and motivations. The School Physical Education Olympiads are designed to test the students' progress and efficiency of the valid school Physical Education curricula and educational materials in practical competitive environments. For the last decade the School Physical Education Olympiads have demonstrated progress in popularity and participation as they effectively motivate the school-children for self-reliant physical education, physical progress and healthy lifestyles. The All-Russian event has evolved into something more than the talents finding mechanism as it rapidly shapes up into a popular

health movement that promotes athletics and health culture in the context of the best spiritual and intellectual progress values and priorities – and therefore, as we believe, deserves a special research [3, 5].

**Objective of the study** was to analyze progress of the theoretical and practical test system for the school and municipal qualifiers for the All-Russian School Physical Education Olympiad.

**Methods and structure of the study.** The School Physical Education Olympiad theoretical and practical tests structure and contents are designed to test the competitors' theoretical competency and skills by combinations of highly challenging tests. The winners need to demonstrate excellent physical fitness standards and skills supported by a profound knowl-



edge of the modern physical education theory within the school syllabus. The theoretical and practical tests are updated in contents and difficulty levels on an annual basis as provided by the guidelines of the Central School Education Methodology Commission. The competitors are tested by responses to a set of standard questions that test their knowledge and skills in the most difficult domains of the primary and secondary school Physical Education materials [2, 4].

**Results and discussion.** The school and municipal qualifiers for the School Physical Education Olympiad represented five districts of Izhevsk city. Table hereunder presents the sample test data [1].

It should be mentioned that the theoretical and practical tests questions covered the key terms and

meanings matching in 80% of the School / Municipal qualifier tests, albeit the sample showed much better performance in the School qualifier than in the Municipal qualifier. Note that one of the boys from Secondary school 72 made 97.1% success in the school theoretical and practical tests event – versus only 26.4% in the municipal event. And his peer from Secondary school 70 was ranked second with 96.1% and 11.7% success rates in the School and Municipal qualifiers, respectively. Going next is a Secondary school 70 schoolboy with 90.2% and 8.4% theoretical and practical tests success rates. The girls' tests showed the same trend.

The absolute theoretical and practical test champion from Secondary school 72 scored 94.1% and 31% success rates in the School and Municipal quali-

**Table 1.** Theoretical and practical tests data for the school and municipal qualifiers for School Physical Education Olympiad

| Place        | School                                  | Qualifier's code | School qualifier score, points | School qualifier test success rate, % | Municipal qualifier score, points | Municipal qualifier test success rate, % |
|--------------|-----------------------------------------|------------------|--------------------------------|---------------------------------------|-----------------------------------|------------------------------------------|
| <b>Boys</b>  |                                         |                  |                                |                                       |                                   |                                          |
| 1            | Secondary school 72                     | M-11-331-20      | 99                             | 97,1                                  | 24,25                             | 26,4                                     |
| 2            | Secondary school 70                     | M-11-151-11      | 98                             | 96,1                                  | 10,5                              | 11,7                                     |
| 3            | Secondary school 70                     | M-11-231-8       | 94                             | 92,2                                  | 32                                | 34,8                                     |
| 4            | Secondary school 70                     | M-11-331-22      | 92                             | 90,2                                  | 7,75                              | 8,4                                      |
| 5            | Secondary school 72                     | M-11-331-16      | 91                             | 89,3                                  | 23,5                              | 25,5                                     |
| 6            | Secondary school 57                     | M-11-151-17      | 88                             | 86,3                                  | 38,75                             | 42,1                                     |
| 7            | Gymnasium 6                             | M-11-152-21      | 88                             | 86,3                                  | 30,75                             | 33,4                                     |
| 8            | Secondary school 85                     | M-11-151-4       | 87                             | 85,3                                  | 19,5                              | 21,2                                     |
| 9            | Secondary school 72                     | M-9              | 85                             | 83,3                                  | -                                 | -                                        |
| 10           | Secondary school 60                     | M-10-252-1       | 83                             | 81,4                                  | 18,75                             | 20,4                                     |
| 11           | Kezabay Berda Udmurt Republic Gymnasium | M-10-151-16      | 80                             | 78,4                                  | 37,25                             | 40,5                                     |
| 12           | Secondary school 7                      | M-11             | 78                             | 76,5                                  | -                                 | -                                        |
| <b>Girls</b> |                                         |                  |                                |                                       |                                   |                                          |
| 1            | Secondary school 72                     | D-9-152-19       | 96                             | 94,1                                  | 28,5                              | 31                                       |
| 2            | Secondary school 72                     | D-11-151-16      | 93                             | 91,2                                  | 28,75                             | 31,25                                    |
| 3            | Secondary school 57                     | D-11-331-5       | 89                             | 87,2                                  | 49,25                             | 53,5                                     |
| 4            | Gymnasium 6                             | D-11-231-12      | 88                             | 86,3                                  | 18                                | 19,6                                     |
| 5            | Secondary school 27                     | D-9-331-21       | 87                             | 85,3                                  | 26,5                              | 28,8                                     |
| 6            | Secondary school 89                     | D1               | 86,75                          | 85                                    | -                                 | -                                        |
| 7            | Secondary school 89                     | D-10-152-2       | 86,75                          | 85                                    | 36,5                              | 39,7                                     |
| 8            | Secondary school 57                     | D-10-331-9       | 86                             | 84,3                                  | 30,5                              | 33,1                                     |
| 9            | Gymnasium 6                             | D-9-253-8        | 85,75                          | 84                                    | 13,25                             | 14,4                                     |
| 10           | Gymnasium 6                             | D-11-253-1       | 84                             | 82,3                                  | 10,75                             | 11,7                                     |
| 11           | Secondary school 100                    | D-11-253-6       | 83                             | 81,4                                  | 24,5                              | 26,6                                     |
| 12           | Secondary school 19                     | D-9-252-12       | 82                             | 80,4                                  | 7,25                              | 7,9                                      |



fiers, respectively. Ranked second was her peer from Secondary school 72 with 91.2% and 31.25% success rates, respectively. And ranked third was a girl from Secondary school 57 with 87.2% and 53.5% success rates in the School and Municipal qualifiers, respectively. The Municipal qualifier event was won by a girl from Gymnasium 83 with 89.49% theoretical and practical test success rate. Most unfortunate in the Municipal qualifier theoretical and practical tests event was a girl from Secondary school 7 with only 2.45% theoretical and practical tests success rate.

A comparative analysis of the theoretical and practical tests data shows better performance of the sample in the School qualifier. We analyzed the Municipal qualifier theoretical and practical tests quality and difficulty and surveyed the qualifiers to find the key difficulties in trainings for the School Physical Education Olympiad theoretical and practical tests. The sample reported a need for systematic theoretical training as Reason No.1 for the failures. They complained the school Physical Education theory being delivered on a fragmentary basis if any. This shortage forces the children to rely on the self-learning of the Physical Education theory— often from scratch – including the history of physical education, traditions and culture; motor skills training basics; Physical Education service design and management basics; self-reliant training systems; training progress tests and medical service basics, etc. Reason No.2 found by the survey is the shortage of the accessible literature in Physical Education theory recommended by the Central School Education Methodology Commission. The Physical Education literature available in the Udmurt Republic Library reportedly fails to cover the recommended list in full. And Reason No.3 mentioned by the sample is the surprises in the theoretical and practical tests difficulty levels and new tests coming up every year, with the children caught unprepared for such tests.

Having analyzed the failure statistics and reported reasons for the poor performances, we developed a pre-theoretical and practical tests training method. The method offers the following training algorithm for the School Physical Education Olympiad theoretical and practical tests qualifiers: learn every element of the Physical Education theory; run knowledge tests in every Physical Education test format (standard tests, open-end questions, enumeration and matching problems, etc.); detect errors if any; come back to the omitted/ challenging Physical Education theory elements to clarify and digest them; go to the next Physi-

cal Education theory domain. In the precompetitive period, we recommend the qualifiers run crash tests in every Physical Education theory domain with stepped difficulty levels, test numbers and growing time pressure in the tests.

The above precompetitive training algorithm was tested by the Udmurt Republic School Education Methodology Commission, with the trainees' progress in every Physical Education theory domain tested by combined versatile test sets. The precompetitive training algorithm has been tested prior to the municipal and republican School Physical Education Olympiad qualifiers and finals.

**Conclusion.** The School Physical Education Olympiads in the Udmurt Republic have accumulated vast organizational and management experience and knowledge to effectively vary the theoretical and practical tests contents and focuses, plus fair scoring, ranking and winner nomination systems. The Udmurt Republic School Physical Education Olympiad Organizing Committee recommended the School Physical Education Olympiad related training elements for broader inclusion in the school Physical Education curricula. Since the School Physical Education Olympiad was first run back in 2001, the event with its theoretical and practical test system has made a great progress and now offers nine theoretical and practical test formats.

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# National physical education and sports sector progress forecast using federal statistical report forms processed by modern it toolkit

UDC 796:658



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## Abstract

**Objective of the study** was to offer an IT toolkit to facilitate the management decision-making in the national physical education and sports offices at every governmental level using the standard Statistical Report Forms.

**Methods and structure of the study.** We collected and analyzed for the purposes of the study Statistical Report Forms 1-FK, 3-AFK and 5-FK for 2015-2020 issued by the relevant municipal, regional and federal agencies – to analyze the reported socio-economic indicators versus the Sports Life Norm Project benchmarks (interim and final) [3]. The reported statistics were processed by a set of mathematical analysis and progress forecast tools using Sportstat Automated Information System (AIS) with Statistica mathematical statistics software toolkit. The Sportstat AIS processed the physical education and sports progress database for 2015-2020 available in the socio-economic section of the Statistical Report Forms, versus the Sports Life Norm Federal Project progress forecast and actual progress data. Our experts selected, for the purposes of the study, about 100 physical education and sports progress indicators from the 1-physical education, 3-adaptive physical education and 5-physical education Statistical Report Forms for the study period, to find their group correlations plus correlations with the socio-economic indicators for a few economic, health, business and other relevant sectors.

**Results and conclusion.** The IT toolkit with an automated statistical data collection and processing capacity to facilitate the management decision-making in the national physical education and sports offices at every governmental level using the standard Statistical Report Forms offers good benefits for the efforts to objectively rate the regional physical education and sports situations and forecast potential progress based on the relevant progress indicators with their time variations and contributions to the progress goals. The IT toolkit offers an algorithm to select the key progress indicators for every region and province; forecast the local physical education and sports progress knowing the actual variation ranges of the key indicators; and take well-grounded management decisions.

**Keywords:** progress forecast, analysis, 1-physical education, 3-adaptive physical education, 5-physical education Statistical Report Forms.

**Background.** A prime goal of the Sports Life Norm Federal Project being implemented as a component of the National Demography Project is to "create popular physical education and sports facilitating provisions including an improved access to and supply of the physical education and sport service infrastructure and sports reserve training services" and thereby increase the habitually sporting population to 55% of the total by 2024, "with the special efforts to motivate people and advance the physical education and sport services in every population group including corporate physical edu-

cation and sport service systems". Progress on the way to this goal is rated by a set of the relevant progress criteria including the physical fitness tests. Regional physical education and sports progress is known to depend on the local socio-economic situations and successes of the ongoing regional development projects and programs [4]. One of the key goals of the physical education and sports development initiatives is to forecast the short- and long-term sector progresses and outline the top-priority initiatives need to be implemented (knowing the labor intensities and claimed resources), with



forecasts and analyses of their contributions to the physical education and sport sector progress and final results.

**Objective of the study** was to offer an IT toolkit to facilitate the management decision-making in the national physical education and sports offices at every governmental level using the standard Statistical Report Forms.

**Methods and structure of the study.** We collected and analyzed for the purposes of the study Statistical Report Forms 1-FK, 3-AFK and 5-FK for 2015-2020 issued by the relevant municipal, regional and federal agencies – to analyze the reported socio-economic indicators versus the Sports Life Norm Project benchmarks (interim and final) [3]. The reported statistics were processed by a set of mathematical analysis and progress forecast tools using Sportstat Automated Information System (AIS) with Statistica mathematical statistics software toolkit. The Sportstat AIS processed the physical education and sports progress database for 2015-2020 available in the socio-economic section of the Statistical Report Forms, versus the Sports Life Norm Federal Project progress forecast and actual progress data. Our experts selected, for the purposes of the study, about 100 physical education and sports progress indicators from the 1-physical education, 3-adaptive physical education and 5-physical education Statistical Report Forms for the study period, to find their group correlations plus correlations with the socio-economic indicators for a few economic, health, business and other relevant sectors.

**Results and discussion.** Our correlation analysis showed the relevant physical education and sports establishments (sport clubs, facilities and businesses, fitness clubs, etc.) being pivotal for the regional physical education and sports progress initiatives on the whole and the habitually sporting population growth goals in particular, with special benefits for the relevant physical education and sports jobs creation aspect. We also found the local growths of the habitually sporting populations being in high correlation with the physical education and sports service personnel – as underlined by the physical education and sports Sector Progress Strategy for the period up to 2030 – that requires the number of trainers and other sports specialists being increased and their qualifications and labor efficiencies improved “for success of the habitually sporting population growth goals” [1].

Our analysis also found a direct correlation between the healthy lifestyle growth and numbers of

the physical education and sports service institutions and businesses. It should be emphasized, however, that growths in numbers of the sports facilities in some regions failed to secure the habitually sporting population growth; whilst in other regions the habitually sporting population progress was ensured mostly by the physical education and sports personnel increasing efforts. Further Statistical Report Forms analysis found that these efforts still need to be complemented by prudent and focused physical education and sports infrastructure development initiatives.

The statistical data analysis found the following correlations of the target/ other physical education and sports progress indicators:

- Healthy lifestyle growth rates were found correlated with the numbers of physical education and sports establishments and businesses and physical education and sports personnel/ payroll data;
- Target physical education and sports assets were found correlated with the design service capacities of the physical education and sports facilities and actual local popular demands for the physical education and sports facilities – versus the actual habitually sporting population statistics;
- Physical education and sports sector funding was found correlated with the relevant actual physical education and sports finance disbursement statistics – dominated by the payroll of the full-time physical education and sports personnel and the sports assets operation, maintenance, construction, rehabilitation, procurement and other relevant costs.

It should be emphasized that the actual contributions of the above correlations and indicators in the regional/ provincial statistics were found to vary in a wide range. The habitually sporting population growth forecast for the period up to 2030 based on the actual 2015-2020 physical education and sports progress statistics showed that a special priority should be given to the local physical education and sports facilities accessible for the active communities, conditional on efficient theoretical and practical support from the physical education and sport service personnel – instructors, practitioners, trainers, coaches, etc. It should be mentioned that in 2021-2030 most of the regions will need to expand their popular physical education and sports service ranges and physical education and sports assets due to the growing popular demand for the physical education and sports infrastructure and services.

We offer the following statistical data processing algorithm to rate the physical education and sports



progress versus the project benchmarks, select the region/ province-specific progress criteria and forecast the physical education and sports progresses within the relevant realistic variation ranges:

1) Calculate correlations between the physical education and sports progress indicators reported by the 1-physical education, 3-adaptive physical education and 5-physical education Statistical Report Forms and the relevant socio-economic progress rates (regional health, business, economic and other statistics);

2) Select the progress indicators showing the highest (both positive and negative) correlations;

3) Analyze the causes and effects of these correlations to find the key/ most informative progress indicators;

4) Find the permissible (achievable) variation ranges for the selected indicators with account of the relevant labor intensity rates and resources claimed by the regional physical education and sports progress initiatives;

5) Make forecasts of the regional physical education and sports progresses based on the actual variation statistics;

6) Select of the key physical education and sports progress indicators with account of the realistic implementation scenarios;

7) Make a progress function using the above selected key indicators;

8) Rate the interim physical education and sports progress versus the project benchmarks using the selected key indicators;

9) Find the best solution to attain the physical education and sports progress benchmarks; and

10) Take a management decision.

**Conclusion.** The IT toolkit with an automated statistical data collection and processing capacity to facilitate the management decision-making in

the national physical education and sports offices at every governmental level using the standard Statistical Report Forms offers good benefits for the efforts to objectively rate the regional physical education and sports situations and forecast potential progress based on the relevant progress indicators with their time variations and contributions to the progress goals. The IT toolkit offers an algorithm to select the key progress indicators for every region and province; forecast the local physical education and sports progress knowing the actual variation ranges of the key indicators; and take well-grounded management decisions.

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# University physical education and sports advancement program: provisions and analysis

UDC 796.06



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## Abstract

**Objective of the study** was to develop an Udmurt State University Physical Education and Sports Progress Program for the period up to 2030 (hereinafter referred to as the Program).

**Methods and structure of the study.** We used the following methods in the study: analysis of the valid legal and regulatory documents for the physical education and sports sector management and the relevant physical education and sports service policy documents for universities; questionnaire surveys using the Google Forms online service, interviews, and mathematical tools for the questionnaire survey data processing and analyses. The survey data produced by the Google Forms were instantly processed and analyzed. We sampled the 1-3-year students attending the university physical education and sports classes for questionnaire survey-1 in March 2018 (n=689) and questionnaire survey-2 in October 2020 (n=345).

**Results and conclusion.** The recent federal governmental policy documents to encourage the national physical education and sports progress require from the national higher educational establishment taking challenging projects to increase their habitually sporting student populations. The federal strategy sets the goals that should be attained on a systematic basis, with every university expected to develop and implement its own physical education and sports progress program. These university physical education and sports progress programs for the period up to 2030 should respect the following: every university's university sports progress history and traditions for the whole service period; key university sports progress provisions; university physical education and sport service assets/ infrastructure and accessibility; interests and needs of the student community profiled by the questionnaire survey; best practices and experiences of the peer universities implementing the similar Programs.

**Keywords:** *Udmurt State University, methodology, university sports, program, progress.*

**Background.** The recently adopted national Physical Education and Sports Progress Strategy for the period up to 2030 [2, 3, 4] laid a basis for further policy documents that spell out the specific relevant policies, tools and progress benchmarks for every sector including the higher education system. One of the main objectives set by the Physical Education and Sports Sector Progress Strategy and the interdepartmental progress programs is to have increased the young habitually sporting population (children and youth) to 80% of the total by 2024 [1]. The Strategy also sets the following physical education and sports progress

provisions: complement the academic education progress reporting system with the physical education and sport service quality rating criteria; monitor the university sports progress in every high educational establishment; and complement the effective contracts of the high educational establishment management personnel with the physical education and sports service management quality rating criteria.

**Objective of the study** was to develop an Udmurt State University Physical Education and Sports Progress Program for the period up to 2030 (hereinafter referred to as the Program).



**Methods and structure of the study.** We used the following methods in the study: analysis of the valid legal and regulatory documents for the physical education and sports sector management and the relevant physical education and sports service policy documents for universities; questionnaire surveys using the Google Forms online service, interviews, and mathematical tools for the questionnaire survey data processing and analyses. The survey data produced by the Google Forms were instantly processed and analyzed. We sampled the 1-3-year students attending the university physical education and sports classes for questionnaire survey-1 in March 2018 (n=689) and questionnaire survey-2 in October 2020 (n=345).

**Results and discussion.** Pursuant to the national policy documents for the long-term progress of the university sports, the Rector's office made Decision No. 25/1 dated 17.02.2020 to develop the Udmurt State University Physical Education and Sports Progress Program for the period up to 2030. The decision was based on the 2018-2020 questionnaire survey of the student population. Thus the questionnaire survey 1 in March 2018 (n=689) found 48.8% and 46.3% of the female and male groups (respectively) motivated for the GTO Complex tests. The questionnaire survey 2 in October 2020 (n=345) found the same enthusiasm in 42.6% of the sample. It should be emphasized that most of the sample reported the regular 4-hour [per week] trainings being too short for them and, hence, necessarily complemented (as reported by 56.4%) by extracurricular physical education and sports. Only 14.5% of the latter reported being driven by the academic physical education credits; whilst 19.4% reported needs for competitive accomplishments; 25.2% the physical education and sports versatility related needs; 19.7% socializing/ friends-making needs; and 17.2% health, weight control and performance/ fitness needs.

The Udmurt State University Rector effectuated by his Order No. 543/01-01-04 Dated April 27, 2021 the Udmurt State University Physical Education and Sports Progress Program for the period up to 2030 – to encourage the students' healthy lifestyles, habitual physical education and sports activity, access to the university physical education and sports infrastructure and competitive agencies, with the best athletes expected to qualify for the regional and national sports teams. The Program sets the following progress stages:

**Stage 1 (2021-2025)** designed to launch the physical education and sports infrastructure rehab, re-construction and development projects; establish the university physical education and sports management system; start up the physical education and sports service reform; expand the existing network of sports groups; offer new competitive events in the physical education and sports calendars; provide special funding for the formal team competitions; and secure growth of the habitually sport-ing student community up to 65% of the total; and

**Stage 2 (2025-2030)** to complete the major physical education and sports infrastructure rehab, re-construction and development projects; finalize the physical education and sport service reform; and increase the habitually sporting student community to 80% of the total.

It is handball and athletics that has been the core Udmurt State University sports for many decades. The women's "University" handball team was ranked the 8th in the 2020-2021 Russian Super League Championship, albeit it is still considered a backbone of the student national team. Taking pride in the Udmurt State University handball and athletics traditions and accomplishments, the Program provides for a new project to establish a sports training center for beginners to the sports elite. The Program gives a special priority to the university physical education and sports popularity by making provisions for improving the regular physical education and sport service and facilitate progress of the extracurricular physical education and sports including services of the student sports clubs and new sports training center.

The Program is expected to: attain the goals versus the progress benchmarks; develop a modern physical education and sports infrastructure for the amateur and elite sports; modernize the existing physical education and sport services; engage 80% of the student population in habitual physical education and sports; and promote the Udmurt State University sporting brand name in the Udmurt Republic, Russia and abroad.

**Conclusion.** The recent federal governmental policy documents to encourage the national physical education and sports progress require from the national higher educational establishment taking challenging projects to increase their habitually sporting student populations. The federal strategy sets the goals that should be attained on a system-



atic basis, with every university expected to develop and implement its own physical education and sports progress program. These university physical education and sports progress programs for the period up to 2030 should respect the following: every university's university sports progress history and traditions for the whole service period; key university sports progress provisions; university physical education and sport service assets/ infra-structure and accessibility; interests and needs of the student community profiled by the question-naire survey; best practices and experiences of the peer universities implementing the similar Pro-grams.

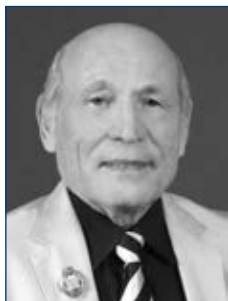
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# Digital progress trends in national physical education and sports sector

UDC 796.01:002(045)



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## Abstract

**Objective of the study** was to analyze the digital transformation experience in the physical education and sport sector on the whole and the physical education and sport specialist education system in particular.

**Methods and structure of the study.** We used in the study the following methods: analysis of the relevant theoretical and practical study reports; and summary of our own practical experience in the physical-education-and-sport-specific digital information technologies schooling, design and application.

**Results and conclusion.** Our analysis of the relevant theoretical and practical study reports and practical digital transformation implementation experiences in the national physical education and sport sector showed the physical education and sport specialist education, retraining and advanced training service being one of the most promising digital transformation progress trends. In this context, a special priority in the physical education-and-sport-specific digital transformation development projects will be given to the advanced training of the academic faculties to help them establish and use modern e-learning resources, develop knowledge and skills in a variety of modern online and mixed education service formats, and keep abreast with the modern physical education-and-sports-education-specific digital transformation progress trends to ensure high quality of their students' professional service in future.

**Keywords:** digital transformation, physical education, e-learning resources, physical education and sport sphere.

**Background.** The ongoing transition to the information society in the country is associated with a growing social demand for the specialist IT competences for progress of professional services in every sector (economics, medicine, education, physical education and sports, etc.) subject to digital transformation. The need for digital transformation is addressed by the relevant regulatory documents including the national Digital Economy Project and the IT Education Development Strategy of the Russian Federation for 2017-2030. Of special interest in this context are the main digital transformation policies for progress of the physical education and sport sector on the whole and physical education and sport specialist education system in particular and analyses of the relevant digital transformation application experiences.

**Objective of the study** was to analyze the digital transformation experience in the physical education

and sport sector on the whole and the physical education and sport specialist education system in particular.

**Methods and structure of the study.** We used in the study the following methods: analysis of the relevant theoretical and practical study reports; and summary of our own practical experience in the physical-education-and-sports-specific digital information technologies schooling, design and application.

**Results and discussion.** Based on our practical physical education-and-sport-specific digital information technologies application experience, we would classify the application fields into the physical education and sport specialist (bachelor, master, postgraduate) training and retraining system with a wide range of advanced training options; sports training systems in many disciplines; sport event hosting and management service; fitness clubs and wellness centers; digital-information-technolo-



gies-assisted research, theory and practice; modern computerized physical fitness and functionality tests systems applicable in the professional and amateur sports/ physical education; physical progress and health monitoring systems for physical education and sports services; mental health (psycho-diagnostics) test systems using modern digital information technologies; initiatives to establish synergized education environments at universities, sports organizations, wellness centers and in the sector management system on the whole using modern digital information technologies [1,5, 8].

The educational digital transformation may be referred to in a narrow or broad sense. The narrow approach would consider digital transformation as limited by the education-specific needs including new service goals, contents, methods and tools, plus new institutional forms to facilitate an individual progress by customizable services offered by the modern e-learning resources. And the broad approach would consider digital transformation in the above aspects plus the education service design and management context to ensure high quality specialist education standards. These mean the teaching workload management, educational process scheduling, student's portfolio forming, e-learning service accessibility – including the electronic library system (EBS) accessibility – and other relevant service standards.

The educational digital transformation requires, above all, modern e-learning resources being widely applied in the academic education system supported by the new-generation didactic materials including digital multimedia curricula and progress test systems; digital multimedia multipurpose training systems; digital multimedia presentation toolkits primarily used to built up the knowledgebase; e-learning databases; educational resources formatted for uploading in the Internet; online/ distant education courses; digital e-learning videos and video tutorials; mobile e-learning applications, etc. [1-4].

As provided by I.V. Robert [9], "Digital information technologies gives the means to: reform the learning material presentation system using hyper-texts and hypermedia formats; revise the communication paradigm in the educational process (teaching, learning and interactive information resource); introduce an automated progress test and education service management systems; and offer a wide range of e-learning resources".

Of special interest in this context are the e-learning resources design and management issues in some specific training sectors on the whole and their practical applications in the physical education-and-sport specialist trainings system for the professional services quality in particular. As far as the other physical education and-sports-specific digital transformation application fields are concerned, we would mention, first of all, the key physical education and sport service fields including the sports training, competitive event hosting and management, physical education / wellness services, etc. These physical education and sport service fields are open for the modern theoretical and practical training software tools and equipment including the trainees' progress and health testing and monitoring systems – both the laboratory and portable/ field ones. These systems have proved beneficial as they greatly facilitate the service management standards on the whole and the competitive event management service in particular – due to the objective performance tracking, analyzing and scoring systems among other things [1].

Increasingly promising in these physical education and sports service domains are the modern smart sensors, with the test data processed by the relevant mobile applications to produce a wide range of health/ fitness/ performance test indices (Strava, NTC, Watch, 8fit, Runtastic, etc.). Of special interest and potential benefits among them, as we believe, is the multifunctional DexBee application. A special priority will be given today to a central digital transformation advancement system that should help implement digital transformation in the physical education and sport sector on the whole and in every region and by every corporate physical education and sport service provider in particular [6,8].

**Conclusion.** Our analysis of the relevant theoretical and practical study reports and practical digital transformation implementation experiences in the national physical education and sport sector showed the physical education and sport specialist education, retraining and advanced training service being one of the most promising digital transformation progress trends. In this context, a special priority in the physical education-and-sport-specific digital transformation development projects will be given to the advanced training of the academic faculties to help them establish and use modern e-learning resources, develop knowledge and skills



in a variety of modern online and mixed education service formats, and keep abreast with the modern physical education-and-sports-education-specific digital transformation progress trends to ensure high quality of their students' professional service in future.

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# Public information services of regional sports federations: demand and supply situation survey

UDC 796.062



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## Abstract

**Objective of the study** was to analyze the demand and supply situation for the sports federation information services including the information resource demand surveys of different population groups.

**Methods and structure of the study.** The first stage of the study was designed to analyze the sports federations information resource demand statistics, their contents and update frequencies for the Udmurt Republic sports federations ( $n=78$ ). And then a questionnaire survey was run to profile the population group demands for the sports federation information resources, their update frequencies, contents and data flows on the whole. We sampled for the questionnaire survey 145 people including 55 coaches (37.9%), 39 sports activists (26.9%), 25 professional athletes (17.2%), 19 physical education and sports managers (13.1%) and 7 practicing instructors (4.8%).

**Results and conclusion.** The sports federation information resource users reported the highest interest in the following sports federation information: news, reports, event schedules, regulations of competitions and final reports; and the lowest interest in referees, ratings and picked team members. The survey also found 71% of the sample needing the information on a daily basis and 29% prepared for delays of a few days. The survey data and analyses may be helpful for the sports federation data flow structuring and prioritizing purposes and selections of the best websites and contents of special interest for the potential users.

**Keywords:** sports federations, information service, internet resource, website, social networks.

**Background.** As provided by the Federal Law “On Physical Education and Sports in the Russian Federation”, one of the main goals of a sports federation is to promote its sport discipline(s) by a variety of methods – increasingly dominated by the modern communication tools such as websites, social networks and messengers [3]. In addition, the valid Physical Education and Sports Sector Development Strategy for the period up to 2030 gives a special priority to the information services in the physical education and sports sector [2]. As emphasized by Ermilova V.V., the sports federation management standards should be improved by the modern information service advancement efforts [1]. However, these efforts need to be sensitive to the actual demand and supply situations in every sports federation rated by the popular information service survey data.

**Objective of the study** was to analyze the demand and supply situation for the sports federation information services including the information resource demand surveys of different population groups.

**Methods and structure of the study.** The first stage of the study was designed to analyze the sports federations information resource demand statistics, their contents and update frequencies for the Udmurt Republic sports federations ( $n=78$ ). And then a questionnaire survey was run to profile the population group demands for the sports federation information resources, their update frequencies, contents and data flows on the whole. We sampled for the questionnaire survey 145 people including 55 coaches (37.9%), 39 sports activists (26.9%), 25 professional athletes (17.2%), 19 physical educa-

**Table 1.** Sports federations information resource demand and update frequency data

| Information re-<br>source pages | Update frequency |        |         |                      |           |
|---------------------------------|------------------|--------|---------|----------------------|-----------|
|                                 | Few times a week | Weekly | Monthly | Once in a few months | Neglected |
| VKontakte (57)                  | 61%              | 7%     | 9%      | 12%                  | 11%       |
| Website (30)                    | 13%              | 7%     | 27%     | 53%                  | 0%        |
| Instagram (10)                  | 20%              | 50%    | 10%     | 10%                  | 10%       |
| Facebook (3)                    | 33%              | 0%     | 0%      | 0%                   | 67%       |
| YouTube (2)                     | 0%               | 0%     | 50%     | 50%                  | 0%        |
| Twitter (1)                     | 0%               | 0%     | 0%      | 0%                   | 100%      |

**Table 2.** Sports federation information resource content analysis: corporate websites and VKontakte pages

| Sports federation contents on VKontakte pages, n=57 |             |                      |            |
|-----------------------------------------------------|-------------|----------------------|------------|
| News                                                |             | 54 (94,74%)          |            |
| Photo reports from competitions                     |             | 50 (87,72%)          |            |
| Competitive data, reports, standings                |             | 45 (78,95%)          |            |
| References to partners (ads)                        |             | 40 (70,18%)          |            |
| Event video coverage                                |             | 38 (66,67%)          |            |
| Sports federation contacts                          |             | 28 (49,12%)          |            |
| Video content                                       |             | 24 (42,11%)          |            |
| Coaches' contacts                                   |             | 15 (26,32%)          |            |
| Sports federation websites, n=30                    |             |                      |            |
| Content                                             | Share       | Content              | Share      |
| Sports federation contacts                          | 27 (90%)    | Rules                | 5 (16,67%) |
| Event schedule                                      | 25 (83,33%) | Ratings              | 5 (16,67%) |
| News                                                | 19 (63,33%) | Anti-doping codes    | 4 (13,33%) |
| Reports                                             | 19 (63,33%) | Sport referees       | 3 (10%)    |
| Sports federation regulations                       | 19 (63,33%) | Records              | 3 (10%)    |
| Sports federation statutes                          | 17 (56,67%) | Practical guidelines | 2 (6,67%)  |
| Sports federation membership                        | 14 (46,67%) | Articles             | 2 (6,67%)  |
| Sports schools                                      | 14 (46,67%) | Ads                  | 1 (3,33%)  |
| Photo galleries                                     | 12 (40%)    | Services             | 1 (3,33%)  |
| Coaches' contacts                                   | 11 (36,67%) | Charity              | 1 (3,33%)  |
| Picked team                                         | 9 (30%)     | Training schedules   | 1 (3,33%)  |
| Video                                               | 8 (26,67%)  | Vacancies in groups  | 1 (3,33%)  |
| Partners                                            | 8 (26,67%)  | References           | 1 (3,33%)  |
| Background                                          | 8 (26,67%)  | Sponsorship          | 1 (3,33%)  |
| History                                             | 7 (23,33%)  | Bulletin             | 1 (3,33%)  |
| Picked team coaches                                 | 5 (16,67%)  | Projects             | 1 (3,33%)  |

tion and sports managers (13.1%) and 7 practicing instructors (4.8%).

**Results and discussion.** The Udmurt Republic sports federation information resource demand and supply profiling survey found 57 sports federations having pages in VKontakte and 30 sports federations running their websites. The least demanded were reportedly Facebook (3), Instagram (10), YouTube (2) and Twitter (1). And 15 sports federations were found non-represented in the Internet. Given in Table 1 hereunder are the Udmurt Republic sports federation information resource situation survey data with the update frequencies – that demonstrate VKontakte being the most popular social networks with 61% demand in the sample.

Table 2 gives the prevailing contents on the information resource. Note that Instagram and YouTube are dominated by media contents rather than sports-federation-specific ones.

At the next stage of the study, we analyzed if the content meets the demand of the physical education and sports sector clientele, if it is relevant and interesting, and what information resources are particularly popular. These data were reported by the sample in the questionnaire survey.

The sample reported relatively high interest in the sports federation news, reports, event schedules and regulations of competitions, with the other information being of little if any interest. The interest was found largely dependent on the data flow rate, with

**Table 3.** Sports federation clientele demand for the sports information

| Content            | No interest | Interesting | Of interest |                  |                   |                  |
|--------------------|-------------|-------------|-------------|------------------|-------------------|------------------|
|                    |             |             | Every day   | Few times a week | Few times a month | Few times a year |
| Event schedule     | 2%          | 98%         | 34%         | 20%              | 32%               | 12%              |
| Event statute      | 3%          | 95%         | 28%         | 25%              | 31%               | 11%              |
| Regulations        | 7%          | 92%         | 24%         | 23%              | 36%               | 9%               |
| Startup reports    | 7%          | 83%         | 26%         | 21%              | 23%               | 13%              |
| Final reports      | 4%          | 93%         | 39%         | 23%              | 23%               | 8%               |
| Interim results    | 8%          | 85%         | 23%         | 23%              | 29%               | 11%              |
| Live broadcasts    | 9%          | 85%         | 32%         | 21%              | 25%               | 6%               |
| Event replays      | 8%          | 89%         | 34%         | 17%              | 27%               | 11%              |
| Photo galleries    | 4%          | 94%         | 42%         | 23%              | 19%               | 10%              |
| Referees           | 17%         | 75%         | 17%         | 11%              | 28%               | 19%              |
| News               | 1%          | 99%         | 57%         | 23%              | 13%               | 6%               |
| Reports            | 2%          | 92%         | 24%         | 34%              | 25%               | 9%               |
| Training videos    | 6%          | 94%         | 30%         | 28%              | 28%               | 8%               |
| Other videos       | 7%          | 86%         | 25%         | 25%              | 28%               | 7%               |
| Sport rules        | 8%          | 89%         | 20%         | 25%              | 26%               | 19%              |
| Sport history      | 11%         | 87%         | 14%         | 22%              | 25%               | 25%              |
| Sport groups       | 10%         | 90%         | 27%         | 19%              | 24%               | 19%              |
| Coaches' data      | 8%          | 91%         | 22%         | 21%              | 26%               | 23%              |
| Training schedules | 8%          | 92%         | 35%         | 18%              | 22%               | 17%              |
| Athletes, coaches  | 6%          | 91%         | 22%         | 21%              | 31%               | 17%              |
| Picked team        | 18%         | 82%         | 22%         | 11%              | 29%               | 21%              |
| Records            | 17%         | 83%         | 23%         | 11%              | 31%               | 18%              |
| Rating             | 20%         | 79%         | 24%         | 9%               | 30%               | 16%              |

71% of the sample needing the information every day, 23% tolerant to a daily delay, 13% to delay of a few hours, and 13% needing it as soon as possible; plus 29% of the sample reportedly prepared to a few days of delay.

The questionnaire survey ranked the preferred sports federation information resources as follows: VKontakte: 90.3%, sports federation website: 64.1%, YouTube: 59.3%, Instagram: 38.6%, Telegram: 11.7%; and the others under 10%. Reasons for the sports federation information resource poor performance or neglect were reported as follows: understaffing (53.5%), shortage of competencies (27.9%), time limitations (25.6%), and shortage of finance (4.6%). The sports federation staff reported the content updates taking on average one day (27%), 2-3 days (23%), four-plus days (15%); or a few hours at most (10%). Labor intensity of the updates was reportedly the highest for the event schedules (53%) followed by live broadcasts (27%).

**Conclusion.** The sports federation information resource users reported the highest interest in the following sports federation information: news, reports, event schedules, regulations of competitions and final reports; and the lowest interest in referees, ratings and picked team members. The survey also

found 71% of the sample needing the information on a daily basis and 29% prepared for delays of a few days. The survey data and analyses may be helpful for the sports federation data flow structuring and prioritizing purposes and selections of the best web-sites and contents of special interest for the potential users.

## References

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