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TRANSFER OF EFFECT OF DRY-LAND RESISTANCE TRAINING ON SPEED AND PARAMETERS OF SWIMMING TECHNIQUE

UDC 796.21

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Annotation

The aim of the study was to determine the type and size of the cumulative transfer of the effect of dry-land upper limb resistance training on the speed and parameters of swimming technique. The study involved (n = 40) physical education students aged 21.3 ± 1.8 years, body weight: 79.1 ± 2.4 kg, body height: 179.8 ± 2.7 cm. The participants were randomly divided into three groups, i.e. two experimental groups: T (n = 16) and P (n = 12) and one control group K (n = 12). The basic research method was a twelve-week experiment. The experimental groups carried out resistance training - group T on the training simulator, group P in the form of arm stroke swimming. There was no training in group K. Control measurements included arm stroke swimming speed at a distance of 75 m during which the motor cycle length and the frequency of arm performance were determined. The measurements were carried out before and after the experiment. A positive transfer of the cumulative effect of upper limb resistance training on swimming speed at a distance of 75 m was found in groups T and P. The training transfer was higher in group T than in group P by 0.6%.

Keywords: *dry-land training, motor cycle length, ergometer, arm performance frequency.*

Introduction. One of the promising and dynamically developing directions of increasing the efficiency of special preparation of swimmers is the use of various means during dry–land training. The main problem of dry–land resistance training is that strength, power and strength endurance often develop only in training exercise forms and not in competition–like forms, or negative transfer occurs. The size and direction of the cumulative transfer of the resistance training effect from dry–land to swimming conditions depends on the degree of copying the movement habit which occurs during swimming . Zaciorski [9] showed that even by using the barbell bench press exercise, you can get different strength gains depending on the position of the exerciser (angle of the bench). This shows how difficult and complex the process of selecting effective training means is. To maximize the positive transfer of the resistance training effect to the competition–like exercise, training simulators are used during swimming training [5, 7,8].

Objective of the study was to determine the type and size of transfer of the effect of upper limb resistance training carried out on dry land with the use of a training simulator on the speed and parameters of the front crawl arm stroke technique.

Research structure and methods. The study involved (n = 40) physical education students, age: 21.3 ± 1.8 years, body weight: 79.1 ± 2.4 kg, body height: 179.8 ± 2.7 cm. The students were randomly divided into three groups, i.e. two experimental groups: T (n = 16) age 20.1 ± 0.9 years, body weight 79.0 ± 9.3 kg, body height 180.9 ± 4.9 cm, P (n = 12) age 20.4 ± 1.0 years, body weight 76.8 ± 7.0 kg, body height 181.7 ± 3.0 cm and one control group K (n = 12) age 23.4 ± 1 ,5 years, body weight 81.5 ± 7.3 kg, body height 176.7 ± 4.7 cm. The analyses included only those students who completed the experimental program in full (100%).

A 12–week experiment was carried out. Group T did the swimming training supplemented with additional dry–land resistance training, while group P carried out the resistance and swimming training only in water. Group K participated only in the initial and final measurement. Swimming training sessions took place in a 25–meter swimming pool four times a week. Complementary resistance training sessions on dry land and in water took place three times in a microcycle. Group T practised on a training simulator, and group P swam using upper limbs only. The volume of resistance load was 300 seconds for each training session. Training in group T consisted of 6 series of 50 seconds of performance and 10 seconds of rest, and in group P the subjects swam according to the same scheme using upper limbs only for front crawl. In the power training, an ergometer according to the author's design made by JBA Zbigniew Staniak was used, together

with the CPCv2.2 computer software [8]. Video analysis was performed when swimming at a distance of 75 m. It included measurement of swimming speed V (m/s), motor cycle length LC (m) and frequency of arm performance FC (cycles/min.). After exceeding the frequency of arm performance of 60 cycles/minute [2], the amount of resistance (blade surface) was increased (by 10%). The research was conducted in accordance with the ethical standards of the Declaration of Helsinki and the research was approved by the University Research Ethics Committee.

Methods of statistical analysis of research results. The effectiveness of experimental training was presented on the basis of the effect size [ES] calculated according to Cohen [1].

$$ES = \frac{\text{result after the experiment} - \text{result before the experiment}}{\text{SD before the experiment}}$$

SD – standard deviation

The size of the transfer was calculated according to [3].

$$WT = \frac{ES\ e - ES\ k}{ES\ e + ES\ k} \times 100\%$$

WT – transfer rate,

ES e – standard effect of experimental groups,

ES k – standard effect of the control group.

Control measurements were carried out before and immediately after the experiment. The computer program Statistica 13.3 was used for the calculations. Results. During the experiment, subjects from groups T and P performed the work in water with a volume of 74375 m. Efforts in the aerobic zone constituted 74.96%, anaerobic-aerobic performance accounted for 18.82%, while anaerobic performance made up 6.2% of the total work. In total, the volume of dry-land resistance training and training in water during the experiment was 10800 s each. Training effectiveness was assessed by the size of ES (Fig. 1). Group P achieved the greatest effects in arm stroke swimming only. According to Cohen, it was high ES (Fig. 1). In the analyzed parameters of swimming technique, only group P achieved medium ES in the LC, whereas the effect of changes in FC was low in both groups.

It turned out that the WT size depended on the type of resistance training (Fig. 2). Both positive and negative transfers were reported. FC analysis showed that the transfer size was the highest in group T. In group P, WT was 4.1% lower than in group T (Fig. 2). A positive transfer of the resistance training effect on the LC was also observed. WT in group T was about 18% higher than in group P. The most objective reflection of the phenomenon of transferring the resistance training effect was to compare the swimming results. The highest WT was noted in group T (103.4%), although in group P (102.7%) it was equally high (Fig. 2).

Discussion. Nowadays, the latest technologies and various types of equipment are used in the training of swimmers. Also, feedback is used to maximize the arsenal of effective training means [2, 4, 5, 6, 7, 8, 9, 10]. The aim of the study was to determine the type and size of transfer of the effect of upper limb resistance training carried out on dry land with the use of a training simulator on the V and parameters of the front crawl arm stroke technique. A similar size of transfer was observed in groups P and T. Also, positive transfer of the resistance training effect on the FC observed in groups P and T – it was higher than in the control group by 56.9% and 61%, respectively. The transfer on the LC was higher. It was 108.8% in group P and 126.5% in group T. One of the highest values of transfer of the resistance training effect on the LC was found in their research by Naczk et al. [5]. Using the inertial training simulator, they recorded the effect transfer on the LC: at a distance of 50 m – 75.8% and at 100 m – 82%. In turn, Priluckij et al. [6] revealed a negative transfer of the effect of resistance training performed in water with the use of blades on the LC. Moreover, Roberts et al. [7] noted a negative transfer on the LC while swimming at a distance of 100 yards after resistance training on a biokinetic training simulator. It is worth noting that the transfer of the cumulative effect of resistance training on the LC depends to a small extent on the structure of the movement, and to a greater extent on the resistance used. Probably, similar volume and intensity of performance in resistance training used in our research gave similar effects. These results show the specificity of the effects of using certain training means. Next, the transfer of the resistance training effects on arm stroke swimming was analyzed. The transfer was the highest in group T and it was 0.6% higher than in group P. Many authors [4, 6, 8, 9] claim that the course of adaptation to training loads is definitely specific. Resistance exercises performed on the ergometer were similar to arm stroke swimming, and a slight advantage of group T over group P may be due to more accurate and easier

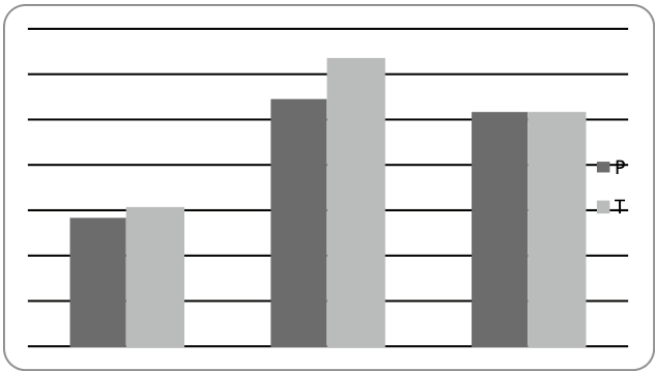

Fig. 1. Standard effect of resistance training at a distance of 75 m. (ES)

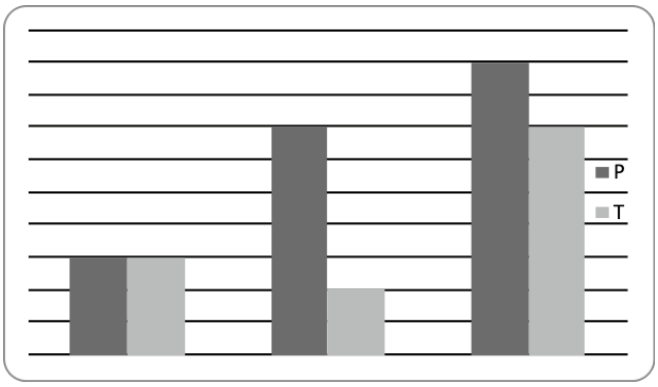

Fig. 2. Transfer of the resistance training cumulative effect on FC, LC and V in groups T and P in relation to group K at a distance of 75m (%)

power control on the training simulator. The research results prove the possibility of replacing resistance training in water with dry-land training with the use of the author's design training simulator.

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FLEXIBILITY FOCUSED STRETCHING GAMES FOR BEGINNER RHYTHMIC GYMNASTS

UDC 37.037

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Annotation

Objective of the study was to improve the methodology of flexibility development at the initial stage of training of junior rhythmic gymnasts aged 5-6 years through the application of the stretching game elements.
Methods and structure of the study. The study was carried out at the premises of the municipal budgetary institution "Sports School No. 1" of the Elabuga municipal district of the Republic of Tatarstan. Sampled for the study were the 5-6 year-old girls engaged in rhythmic gymnastics. The Experimental and Control Groups were made, homogeneous in terms of physical development indices, 15 subjects each. Physical exercises to determine the level of development of flexibility were selected as tests.
The new flexibility building stretching game model for beginner 5-6 year old rhythmic gymnasts was tested beneficial as verified by the Experimental group progress test rates being higher than in the Control Group in every test save for the front splits test. It should be emphasized that the Experimental group showed much higher interest in the trainings facilitated by the animals-mimicking stretching games – that were noted to greatly encourage the trainees. The new stretching game model may be recommended for application in the flexibility trainings of the beginner rhythmic gymnastics groups.

Keywords: *game-like method, flexibility, stretching games, rhythmic gymnastics, exercises.*

Background. Competitive success in the modern rhythmic gymnastics depends on how efficient the training systems are in every aspect including the flexibility training components [5, p. 59]. Modern trainings systems widely apply high technologies, sophisticated tools, equipment, consumables, biomedical functions and physical fitness tests [4, p. 482] for progress. Many national researchers including A.V. Levatskaya, A.G. Nazarova, Yu.M. Portnov and G.N. Pshenichnikova have studied the flexibility training issues in the modern underage/ junior rhythmic gymnastics sport.

Having analyzed the existing flexibility training technologies, we opted for the flexibility training stretching game model for preschoolers based on the A.G. Nazarova' method. This stretching game model is dominated by the 'tranquil dynamic/ static stretching exercises for the limb/ spine ligaments and joints to prevent and correct postural disorders with profound healing effects on the whole body' [1, p. 25].

Objective of the study was to test benefits of a new flexibility building stretching game model for beginner 5–6 year old rhythmic gymnasts.

Methods and structure of the study. The study was run at Sports School #1 in Elabuga, with 5–6 year old girls (n=30) trained in rhythmic gymnastics groups sampled for the model testing experiment and split up into Experimental and Control Groups of 15 people each – tested virtually equal by the prior qualification tests.

Pre-experimental physical fitness tests run in January 2019 were as follows: 5s sitting forward lean test to rate the spine flexibility; supine gymnastics bridge test to rate spine motility; left/ right/ front splits test to rate hip joint motility; and jump rope twist test to rate shoulder girdle flexibility. Individual performance in the first three tests was rated on a 5-point scale as excellent, good, fair, satisfactory and poor (5.0–4.5; 4.4–4.0; 3.9–3.5; 3.4–3.0 and 2.9–minus points, respectively); and in the last test it was rated in cm.

As provided by the valid Federal Sports Training Standards item 40 applicable to rhythmic gymnastics, the general and special physical fitness test benchmarks for qualifiers to the beginner rhythmic gymnastics groups are the following: see Table 1 [3].

The new model testing experiment was run in January to June 2019, with the Experimental group trained twice a week for 45 min. The warm-up part included general developmental exercises for large muscle groups to make the musculoskeletal system fit for the further flexibility-focused stretching games. The core part of each Experimental group training session was dominated by active stretching games including 10–11 muscle-group-spe-

cific exercises, namely: 2–3 abdominals training exercises; 4–5 dorsal muscles training exercises; 3–4 leg muscles training exercises; and 1–2 shoulder girdle training exercises.

A special priority in the Experimental group trainings was given to the following quest games: "Journey of funny frogs" with the gymnasts mimicking frog movements and jumps and facing special problems like "Jump over the ditch" (from a deep squat); "Kayaking frogs" (to train shoulder joints and ligaments with a jump rope); plus role games, e.g. "Visiting the Zoo" with elements of fairy-tale situations and puzzles like "How does an ostrich hide its head in the sand?", "Can we curl up like the hedgehogs?", "What does a cobra look like?"; with the gymnasts expected to mimic movements of every animal.

Every Experimental group training session was designed to both work out every muscle group and master their sequential conditioning skills by a variety of active games including "Stormy sea", "Make a figure", "The plane takes off," "Heron," etc., with the children taking fixed postures to train the spine and hip joints. Each training session was finalized by the passive flexibility focused exercises. The children's families were recommended to complement the trainings by the following daily practices at home: repeated springing practices; maximal-amplitude practices; amplitude-stepping swinging practices etc. [2, p. 8].

Results and discussion. We tested the group progresses by the post-experimental tests after the six-month training model testing experiment: see Table 2. The Experimental group versus Control Group progresses in the pre- versus post-experimental tests were as follows: in the 5s sitting forward lean test, the Experimental group progress was 0.2 points better (0.6 versus 0.4 points, respectively); in the supine gymnastics bridge post-experimental test, the Experimental and Control Group scored 4.1 and 4.2 points, respectively. In the right splits test, the Control group scored 4.5 points, i.e. 0.4 points higher than the Experimental group. In the front splits test, the both groups were tested good with 0.1 point difference. And in the jump rope twist test the Experimental group made progress of 2cm that was 1cm better than in the Control Group.

As demonstrated by the above data, the Experimental and Control Group made progress of 6% and 4% in the 5s sitting forward lean test; equal 3% progresses in the supine gymnastics bridge test; and 6% versus 5% progresses, respectively, in the right splits test. The Experimental group showed twice as little progress in the left splits test (the Control Group made progress of 4% in the test). And in the front splits test, the Experimental and Control Group made progresses of 4% and 6%, respectively. The Experimental group progress in the shoulder girdle motility test was estimated at 20% versus 10% in the Control Group.

Conclusion. The new flexibility building stretching game model for beginner 5–6 year old rhythmic gymnasts was tested beneficial as verified by the Experimental group progress test rates being higher than in the Control Group in every test save for the front splits test. It should be emphasized that the Experimental group showed much higher interest in the trainings facilitated by the animals-mimicking stretching games – that were noted to greatly encourage the trainees. The new stretching game model may be recommended for application in the flexibility trainings of the beginner rhythmic gymnastics groups.

Table 1. *General and special physical fitness test benchmarks for qualifiers to the beginner rhythmic gymnastics groups*

Tested qualities/ skills	Tests	Scores
Flexibility	5s sitting forward lean	5 points: tight floor contact with straight legs; 4 points: deep lean with hands behind the feet, with straight legs; 3 points: medium lean with hands reaching the feet, with straight legs
Flexibility	Standing gymnastics bridge	5 points: high bridge with the hands on the shins; 4 points: good bridge with hands resting tight to the heels; 3 points: fair bridge with the hands 2–6cm far from the heels
Spine flexibility	Fixed knee bridge with hands on feet	5 points: high bridge with the straight arms and tight legs; 4 points: the same with bent arms; 3 points: the same with bent arms and loose legs
Hip joint flexibility	Left/ right splits	5 points: right/ left thigh tight on the floor with straight pelvis; 4 points: the same with the thigh 1–5cm above the floor; 3 points: the same with the thigh 6–10cm above the floor;
Hip joint flexibility	Front splits	5 points: thighs tight on the floor and lined up; 4 points: the same with the thighs imperfectly lined up; 3 points: the same with the groin up to 10cm far from the line

Table 2. *Flexibility building stretching game model testing experiment: pre- versus post-experimental test data*

Tests	Control Group		EG	
	Pre-exp.	Post-exp.	Pre-exp.	Post-exp.
Sitting forward lean	3,900±0,687	4,167±0,556	3,833±0,488	4,233±0,530
Gymnastics bridge	3,800±0,493	4,067±0,495	3,900±0,507	4,233±0,458
Shoulder twists	22,600±1,639	20,600±1,502	22,800±1,740	20,867±1,598
Right splits	3,833±0,645	4,067±0,495	4,000±0,681	4,367±0,581
Left splits	3,633±0,442	3,833±0,309	3,467±0,399	3,8±0,414
Front splits	3,867±0,55	4,333±0,362	3,833±0,673	4,4±0,387

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3X3 BASKETBALL AT TOKYO 2020 OLYMPICS: COMPETITION ORGANIZATION MODEL

UDC 796.323

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Annotation

Objective of the study was to analyze the most effective competitive progress models for ratings and qualifications in the modern 3x3 basketball.
Methods and structure of the study. During the study the following methods were applied: analysis, synthesis of video recordings of the basketball games and static protocols in 3x3 Basketball World Championships of 2018 and 2019 (96 games), European Championships of 2017, 2018, and 2020 (96 games), Russian Championships of 2018, 2019, and 2020 (249 games), World Tour stages of 2017, 2018 and 2019 (589 games); simulation method.
Results and conclusions. The study of the models of organization of 3x3 basketball competitions at the international and national levels enabled to elaborate recommendations on the development of a national effective model of competitive activity: it is advisable to differentiate the work of the federations into two areas: professional and mass. To ensure high rating points and competitive experience at the international level club teams are to participate in 80% of competitions organized by FIBA (3x3 World Tour and 3x3 World Tour Qualifiers) and in other competitions - participation for the Russian national team and in national tournaments of the Russian Basketball Federation, intensify the work on the system for organizing and holding international competitions of the World Tour and World Tour Qualifiers. To attract new players in 3x3 basketball it is advisable to hold national competitions on the basis of the classical basketball model: Russian championships for different age groups, regional and municipal competitions; use reserve opportunities: organize prestigious tournaments during the off-season of classical basketball (May-September).
The findings emphasize the importance of advanced trainings of physical education and sports specialists in the field of information technology, digital services and technologies. The article presents the analysis of the modern system for organizing and holding 3x3 basketball competitions. We identified the peculiarities of participation of national teams in competitions of different levels and elaborated recommendations on optimization of 3x3 basketball development aimed to raise the federation's world ranking.

Keywords: *3x3 basketball, competitive activity (CA), 2020 Olympic Games in Tokyo.*

Background. Analyses of the theoretical and practical study reports with concern to the 3x3 basketball progress demonstrate the need for a standard competitive progress model [1, 10–12]. The FIBA website [3] offers recommendations of analysts from the Netherlands [2] on how the modern 3x3 basketball competitions should be promoted including: actions to lure elite basketball players from the traditional 5x5 format to 3x3 basketball; 3x3 basketball development programs; mass national competitions in this sport discipline; efforts to train high-skilled basketball players for the 3x3 competitions etc. Therefore, presently the FIBA [7] offers no practical guidelines for the 3x3 basketball competitive formats; and every country has to develop its own competitive progress model for rating events and qualifications.

Objective of the study was to analyze the most effective competitive progress models for ratings and qualifications in the modern 3x3 basketball.

Results and discussion. Presently the 3x3 basketball competitions are classified as follows: mass tournaments; club team competitions; and competitions of national teams. Mass 3x3 basketball tournaments are open for everyone as provided by the valid Statute of Competitions, and are normally timed to the municipal festivals and other public events. Club team competitions is the competitive format for highly skilled athletes with their qualifications for the FIBA World Tour, a top-ranking club event [9] that was run for the 8th time in 2019. The tournament includes a few qualifications and a final, with 12 teams selected on special conditions for every qualification event. And the national team competitions may be defined as the top-

ranking international events including: continental championships; World Championship; and Olympic Games. A detailed analysis of the modern competitive formats shows that a special qualification system is being used for the national teams' qualifications for the European Championships [2],World Championships [3],and Olympic Games [4]. Thus every European national federation could compete in the qualification events in Andorra, France and Romania for the 2018 European Championship (Figure 1). As a result,12 teams successfully qualified for the 2018 European Championship [2].

World Championship titles are contested by 20 men's and 20 women's teams qualified based on their rating points. National ratings include 2 components: rating points scored by the individual top players in the top-ranking events; and the points scored in the rating events hosted by the country. Competing in the 3x3 tournaments of the 2020 Olympic Games will be 8 men's and 8 women's teams [4]; with four teams qualified based on the world ranking list as of November 1, 2019; and the other teams qualified via the qualification events (see Figure 2).

Therefore, the national Federation should take special efforts to run 3x3 basketball events, step up their popularity and secure inflow of top-professional players for qualifications for the 2020 Olympics. Many countries host tournaments of different levels this year, with the numbers of competitive 3x3 events reported to grow in 2019 versus 2018 (Figure 3) as follows: professional 3x3 competitions has grown by 20%; and qualifications for the professional 3x3 competitions and national competitions have grown by 39% and 30%, respectively. This means that the national federations are increasingly active in the rating events to qualify for the Olympic Games.

It should be mentioned that the individual competitive activity of the leading 3x3 Russian players is still lower than in many other countries,particularly in the World Tour qualifiers and Challenger qualifiers that yield the highest rating points (Figures 4,5).

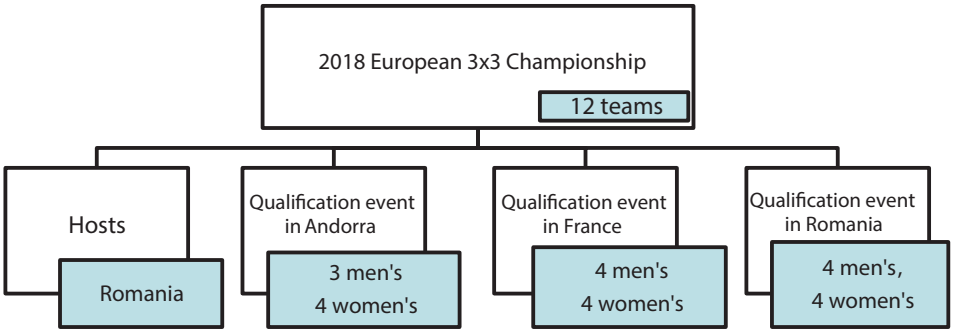

Figure 1. *Qualification system for the 2018 European Championship*

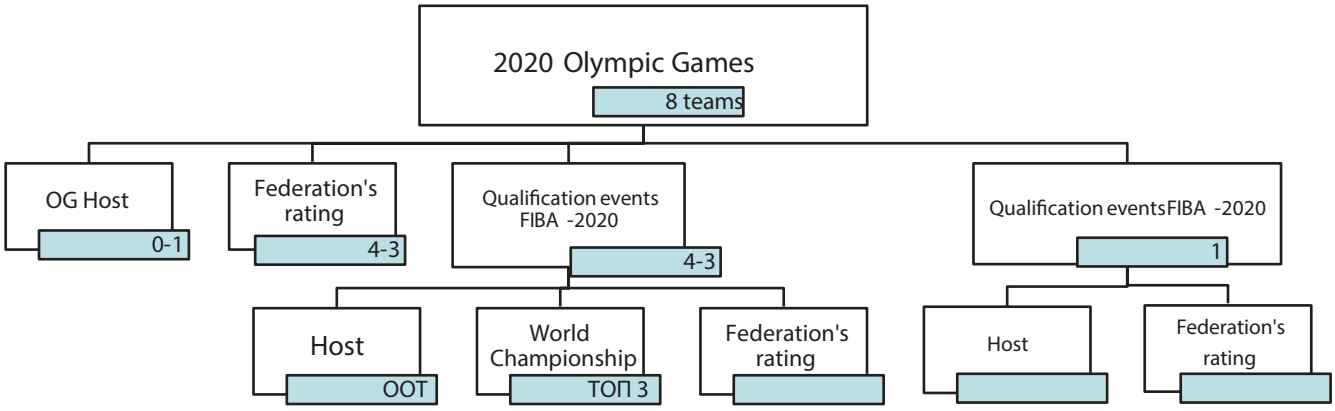

Figure 2. *Qualification system for the 2020 Olympics in Tokyo*

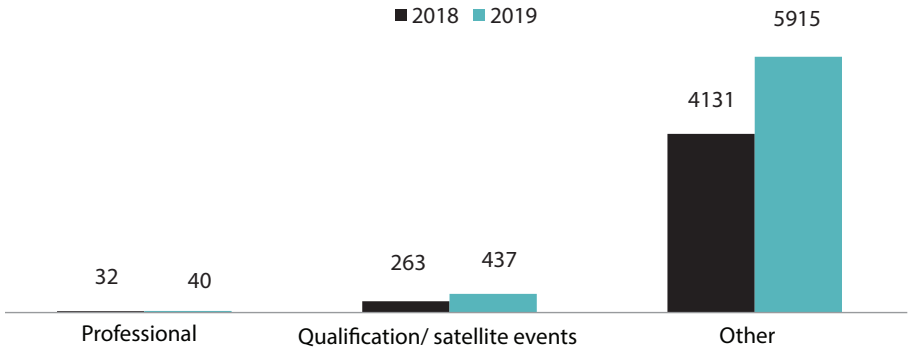

Figure 3. *2018-2019 statistics of the 3x3 basketball tournaments Professional Qualification/ satellite events Other*

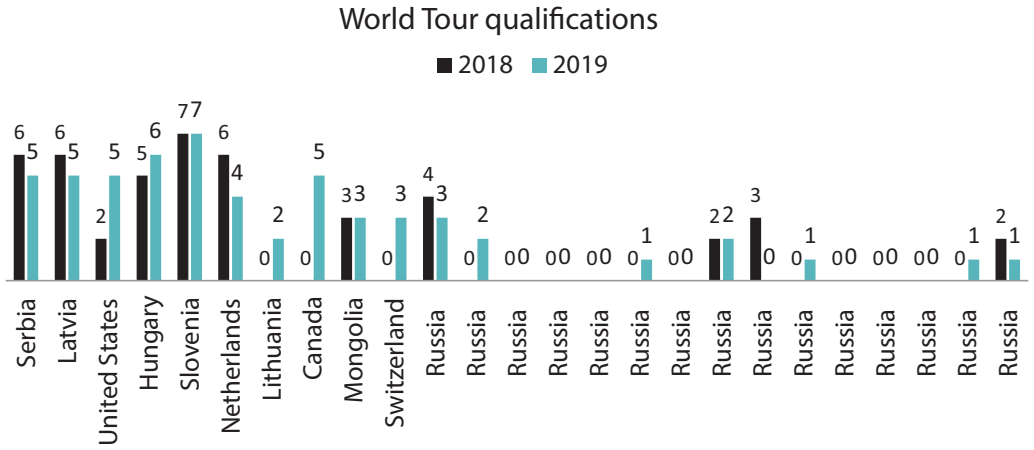

Figure 4. *National qualifications for the 2018-2019 World Tours*

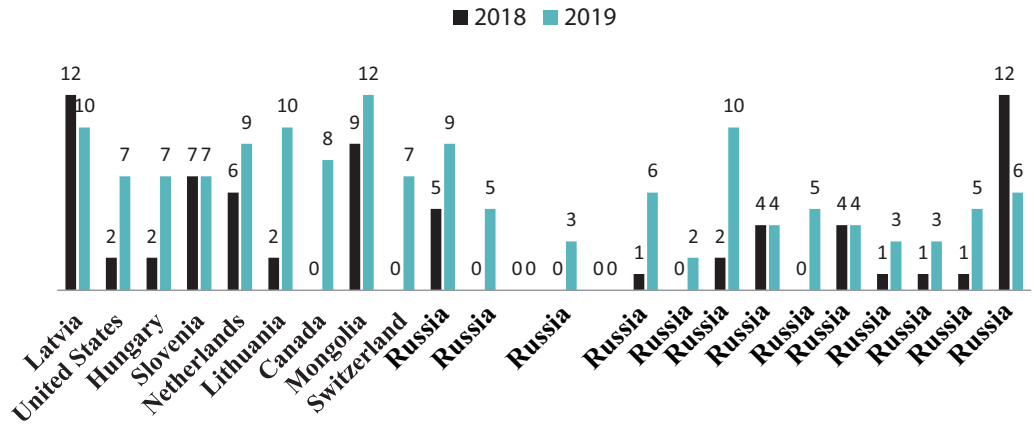

Figure 5. *National statistics of 2018-2019 Challenger qualifiers*

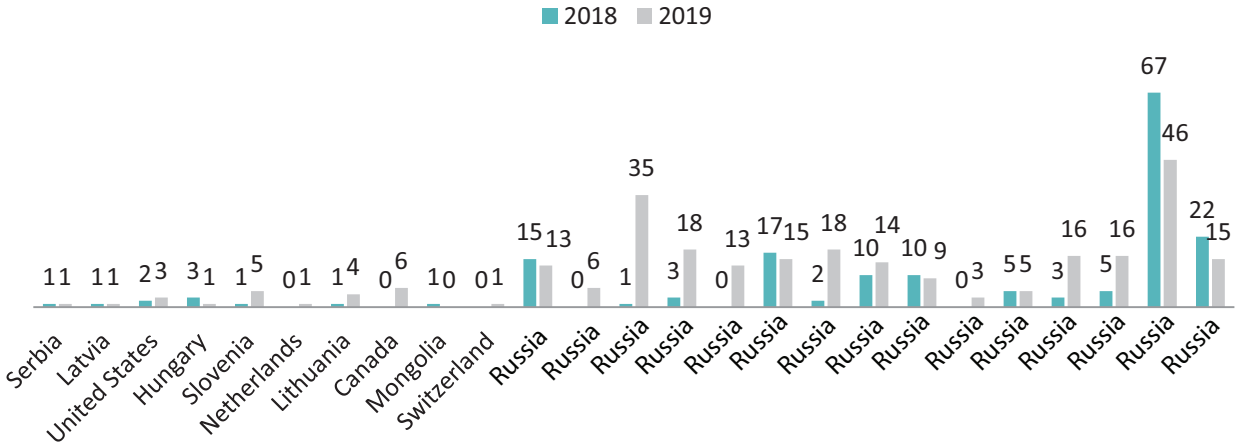

Figure 6. *National 3x3 tournaments in 2018-2019*

No wonder that the Russian 3x3 elite still needs to accumulate competitive experiences in the top-ranking events. Further analysis has shown that national tournaments make it possible to collect the necessary rating points and gain high competitive experiences: see Figure 6.

Conclusion. The competitive progress models for the Russian 3x3 basketball elite need to secure a broader participation in the foreign top-ranking events otherwise the players have to intensely compete in the lower-ranking events draining their resources and still having little if any top-level competitive experiences for success in the top-ranking tournaments.

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FEATURES OF DIVING REFLEX IN SYNCHRONIZED SWIMMERS

UDC 796.01:612

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Annotation

Objective of the study was to identify the features of diving reflex in synchronized swimmers.
Methods and structure of the study. Sampled for the study were 36 female synchronized swimmers of different sport qualifications (masters of sport and first-rank athletes). Their cardiovascular indices were analyzed.
Results and conclusions. We detected an inverse high correlation between the apnea duration, degree of bradycardia, and rate of its increase during immersion. Considering that the breathhold duration in synchronized swimming and the ease with which it is tolerated is essential for the performance of figures, it can be concluded that the most favorable type of reaction in this sport is an areactive one, characterized by a slight deceleration of the heart rate and moderate constriction of the peripheral vessels. Although the diving reflex performs a protective function during immersion, thus contributing to the economical oxygen consumption and preservation of the cerebral blood flow, during short-term immersion the strong vagal effects on the cardiac function realized at the moment of immersion and slowing down of the blood flow hindered mobilization of the functional reserves of the body. This may adversely affect the competitive results.
Therefore, the optimal type of cardiovascular response to diving in synchronized swimming was identified. The authors propose that evaluation of the cardiovascular response to diving should be included in the sports selection for synchronized swimming.

Keywords: *synchronized swimmers, diving reflex, cardiovascular system, body functional reserves.*

Background. The activities of synchronized swimmers are characterized by a number of physiological features that distinguish them from the dry land activities. Water is a powerful irritant of the thermal and tactile skin receptors. Facial and neck skin are particularly sensitive to its effects. When these body parts are submerged in the water, a powerful chain of inherent reflex cardiovascular reactions, the so-called diving reflex, is activated [4]. The diving reflex during submersion is accompanied by the activation of the cold and tactile receptors. From them, on the afferent pathways of the facial and triple nerve, the signals are transmitted to the X pair of the cranial nerves, and from them – to the sinus node of the heart, which results in a reflex decrease of the heart rate, sometimes a decrease in the stroke volume, with a reduction of the minute blood volume. At the same time, the signal is transmitted from the vasomotor center of the oblongata brain through the sympathetic nerve fibers of peripheral vessels, causing the constriction of the skin vessels, inactive muscle vessels, vessels of the gastrointestinal tract and abdominal cavity (see Figure 1).

These reactions are amplified if immersion is associated with breath-holding, drop in the partial pressure of oxygen, and accumulation of carbon dioxide in the blood and tissue. At the same time, the blood flow is selectively redistributed from oxygen-resistant organs to the heart and brain, which have no tolerance to hypoxia [4]. Therefore, oxygen consumption is reduced in terms of oxygen deficiency. In other words, this series of responses perform a protective function. However, due to high energy consumption physical loads are accompanied by intensive oxygen consumption. On dry land, this entails mobilization of the cardiorespiratory system: an increase in heart rate, stroke volume, breathing rate and depth. There is a conflict – an inherent reflex aimed to save oxygen (reflex bradycardia, constriction of blood vessels) and strenuous physical work require additional oxygen supply and hence mobilization of the gas transport systems. How does the body react to these conditions? Let us take the example of the female synchronized swimmers.

Objective of the study was to identify the features of diving reflex in synchronized swimmers.

Methods and structure of the study. Sampled for the study were 36 female synchronized swimmers of different sport qualifications (masters of sport aged 15–17 years old and first-rank athletes 12–14 years old). Their cardiovascular indices were analyzed. The manifestation of the diving reflex response can be evaluated by immersing the face in the water. This makes it possible to conduct an in-house study using a simulated diving model [1, 2].

The subjects were to lay down on their stomachs, hold their breath, and immerse their faces in the water. The water and air temperatures were close to the swimming pool conditions and amounted to 27±1.3°C and 26±2.1°C, respectively. Heart rate was measured in the pool with the head fully immersed in the water by the method of radiopulsometry using PolarTeamSystem transmitters. In the laboratory conditions, during the rest pause, during the simulated diving test, and during the recovery period after the test, we measured the subjects' stroke volume (SV, mg) and minute blood volume (MBV, l) using Tishchenko's integral rheography, and systolic wave amplitude (SWA, pm) distal phalanx of the hand, which indirectly reflects the peripheral vascular tone, using photoplethysmography. We also registered ECG in the standard leads and blood pressure (BP) rates. The ECG indicators were used to determine the type of diving response by the method developed by T.I. Baranova [2]. The following indicators were considered: latent period of reflex bradycardia (when the RR interval during the face immersion in the water exceeded the maximal baseline value – *L*, sec); degree of bradycardia (ratio between maximal RR interval during immersion and maximal baseline RR interval – DB, c.u.); time of onset of the maximal RR interval during immersion – t (sec). We recorded the breath holding time during immersion – *T* (sec). Based on these indicators, we determined the type of cardiovascular system response: high-reactive type – the latent period of bradycardia *L*<9sec, DB>1.25, *t* – close to the end of apnea; reactive type – the latent period of bradycardia *L*>9sec, DB>1.11, *t* – can appear in the middle of apnea; paradoxical type – the increase of heart rate during immersion, DB<0.89. The body's reaction to immersion is similar to its reaction to stress. The areactive type – there is no bradycardia, 1.1<DB>0.9.

Blood saturation was determined by the method of pulse oximetry (using the pulse oximeter by "Mizar").

The Wilcoxon and Mann–Whitney non-parametric methods were used to assess the statistical significance of the changes. The correlation analysis was conducted using the Spearman's correlation method.

Results and discussion. The deceleration of heart rate and peripheral vessel constriction, as well as increased blood pressure during submersion depend on the reactivity of the autonomic nervous system, adaptability to work in the water (diving and swimming), as well as on the genetic features of the body [3].

Diving reflex in the female synchronized swimmers. The comparative analysis of the changes in heart rate of the female athletes in the laboratory conditions and in the swimming pool with the complete submersion failed to reveal any differences.

The duration of apnea during simulated diving was on the average 83.6±23.9 sec per group. The analysis of the deceleration of heart rate during submersion showed that the latent heart rate deceleration period was longer in the masters of sport than in the untrained females. The percentage of females with the areactive type of response was higher among the synchronized swimmers than among the untrained females. For example, the percentage of the female athletes with the areactive type of response was 40%, with the reactive type – 50%, with the high-reactive type – 6.7%, with the paradoxical type – 3.3%, while among the untrained females, the percentage ratio was as follows: 13–15%, 45–55%, and 3.5–5%, respectively. At the same time, in the group of first-rank female athletes, the percentage ratio of response types was slightly different: high-reactive type – 30%, reactive type – 40%, areactive type – 20%, and paradoxical type – 10%. The correlation analysis revealed a direct correlation between the apneic time, latent period, and the time of onset of the peak RR interval during submersion (CC=0.88, p<0.01). There was an inverse correlation between the degree of bradycardia and apneic time (CC=0.68, p<0.01). Therefore, the stronger the cholinergic effect decelerating heart rate, the shorter the apneic time during simulated diving.

The most pronounced decrease in SpO_2 was observed in the female athlete with the paradoxical type of re-

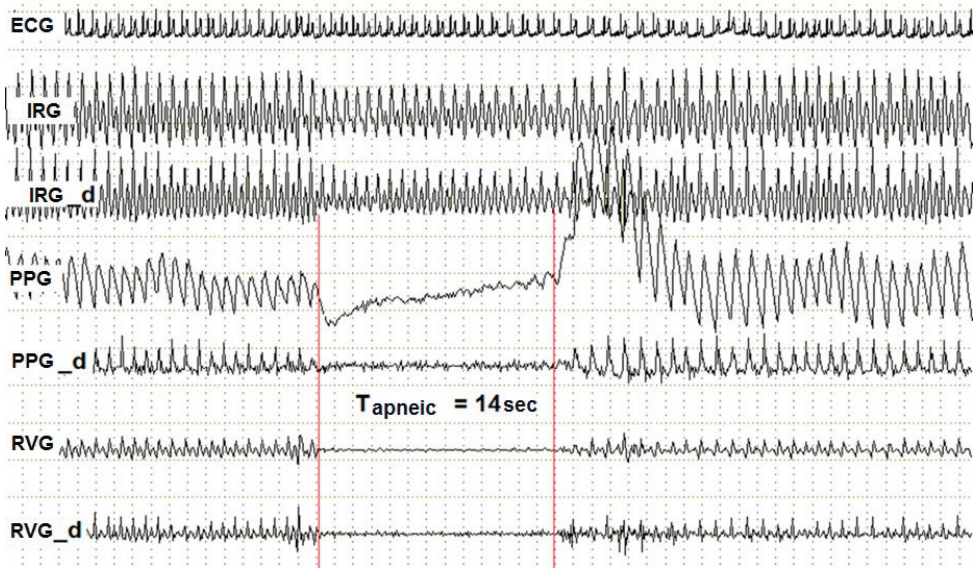

Fig. 1. *Dynamics of blood flow when diving on the example of testee I.K.*
ECG – electrocardiogram, IRG – integral rheogram, PPG – photoplethysmogram, RVG – rheovasogram, d index – differential of corresponding rheogram, T_{apneic} – diving time.

Table 1. *Blood pressure changes in the female synchronized swimmers (first-rank and masters of sport) during simulated diving*

Parameters	Baseline		Simulated diving	
	Masters of Sport	First-rank athletes	Masters of Sport	First-rank athletes
Systolic blood pressure, mmHg	109.5± 3. 5	104.5± 2.9	124.3±4.1	137.6±4.7**
Diastolic blood pressure, mmHg	66±1.9	67±2.1	79.3± 2. 1	92.7±3.1**

Note. *p<0,05; ** p<0.01 – between the masters of sport and first-rank female athletes by the Mann-Whitney criterion.

sponse (with the predominance of adrenergic effects on the heart): the 53-sec apnea led to a decrease in oxygen saturation to SpO_2=84%. While in the female athlete with the areactive type of response, the 71-sec apnea led to a decrease in oxygen saturation to SpO_2=94%.

Peripheral blood flow during simulated diving. All female athletes were found to have a decrease in the systolic wave amplitude, reflecting the blood filling in peripheral vessels. The decrease in the systolic wave amplitude in the first-rank female athletes was significantly greater (p<0.01) than in the masters of sport. The systolic wave amplitude rates at rest and during submersion were as follows: first-rank female athletes – 0.82±0.21 and 0.26±0.07, masters of sport – 0.87±0.13 and 0.53±0.03, untrained females – 0.74±0.15 and 0.33±0.04, respectively.

The blood pressure increase during simulated diving. One of the differences in human diving is the blood pressure increase. At the same time, in some individuals, blood pressure increases by 10-15 mmHg, in others – by 80-100 mmHg. The increase in blood pressure during diving is a consequence of peripheral vasospasm. It should be noted, however, that in the masters of sport the blood pressure increase, as well as the narrowing of peripheral vessels, was less pronounced than in the first-rank female athletes (see Table 1).

Conclusions. We detected an inverse high correlation between the apnea duration, degree of bradycardia, and rate of its increase during immersion. Considering that the breathhold duration in synchronized swimming and the ease with which it is tolerated is essential for the performance of figures, it can be concluded that the most favorable type of reaction in this sport is an areactive one, characterized by a slight deceleration of heart rate and moderate constriction of the peripheral vessels. Although the diving reflex performs a protective function during immersion, thus contributing to the economical oxygen consumption and preservation of the cerebral blood flow, during short-term immersion the strong vagal effects on the cardiac function realized at the moment of immersion and slowing down of the blood flow hinder mobilization of the body functional reserves. This may adversely affect the competitive results. Is the type of response innate? Or can it change in the training process? Our long-term observations showed that, in 75% of synchronized swimmers with the high-reactive type of cardiovascular system response, reactivity decreases due to trainings. In 25%, the type of reactivity is preserved throughout life. There was also a case of neutralization by the sympathetic nervous system of adverse vagal effects on the heart of the female athlete with the high-reactive type of cardiovascular system response (paradoxical type of response). In other words, a stress reaction to diving is developed. This type of response is not beneficial since it increases hypoxic loading. At the same time, observations revealed that such compensation can lead to neurogenic hypertension over time.

We assume that the type of cardiovascular system response to diving should be considered in the sports selection for synchronized swimming.

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OVERALL COORDINATION FITNESS IN FOOTBALL: RATING CRITERIA

UDC 796.332

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Annotation

Objective of the study was to develop quantitative criteria for evaluation of the level of development of coordination abilities in 9-17 year-old football players to improve the training process control and correction model.
Methods and structure of the study. The level of coordination preparedness of the football players was assessed using the standard methods currently applied by the researchers (stabilography, psychomotor and pedagogical testing). We also used the methods of mathematical modeling and statistics. Sampled for the study were 258 football players aged 9-17 years (qualification levels: Candidate Master of Sports, 1st-3rd senior categories).
Results and conclusions. Evaluation of the level of overall coordination preparedness of the 9-17 year-old football players enabled to analyze the dynamics of changes in the accuracy of motor actions, responsiveness and ability to maintain statodynamic equilibrium in the age aspect. The data obtained made it possible to monitor the subjects' level of coordination preparedness, more precisely forecast and estimate individual age-specific growth of coordination abilities rates in the football players and plan training loads accordingly. Fixation on the model level of development of coordination abilities facilitates the identification of gifted and talented athletes, timely correction and individualization of the process of coordination training of football players.

Keywords: *movement coordination qualities, coordination fitness, football, model characteristics, training process*

Background. Modern team sports give a special priority to the movement coordination qualities among the other physical qualities and abilities [3,4] as they are considered particularly important for success and need to be trained by special methods and tools; although the range of individual coordination qualities and skills appears to be genetically predetermined to a degree. This is the reason why so much attention is paid to coordination trainings at every stage of the long-term training process in football, albeit in actual practice the coaches often apply very limited sets of the movement coordination tests dominated by the shuttle sprints and shooting accuracy rating tests [1, 2, 5, 6]. The question of whether or not some of the coordination qualities and abilities are really trainable still remains underexplored, as well as the question of what coordination progress rating criteria should be applied in the age-specific tests.

Objective of the study was to offer an integral coordination fitness test system to facilitate the coordination trainings of the 9–17 year old footballers.

Methods and structure of the study. We used for the coordination fitness testing purposes the common standard techniques including stabilographic (body balancing) and psychomotor progress tests in trainings; plus the relevant progress modeling (benchmarking) methods and mathematical statistical data processing tools. We sampled for the study 9–17 year old football players having adult Class III to CMS qualifications.

Results and discussion. The general coordination fitness of the sample was rated by a set of body balancing, reactive and kinesthetic abilities and the movement accuracy, timing, pacing, spacing and strength-controlling qualities rating criteria. Knowing that the movement coordination abilities are highly sensitive to many factors of influence (including fatigue, training season, current/ prior workloads etc.) the tests were standardized as much as possible in their schedules and conditions and timed to the preparatory phase of an annual training cycle.

The tests were designed to obtain the absolute values and profile movement coordination progress in the 9–17 year-olds. Based on the averaged test data with standard deviations, we worked out a set of the coordination progress rating criteria that may be used for progress tests on a group/ individual basis for the training system correction purposes (see Tables 1–3). The data averages were limited by $X \pm 0.5\sigma$, with the higher and lower test rates interpreted as indicative of the high and low coordination fitness. For the coordination progress benchmark-

ing/ modeling purposes, we recommend the benchmarks/ targets being set beyond the standard deviation range i.e. above or below X ± σ.

Based on our long practical experience, we would recommend to rate the athletes demonstrating model (ideal) test results in a few coordination ability tests as gifted and promising, particularly in the beginner selections/ qualifications for football groups. Movement coordination qualities are known to facilitate technical progress, particularly in the high-coordination-intensive and situational sports, including football. The athletes rated high on a few coordination fitness test scales are known to fast progress in the sport techniques mastering and excelling processes and being more efficient and versatile in the technical toolkit application in response to the game situations.

The static body balancing skills tests of the sample found this coordination quality being moderate versus the other sports samples – that may be explained by the fact that these qualities are not so critical for success in football. The Romberg tests of the static body balancing abilities showed progresses with age and skill level. As for the statodynamic stability test data, they showed less expressed progress with age and skill level, as demonstrated by the stabilographic tests with involute and stepped tests: they showed insignificant progress in the equilibrium function rates: see Table 1. These data may be interpreted as indicative of these qualities being less trainable – that means that they need to be well tested at the qualification stage to find the individuals with the highest test rates in the stabilographic and other similar tests.

Reactive capacity tests showed coordination progress correlated with the growing physical fitness in a few relatively simple tests. However, the stepped stabilographic test data (with the fast movement redirections and accurate spacing and controlled-strength responses) were found virtually unchanged with age in the sample. The same insignificant progress was found in the maximal-frequency hand tapping test – probably due to these abilities being beyond the sport-specific skill set: see Table 2.

Kinesthetic coordination abilities were rated by the repetition accuracy, timing and spacing ability rating tests. The highest progress in these tests was made by the 15+ year-olds with stable test rates thereafter, save for the angular discrimination accuracy (rotating angle) rating test); with the error rates tested to rapidly fall since 11 years of age. The timing (time intervals rating) accuracy was found the most stable in the sampled age band – that may be interpreted as indicative of a strict genetic dependence of this movement accuracy securing qualities: see Table 3.

Conclusion. The integral coordination fitness rating test system in application to the 9–17 year old skilled football players was found beneficial as it makes possible to profile progress in the movement control and coordination accuracy, reactive abilities and equilibrium function (by statodynamic tests) on an age-specific basis. The test procedures and analyses are recommended for application in the coordination training systems to accurately forecast and rate the individual age-specific progresses in coordination abilities and adequately design and manage the individual trainings. The coordination fitness progress

Table 1. *Equilibrium function test data of the sample, X ±*

Tests	Age, years								
	9	10	11	12	13	14	15	16	17
SVMR test, ms	550±35	500±32	470±30	450±45	450±40	380±35	350±32	320±30	300±45
CVMR (choice) test, ms	640±48	580±52	530±40	520±	480±35	470±40	470±45	460±40	460±35
CVMR (tracking) test, ms	240±32	230±30	235±22	235±25	196±20	215±20	185±20	155±15	155±15
Max-frequency tapping 10s test, score	45±6	46±6	49±7	50±8	51±7	53±6	54±6	54±5	54±5
Stepped stabilographic throw test, s	0,6±0,02	0,8±0,04	0,9±0,04	1±0,1	0,9±0,1	0,8±0,2	1±0,2	1,2±0,4	1,3±0,3
Stepped stabilographic throw-and-back test, s	0,8±0,05	0,9±0,1	0,8±0,1	1±0,2	1,1±0,3	0,9±0,3	1±0,3	1,7±0,4	1,7±0,5
Stepped stabilographic RMO test, s	4,1±0,8	4,3±0,6	4±0,7	4,2±0,9	3,9±0,6	4±0,9	4,1±0,9	4,2±1,0	4,2±0,8
Stabilographic targeting test with fast redirections, %	11±3	13±4	12±3	14±3	15±4	17±4	16±5	23±	24±3
Stabilographic targeting test with fast redirections and involute, %	8±1	9±2	9±2	9±2	8±2	10±2	12±4	14±4	15±4

Table 2. *Kinesthetic coordination ability test data of the sample, X ±*

Tests	Age, years								
	9	10	11	12	13	14	15	16	17
Romberg heels-to-tips test, c	24±10	29±8	26±8	27±7	28±7	32±12	39±12	38±12	43±12
Romberg stork pose test, s	4±1	5±1	6±2	7±2	7±2	7±2	9±3	10±3	14±3
Equilibrium function rating stabilographic targeting test, %	45±6	58±6	52±8	62±6	53±8	61±8	60±9	69±8	70±8
Stepped stabilographic test, %	34±5	42±6	35±6	40±6	35±7	35±6	37±7	40±7	42±5
Stabilographic test with involute, %	19±4	25±3	24±5	26±4	25±6	24±6	27±6	31±5	24±5

Table 3. *Reactive qualities test data of the sample, X ±*

Tests	Age, years								
	9	10	11	12	13	14	15	16	17
Timing (time intervals rating) accuracy test: error rate,%	37±4	37±5	35±5	32±4	29±4	26±4	23±4	24±5	22±4
Timing accuracy rating beep test: error rate,%	28±3	28±3	24±3	22±3	16±3	17±2	21±5	22±3	22±3
Repetition accuracy rating half-maximal strength test,error rate,kg	7,2±0,5	7,5±0,5	6,5±0,6	6,3±1,0	5,9±0,9	5±1,0	4,5±0,9	3±0,6	2,5±0,6
Length eye-rating accuracy test, error rate,%	18±3	21±6	17±5	17±6	19±6	19±5	13±4	15±4	15±5
Length eye-cutting accuracy rating test,error rate,%	26±4	21±6	24±4	25±4	21±4	24±4	18±3	18±3	18±3
Angle eye-rating accuracy test,error rate,%	15±1	14±1	12±0,5	15±0,5	12±2	12±2	10±2	10±5	10±5

Note: SVMR/ CVMR simple/ complex visual motor reaction; RMO response to moving object

benchmarking by the model reference points helps to find the most gifted young athletes in the qualification progress and adjust the individual coordination training systems on a timely and well-grounded basis.

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PHYSICAL FITNESS PROFILES OF ELITE FREESTYLE MALE AND FEMALE WRESTLERS

UDC 796.012.1

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Annotation

Objective of the study was to determine the physical fitness profiles of elite freestyle wrestlers taking account of their weight classes and performance in tournaments. The study participants were 72 female wrestlers and 66 male wrestlers who had won medals or had placed fifth to eighth at Poland Senior Championships or other major sports events. Subjects' physical fitness profiles were assessed by measuring their explosive strength, strength endurance, suppleness, special endurance and agility. Differences were found between the profiles of male and female wrestlers, and of lightweight and heavyweight wrestlers of the same gender. Female wrestlers had lower scores than men for explosive strength, special endurance, strength endurance and suppleness while being more agile. The analysis of wrestlers' profiles with respect to their body mass showed that both male and female wrestlers in the lightweight classes were more agile and supple than their counterparts in the heavyweight classes, with the lightweight male wrestlers also having higher scores on the strength endurance test. The study demonstrated that the key abilities that both male and female wrestlers need to win medals are strength endurance, special endurance and explosive strength. The performance of lightweight female wrestlers primarily depends on their strength endurance and special endurance. In the case of lightweight male wrestlers, agility is an essential ability.

Keywords: *motor abilities, male wrestling, female wrestling.*

Introduction. Many studies point to an association between physical preparation and wrestlers' performance [4, 5, 8]. According to some authors, high performance in wrestling is related to strength and endurance [6]. Others give priority to speed, suppleness and agility [5, 7], and still others emphasise the role of suppleness as an ability making possible the execution of wrestling techniques, mainly those aimed to bring the opponent down [1].

The main reason for this is the use of different research methods and subject selection approaches by their authors, as well as changes to competitive wrestling rules [8]. Another problem in this research field is the shortage of studies investigating the physical fitness of elite female wrestlers [2].

This study analyses the motor abilities and agility of elite male and female wrestlers taking account of their weight classes and sports achievements in order to determine the profiles of modern, top-performing wrestlers.

Methods and structure of research. The study was carried out with 138 elite freestyle wrestlers (66 men aged 21.47 ± 2.66 years with training experience of 8.71 ± 2.77 years and 72 women aged 20.57 ± 2.10 years with training experience of 8.11 ± 1.94 years) competing in the senior category. Based on the body mass criterion, subjects were divided into lightweight and heavyweight wrestlers and within these two groups into medal winners and non-winners who had placed fifth to eighth at Poland Senior Championships or other major tournaments.

Subjects' motor abilities (explosive strength, strength endurance, suppleness, special endurance) and agility were assessed by the following tests: standing broad jump (indicator I), pull-ups (indicator II), push-ups (indicator III), wall bar hanging leg raises (indicator IV), a zigzag run (indicator V), suplexes on a wrestling dummy (indicator VI), wrestling carousel (indicator VII), standing gymnastic bridge with return (indicator VIII) [3]. All tests were carried out after a 15-minute standard warm-up during a regular training session. The reliability of the tests as established by the "test-retest" method ranged from 0.63 to 0.91.

The results of the tests were normalised to z-scores for the whole group and the subgroups of male and female wrestlers. Because neither athletes' gender nor weight class was found to be associated with their performance in wrestling matches ($X^2 = 0, p = 1$; $X^2 = 0.03, p = 0.84$), the statistical analysis was performed separately for male and female wrestlers in both weight classes. Inter-group differences were assessed by one-factor analysis of variance,

assuming that they were statistically significant at $p < 0.05$. The study was approved by the Ethics Committee of the University of Physical Education in Warsaw.

Results and discussion. The analysis of tests' results found differences between the profiles of male and female wrestlers and between the profiles of lightweight and heavyweight athletes of the same gender (Fig. 1). The levels of all motor abilities were higher in men ($p < 0.001$), but their scores on the agility test were lower than women's ($p < 0.001$).

Differences between lightweight and heavyweight male athletes proved bigger than between lightweight and heavyweight female wrestlers (Fig. 2). The latter were only different in the levels agility and suppleness which were higher for the lightweight wrestlers ($p < 0.001$), whereas lightweight male athletes were not only more agile and supple than their heavyweight counterparts ($p < 0.001$) but also scored higher on the strength endurance test ($p < 0.01$).

Female medal winners in the lightweight classes were significantly different from non-winners in strength endurance ($p < 0.05$) and special endurance ($p < 0.01$). In the heavyweight classes, the third factor differentiating medal winners from non-winners was explosive strength ($p < 0.05$) (Fig. 3).

Among the male wrestlers, medal winners and non-winners in the lightweight classes ($p < 0.05$) only differed in the level of agility. More differences were found for

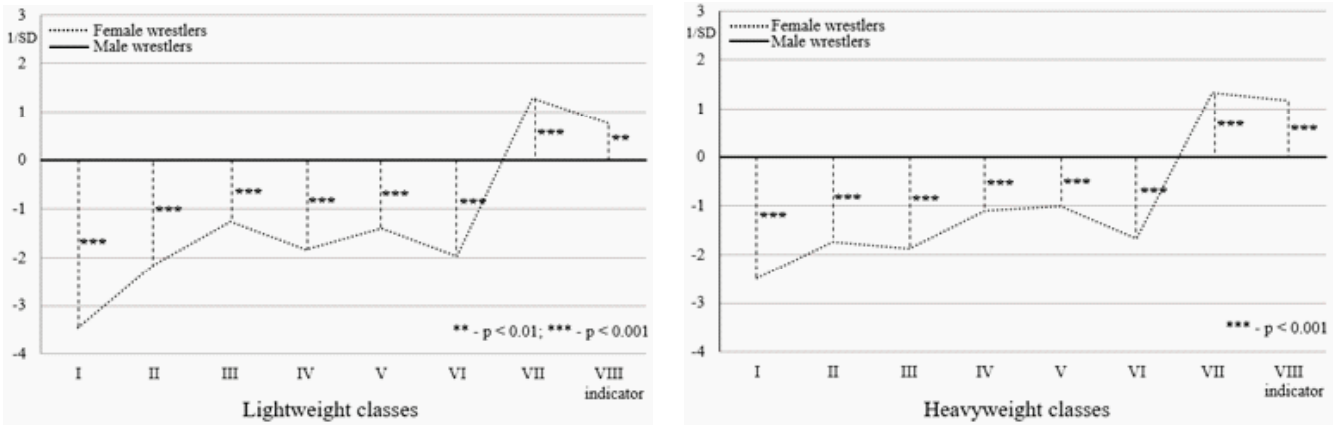

Figure 1. *The female wrestlers' values of motor ability and agility indicators normalised to the male wrestlers' values.*

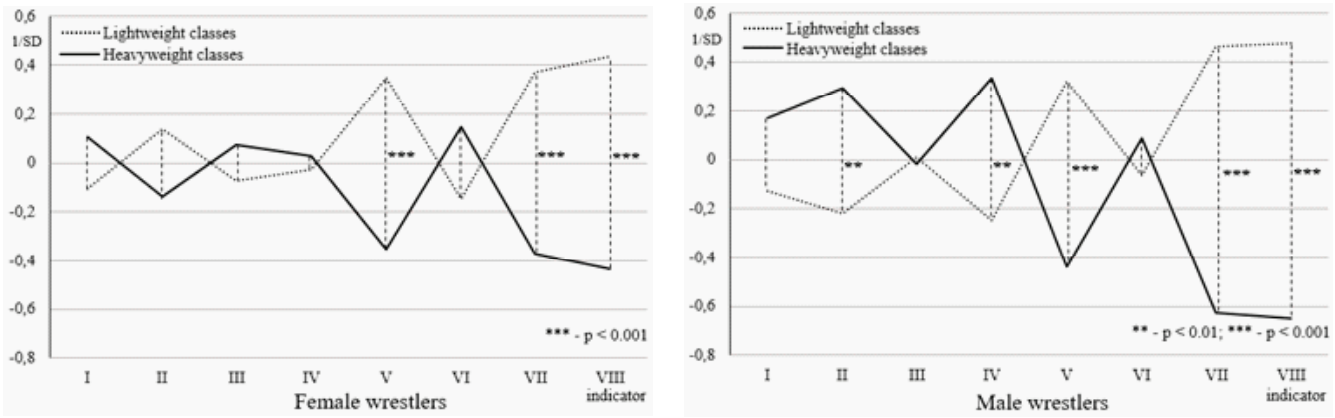

Figure 2. *The values of motor ability and agility indicators for male and female wrestlers in the lightweight and heavyweight classes (normalised to the whole group's values)*

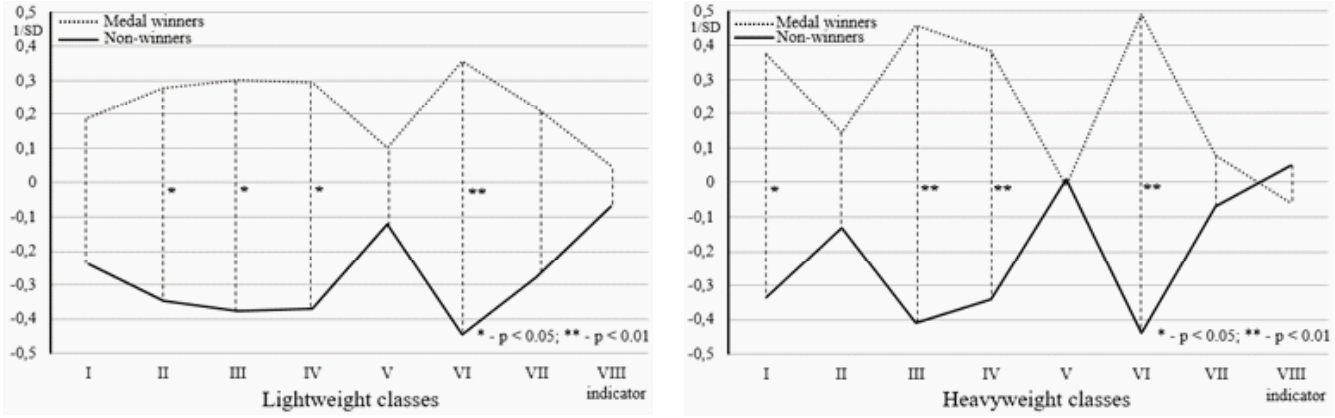

Figure 3. *The physical fitness profiles of female medal winners and non-winners (normalised to the whole group's data)*

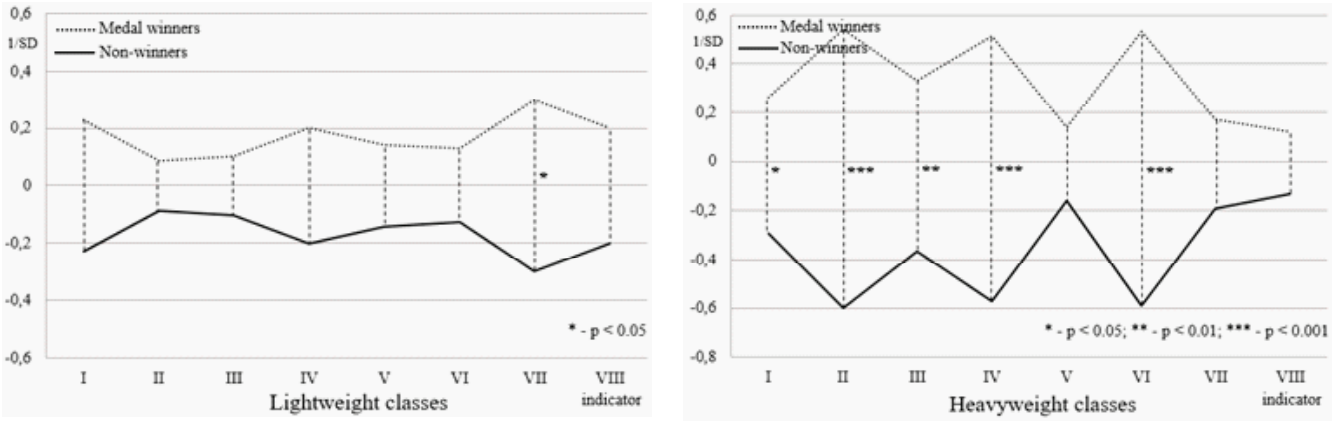

Figure 4. *The physical fitness profiles of male medal winners and non-winners (normalised to the whole group's values).*

the heavyweight classes, where medal winners differed from non-winners in strength endurance and special endurance ($p < 0.001$) and explosive strength ($p < 0.05$) (Fig. 4).

The values of both motor ability and agility indicators differentiated female wrestlers from male wrestlers. Women had lower levels of explosive strength, strength endurance, suppleness and special endurance, but, like in other studies [2], they proved more agile than men.

The comparison of subjects in terms of their weight classes demonstrated that the lightweight female athletes were significantly more supple and agile than their heavier counterparts. Male wrestlers competing in the lightweight classes were also characterised by higher levels of suppleness and agility but did not match the heavyweight wrestlers in strength endurance.

Conclusions. The physical fitness profiles of wrestlers differ because of their gender and weight class. The focus of motor training should be on the wrestlers' key fitness abilities, which are different for male wrestlers and female wrestlers. The knowledge of the key fitness abilities of male and female wrestlers who compete in different weight classes and win medals can be instrumental in improving the wrestling training process. It should be considered in selecting training mean and methods aimed to nurture and master the key abilities of male and female wrestlers.

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14-18/ 18-23 YEAR OLD POWERLIFTING GROUPS: TRAINER-TRAINEE COOPERATION SURVEY

UDC 796.015

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Annotation

Objective of the study was to analyze, based on a questionnaire survey, the trainee-trainer cooperation models for the 14-18 and 18-23 year old (adolescent and youth) powerlifting groups. Methods and structure of the study. Sampled for the questionnaire survey were the 14-18 and 18-23 year old powerlifters (n=30) qualified Class II to Master of Sport with the competitive experiences of 1 to 7 years and 3-plus-months-long trainer-trainee cooperation experiences. The survey was timed to the Russian Junior Powerlifting Championship (January 28 to February 1) in Moscow. We used for the purposes of the study the survey form offered and analyzed in our prior study [5] that classifies the trainer's actions into the actual ("Used by the trainer") and expected ("Need to be used by the trainer") ones, with the respondents asked to rate every actual/ expected trainer's action by the degree of importance on a 13-point scale (e.g. "strongly disagree" to "strongly agree" scored by 1 and 10 points, respectively). Thus the factors scored by 1 and 13 points meant the highest and lowest degrees of importance for the respondents. The survey data was averaged to the arithmetic means, ranked and analyzed.

Results and conclusions. The questionnaire survey data and analyses showed that trainer should be highly knowledgeable and skillful in every trainer-trainee cooperation domain to design this cooperation on a sport- and age-specific basis so as to avoid excessive interference in and pressure on the personality formation process. Trainer should be at the same time highly sensitive in the own behavioral controls in relations with the young athletes to prudently build up trust and healthy cooperation reasonably customized to the individual personality progress, training and competitive progress needs and potentials; avoid, mitigate and overcome every barrier in the trainer-trainee relationship so as to prevent mental burnouts and failures of the underdeveloped athletes due to the trainer' errors in the interpersonal cooperation domain. Highly efficient and healthy trainer-trainee cooperation is critical for competitive success in the junior powerlifting sport.

Keywords: *youth powerlifting sport, trainer-trainee cooperation, coaching service, questionnaire survey.*

Background. Modern sport science gives a special priority to the trainer–trainee cooperation in the studies of the training experiences and specific training systems, with this category being ranked more important than the trainer–family or teammates' cooperation aspects [4, 6]. The trainer–trainee 'professional cooperation' will be generally governed by certain rules and behavioral models to minimize the potential interpersonal frictions, conflicts and disputes and provide the relevant mental progress intensives, including, for example, mutual appreciation and happiness [3]. Every trainer needs to know basics of healthy interpersonal cooperation building models to at least facilitate the trainee's competitive progress, particularly in the most sensitive beginner/ junior groups. Young athletes' volitional qualities and self–control skills are known to be still volatile and sensitive as this age groups are still in the personality formation and psychological qualities development process.

Objective of the study was to analyze, based on a questionnaire survey, the trainee–trainer cooperation models for the 14–18 and 18–23 year old (adolescent and youth) powerlifting groups.

Methods and structure of the study. Sampled for the questionnaire survey were the 14–18 and 18–23 year old powerlifters (n=30) qualified Class II to Master of Sport with the competitive experiences of 1 to 7 years and 3–plus–months–long trainer–trainee cooperation experiences. The survey was timed to the Russian Junior Powerlifting Championship (January 28 to February 1) in Moscow. We used for the purposes of the study the survey form offered and analyzed in our prior study [5] that classifies the trainer's actions into the actual ("Used by the trainer") and expected ("Need to be used by the trainer") ones, with the respondents asked to rate every actual/ expected trainer's action by the degree of importance on a 13–point scale (e.g. "strongly disagree" to "strongly agree" scored by 1

and 10 points, respectively). Thus the factors scored by 1 and 13 points meant the highest and lowest degrees of importance for the respondents. The survey data was averaged to the arithmetic means, ranked and analyzed.

Results and discussion. Given in Table 1 herein are the survey data classified into the actual and expected actions and ranked by the degrees of importance.

The expected trainer's actions showed no serious differences in the rankings, with the scores averaging 9.83 to 10 points, and with 10 factors out of 13 scored by 10 average points – that means that these expected actions are potentially highly important and equally desirable for the respondents. These factors were ranked V,5 in our ranking system.

Leading in the ranking is the "Sensitivity to the individual needs and specifics", and this is quite natural in our opinion. These age groups are in the active personality formation period when the personality identification and socialization issues are highly topical in the young people's communities and subcultures, and, therefore, it is only natural that the trainees expect the trainer to feel and appreciate their gifts, progresses and help in coping with challenges – maybe as opposed to the families' attitudes. It should be mentioned that the teenage and youth development periods are particularly challenging in the psychological aspects, with the growth processes often going via multiple challenges in the socializing attempts and individual resource accumulation and mobilization efforts (in communication with families, friends and respected people in the surrounding) [1]. Sports and competitive accomplishments in this context may heavily contribute to the individual self-assertion agenda, with the trainer being ranked high among the respected role models, particularly when his is sensitive to the physical/ mental and personality progress needs of the growing athlete. Trainer should prioritize the individual approaches in communication with a reasonable sensitivity to every health issue, mood, learning and living problem of the trainees, their relations with the peers and families etc. – i.e. should show high interest in every trainee to facilitate the healthy lifestyle cultivation, mental/ emotional self-control building and self-assertion efforts. Sporting lifestyle and competitive progress in particular is known to generally facilitate the individual age-specific self-assertion and mental controls and help develop a reasonable independence and tolerance to negative opinions and criticism for progress in the self-rating domain. Trainer should be sensitive to the age-specific mental and physical progress challenges to adequately address them.

Ranked second were the trainer's "Explanations of logics of every exercise". It should be noted that the young people that start up their trainings with heavy weights are highly exposed to the risks of injuries of the musculoskeletal system with the relevant negative mental issues. The trainer should take every effort to protect the trainee's physical and mental health and lay a sound foundation for the multiannual progress.

Ranked third was the trainer's actions to "Design and schedule the trainings". It should be mentioned in this context that the age-specific fitness for the trainings is still insufficient and much lower than in the adult groups. It is not unusual that the young athletes overestimate their resource and skills, strive to lift top weights in every training session and, hence, are highly exposed to injury risks [2]. It is highly important for the trainer in this context to spell out the training process in every detail with a special priority to the health safety issues and individual progress management methods and tools.

An analysis of the expected trainer's actions showed that the young people are still unprepared to fairly rate his functions and potential in the trainer-trainee cooperation domain. The young people ranked virtually equally important every expected action in the survey form – that may be interpreted as the psychological unfitness for self-reliant assessments in the training and competitive processes and, as a result, high reliance on the trainer in every aspect. It is not unusual, therefore, for this age group to face multiple physical and mental stressors, particularly in cases of the competitive regresses and failures; and very often the young athletes are unable to effectively cope with them. This is the reason why the range of their expectations is so

Table 1. *Trainer-trainee cooperation survey data classified into the actual and expected actions and ranked by the degrees of importance*

Trainer's actions	Actual actions, average rank, points	Expected actions, average rank, points
Designs and schedules the trainings	III (9,66)	V,5 (10)
Manages practical trainings	V,5 (9,42)	V,5 (10)
Explains logics of every exercise	II (9,75)	V,5 (10)
Supports in competitions	VII,5 (9,17)	V,5 (10)
Offers his own practical training methods	V,5 (9,42)	V,5 (10)
Sensitive to my life issues (private, school, and sport-specific)	XI (8,5)	XI (9,92)
Helps in the precompetitive warm-up and mental conditioning efforts	IV (9,58)	V,5 (10)
Gives psychological support in trainings and competitions	X (8,83)	V,5 (10)
Demonstrates the execution skills in trainings	XII (8,25)	XIII (9,58)
Helps with a good sense of humor	IX (9)	XII (9,83)
Reasonably demanding to the healthy regimen/ diets in trainings and competitions	VI (9,21)	V,5 (10)
Fair in rating my successes and failures	VII,5 (9,17)	V,5 (10)
Sensitive to my individual needs and problems (health issues, moods, life challenges etc.)	I (9,83)	V,5 (10)

wide. The trainer–trainee cooperation will be designed to help the trainer learn the athlete's needs, gifts and personality traits and help the athlete explore himself to adequately rate the own physical resources, mental qualities, volitional controls and potentials, self–assertion agenda etc. Efficient and healthy trainer–trainee cooperation will form a basis for good physical and mental health of the athlete and his competitive progress.

Conclusion. The questionnaire survey data and analyses showed that trainer should be highly knowledgeable and skillful in every trainer–trainee cooperation domain to design this cooperation on a sport– and age–specific basis so as to avoid excessive interference in and pressure on the personality formation process. Trainer should be at the same time highly sensitive in the own behavioral controls in relations with the young athletes to prudently build up trust and healthy cooperation reasonably customized to the individual personality progress, training and competitive progress needs and potentials; avoid, mitigate and overcome every barrier in the trainer–trainee relationship so as to prevent mental burnouts and failures of the underdeveloped athletes due to the trainer' errors in the interpersonal cooperation domain. Highly efficient and healthy trainer–trainee cooperation is critical for competitive success in the youth powerlifting sport.

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VARIABILITY OF KINEMATICS INDICATORS IN SHOT PUT TECHNIQUE DEPENDING ON SPORTS LEVEL

UDC 796.012

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Annotation

Objective of the study was, according to average relative error, to analyze the variability of biomechanical indicators (of athletes and the put) during shot put for the athletes of international level (8 athletes – group A) and for the athletes of national level (6 athletes – group B). Each of them performed 6 trials and all videos were collected using two high speed digital cameras placed on the performance field, perpendicular to each other. Only measured trials were analyzed using three dimensional APAS software. According to the average relative error, selected indicators of the athlete and the put (mainly during release) have generally shown low variability (below 10% in about 80% of the analyzed cases). In only 4 out of analyzed cases (for two release indicators) variability was high (>20%), in 9 of cases variability (according to the average relative error) was medium (10%-20%), while in the remaining cases variability was low (<10%).

Keywords: *throwing, biomechanical parameters, 3D kinematic analysis.*

Introduction. Throwing events in track and field (shot put, hammer throw, javelin throw and discus throw) have been the subject of a number of studies (Ariel, 1979; Bartonietz, 1996). Good performance in these track and field events is mainly determined by the athlete's technique rather than tactics.

Release parameters, i.e. height of release, angle of release and release velocity have been the parameters generally analyzed in the studies on throwing events such as shot put.). The correlation between release velocity and the measured distance is very strong. According to the study of Judge et al. (2011), a summation of forces from various phases of the throw and various body segments is needed to achieve maximum velocity at the moment of release. Release speed is also inversely proportional to the angle of release (Hubbard et al., 2001). According to the classification of physical performance tests suggested by Hopkins et al. (2001), the jumping and throwing tasks fell under the category of the iso – inertial tests. Amongst the trials performed by the same athlete, the performance can vary substantially. Also, in some trials, the athletes fail (they break the rules) and the performance is discarded. We will call the percentage of successful trials the athlete's dependability. Therefor **objective of the study** was to compare selected kinematic indicators of athletes at different sports levels (international level and national level) using average relative error (AV).

Material and methods. Fourteen world – class (right – handed) competitors took place in this analysis. Eight of them (5 using the spin technique (age: 26.3±3.2 y; body mass: 124±6.9 kg; body length: 1.95±0.08 m) and 3 using the glide technique (age: 25±1 y; body mass: 116.8±8.6 kg; body length: 1.92±0.07 m)) performed trials during an international competition (group A) and six of them (3 using the spin technique (age: 25.7±2.5 y; body mass: 122.7±6.1 kg; body length: 1.92±0.06 m) and 3 using the glide technique (age: 22±2 y; body mass: 110±7.1 kg; body length: 1.89±0.02 m)) performed trials during national championships (group B). Each athlete performed 6 attempts during a competition in the final session. Only measured trials (34 in group A and 27 in group B) were analyzed. Two high speed digital cameras (JVC, model GR DVL – 9800) seton the tripods were placed perpendicular to each other (two cameras fixed at an angle of 90˚ between their optical axes) near the shot put throwing circle. All throws performed by 8 competitors in group A and 6 competitors in group B at preliminaries and finals during international and national competitions were recorded at 60 frames per second and then analyzed using Ariel Performance Analysis System (APAS). Synchronized data sequences from all camera views were utilized. For each camera view, 18 points were digitized, 16 points were placed on the athlete body including big toe, ankle, knee, hip, wrist, elbow and shoulder for the left and right side of

Table 1. *Average percentage values of the AV for the angle indicators of the athlete and AV for the velocity indicators and the distances in horizontal, vertical, lateral directions and the resultant distance of the athlete's center of gravity and the center of the put (P)*

		Angle indicators of the athlete							Center of gravity			P		
		φ_p	δ_p	λ_p	λ_l	β_p	β_l	S-H	Vx	Vy	Vw	Vx	Vy	Vw
A	S	2.8	3.6	2.1	1.4	1.8	1.2	20.5	21.8	9	6.2	2.2	2.3	1.4
	G	1.2	2.7	1.5	0.9	1.9	1.2	9.3	20.6	17.7	8.7	1.6	3.6	1.3
B	S	2.5	6.4	2.8	2.3	3.4	1.8	32.8	17.6	20	13.1	5.9	5.9	5.1
	G	8.7	9.8	2.5	2.4	2.3	1.1	19.4	18.4	18.7	15.6	5.1	10.4	5.1

the body as well as the right hand, the chin and the top of the head. The seventeenth point was placed on the center of the shot and the last (eighteenth) was placed on the right-side edge of toe-board of the throwing circle. The analyzed area of the throwing circle was calibrated with a 1.5m x 2m x 1.5m reference scaling frame. The calibration was based on eight reference edges and was performed before and after the competition session. The following kinematic indicators of the athlete (athlete's center of gravity in the case of velocities) and the put (P – the center of the put) during release (RLS – the last contact of the athlete) were taken into account during the analysis including measured trials only: Vw – resultant velocity of the athlete's center of gravity and the center of the put (P), Vx – horizontal velocity of the athlete's center of gravity and the center of the put (P), Vy – vertical velocity of the athlete's center of gravity and the center of the put (P), S-H – shoulder-hip separation, – β_p and β_l – respectively rear (right) and front (left) knee angle, φ_p and δ_p – respectively shoulder and elbow angle of the right arm, λ_p and λ_l, – respectively right and left hip angle. Mean and standard deviations were determined for the examined indicators of the athlete and the put in all measured trials (in the spin and glide technique in group A – international level and group B – national level). Differences between variables were compared using the average relative error (AV): AV = (X – Xav) / Xav [%], where AV – average relevant error, SD – standard deviation, X – value of each release indicator for each athlete, Xav – average value of each release indicator according the sports level (group) and technique used. Two-factor analysis of variance (ANOVA) was used to analyze significant differences depending on the two factors: the GROUP (sports level) and/or the TECHNIQUE (spin/glide). Probability level at $p < 0.05$ was taken to assess the significance of existing differences and correlations. Statistical package: StatSoft, Inc. STATISTICA v. 7 was used for all analyses.

Results. The greatest differences were found for the S-H in relation to both groups and techniques factors (Tab. 1).

Statistically significant differences depending on the GROUP factor (sports level) were proved for the AV of the angle indicators: δ_p ($p \leq 0.0001$), λ_p ($p \leq 0.001$) φ_p ($p = 0.002$), S-H ($p = 0.003$), for the velocity indicators: Vx (CG) ($p = 0.008$), Vx (P) $p = 0.002$, Vy (P) $p \leq 0.001$, Vw (P) $p \leq 0.001$. In terms of the technique, significant differences were obtained for the AV of the two angle indicators: φ_p ($p = 0.002$), S-H ($p = 0.002$) and for the Vx (P) ($p = 0.017$).

Discussion. According to the literature, the most important influence on the distance was observed for the resultant velocity of the put, the angle of release and the height of the center of the put during release (the last frame when the put had the contact with the throwing hand). The last indicator was dependent on human anthropometric characteristics, especially the height and the length of the throwing arm (Alexander et al, 1996) so it might be trained only a little in the training process. Other investigations showed that the angle of release among some athletes using spin techniques varied more than among athletes using the glide technique. It was probably caused by the greater deviations during the spin phase connected with the lower stability of the athlete. The height of release and some external factors influenced the angle of release to a lower degree than e.g. during discus or javelin throw. Also, greater variability (according to the AV) of selected indicators in group B was caused by the lower level of this competition and the participation of slightly worse athletes (in group B the best throws were below 19m, while in group D all throws were over 20m).

Generally, release indicators and the indicators of the path of athletes' center of gravity and the center of the put were observed to be very comparable (low AV) indicators in the shot put. Slightly lower variability was found in the trials of higher sports level athletes from group A (the greatest difference in variability between group A and B without division into two techniques existed for the vertical velocity of the athlete's center of gravity and the lowest one for the angle of the left knee). In the spin technique the greatest differences between group A and B were found for the shoulder-hip separation, vertical and horizontal velocity of the athlete's center of gravity and the smallest for the right shoulder, right hip angle and left knee angle. In the glide technique the greatest differences were also observed for the shoulder-hip separation, vertical velocity of the CG and vertical velocity of the put. The smallest differences were found for the angle of release and right and left knee angle. Only for the horizontal velocity of the athlete's center of gravity general average variability (all in the spin and glide technique) in group A was found to be greater than in group B. In other cases, fewer variabilities (according to the AV) were observed for the indicators of the put and the athletes in group A who performed in the stadium.

Conclusion: Variability of release indicators was found to be low (below 10% according to the AV), especially in the group of higher sports level athletes (group A-international level) compared to group B (national level). On the one hand, it could result from the genetically related factors (which we have very little influence on during a training session – the height of the put and the center of the athlete's center of gravity). On the other hand, higher sports level resulted in more stable technique.

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CLASSIC WEIGHTLIFTING CLEAN-AND-JERK STYLE: GROUND RESPONSE AND BAR CONTROL BIOMECHANICS ANALYSIS

UDC 796.012

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Annotation

Objective of the study was to profile and analyze the ground response and bar control biomechanics for classical clean-and-jerk style in weightlifting sport.

Methods and structure of the study. We used for the purposes of the study the Russian State University of Physical Education, Sport, Youth and Tourism-2012 biomechanics test system to rate the technical and speed-strength fitness of the sample. The bilateral video capturing technology registers the bar butt movement trajectory to obtain the bar mass center movement kinematics and dynamics plus its rotation versus the vertical and sagittal axes. The dynamometric test platform registers the ground response vectors to calculate the pressure center coordinates and profile the athlete-plus-weight system joint mass center travel kinematics and dynamics. We sampled for the tests junior weightlifters (n=12) from Olympic Reserve School #2 in Moscow qualified Class I to MS, with the sample being 17.2±1.9 years old, 69.9±16.1 kg heavy and 1.68±0.1 m tall on average. The athletes executed clean-and-jerk exercise in the tests with the weighs rated at 85–95% of the individual maximums i.e. 102.2±23.1 kg on average.

Results and conclusions. The study analyzes the key phases of the clean-and-jerk sequence versus the competitive success rates in the new clean-and-jerk style phasing system. The analyses made it possible to find additional informative dynamic characteristics to rate the individual technical and speed-strength fitness based on the ground response force rating tests. Absolute and relative vertical ground response force vectors were found to significantly exceed the forces applied to the bar in every movement phase. Thus the maximal horizontal bar force vector at the start of the final acceleration phase was tested almost six times higher than the ground response force gradient. Most of the system acceleration power rates were tested higher than the bar acceleration power, especially in the jerk phases. In the clean (pull on the chest) phase, the bar acceleration power is approximately the same as the whole system acceleration one. The pressure center travel trajectory pattern was virtually the same in the sample, with relatively wide individual variations in the phase-specific shifts of the pressure center. The pressure center shifts were tested the largest in the preliminary acceleration and transition phases.

Keywords: *weightlifting technique, exercise phasing, bilateral video captures, dynamometry, clean-and-jerk biomechanics, ground response, mass center, pressure center, horizontal force.*

Background. Bar weight, inertial forces in the lifting sequence and ground response may be defined the key external forces controlled by weightlifters. Knowledge of the relevant movement biomechanics with variations depending on the weight class, gender, age and some other factors is critical for the progress and training process efficiency management purposes. Training system improvement efforts should give a high priority to the progress tests with biomechanics analyses in the training and competitive processes that need to generate informative and dependable technical and physical fitness test rates [2].

Objective of the study was to profile and analyze the ground response and bar control biomechanics for classical clean-and-jerk style in weightlifting sport.

Methods and structure of the study. We used for the purposes of the study the Russian State University of Physical Education, Sport, Youth and Tourism–2012 biomechanics test system to rate the technical and speed-strength fitness of the sample [1, 3]. The test technology applies two Canon SLR cameras (Japan-made) rated at 50 snapshots per second; and Ristler dynamometer platform (Switzerland-made) with L-Card 1000 Hz analog-to-digital converter unit and a synchronization system. The bilateral video capturing technology registers the bar butt movement trajectory to obtain the bar mass center movement kinematics and dynamics plus its rotation versus the vertical and sagittal axes. The dynamometric test platform registers the ground response vectors to calculate the pressure center coordinates and profile the athlete-plus-weight system joint mass center travel kinematics and dynamics. Operations of both test technologies were harmonized by a synchronization system with a special software toolkit.

We sampled for the tests junior weightlifters (n = 12) from Olympic Reserve School #2 in Moscow qualified Class I to MS, with the sample being 17.2±1.9 years old, 69.9±16.1 kg heavy and 1.68±0.1 m tall on average. The athletes executed clean-and-jerk exercise in the tests with the weighs rated at 85–95% of the individual maximums i.e. 102.2±23.1 kg on average. The ground responses and bar control biomechanics were profiled and analyzed with the movement sequence classified into periods and phases as described in our prior study [5].

Results and discussion. As demonstrated by the clean-and-jerk movement phasing analysis, the prior pull (acceleration) and full-contact sub-squat phase is the longest and the transition (flipping) phase is the shortest in the whole sequence. It should be noted that the best competitors were tested with a longer transition phase (r = 0.65) and a shorter full-contact sub-squat phase (r = −0.95). In addition, we found a negative correlation of the aerial dip-and-split (dive) and final acceleration (drive) phases with the competitive success rate.

As demonstrated by the video-captured bar mass center travel profiles and the athlete-plus-weight system joint mass center pressure center profiles produced by the dynamometer platform, the absolute and relative vertical force vectors exceed the forces on the bar in every phase of the movement sequence. As for the horizontal force, the maximal force on the bar at the start of the final acceleration (drive) phase is almost six times higher than the horizontal force of the ground response. This force is applied to drive the bar mass center along a curved line. It should be noted that the maximum of the relative horizontal force on the bar negatively correlates with the clean-and-jerk competitive success rate (r = −0.88).

In the final acceleration phase in the clean sequence, the maximal vertical forces on the bar and ground response were found to positively correlate with the clean-and-jerk competitive success rate. The same applies to the jerk phase.

Analysis of the forces applied by the athletes to drive the bar and pressure rates of the whole system showed the absolute vertical forces being statistically meaningfully correlated with the competitive success rate, and this is particularly true for the dive and drive phases on the jerk, with the only exception for the average acceleration rate for the whole system.

On most of the test scales, the power applied by the athlete to accelerate the system is higher than the bar acceleration power, particularly in the jerk phase. The force to pull the bar on the chest is virtually the same as the whole system acceleration force. It should be mentioned that the applied forces are highly individual, with the variation rang of 13.6% to 42.3%.

The revealed regularities of bar travel dynamics largely coincide with findings of our prior tests timed to competitions [4]. The dynamometric platform made it possible to obtain a wide range of the technical and physical fitness test rates to complement the current biomechanical test service. Of special interest in this context were the pressure center travel data for the clean and jerk phases, all the more that we could not find experimental data in the available study reports on the issue.

In the clean (bar pull on chest) phase, the pressure center travel trajectory was found virtually the same for every athlete. Given on Figure 1 hereunder is the typical pressure center travel trajectory; and Table 1 gives the pressure center profiling data classified for three clean and two jerk phases, with the positive and negative values indicative of mass center movement towards the toes and heels, respectively.

Given on the left side of Figure 1 are the force, speed, power and pressure center movement coordinates; vertical lines mark the pull phases; athlete's movement prior to the jerk phase is given in the middle; and the bar mass center travel trajectory on the right.

At the start of the preliminary acceleration phase, the pressure center moves towards the toes by 2.6±1.5 cm on

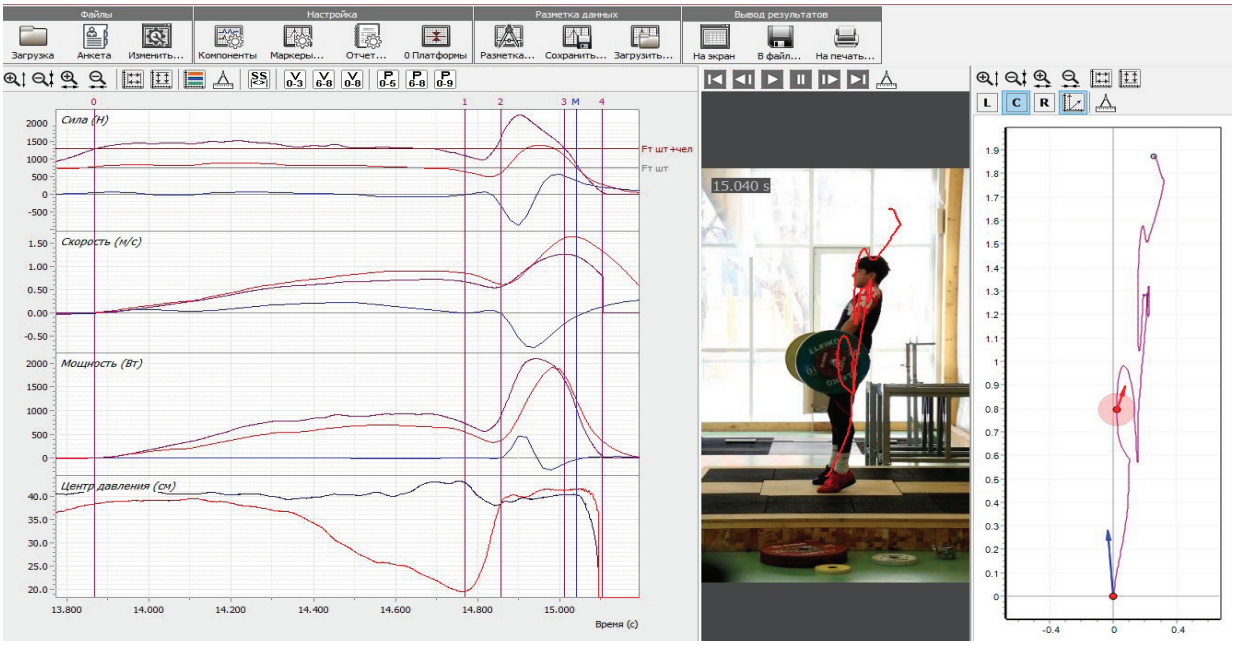

Figure 1. *Clean (pull on the chest) kinematics and dynamics profiling test data*

Table 1. *Pressure center travel trajectory in the clean-and-jerk sequence and its correlation with the competitive success rate*

Test phases	Mean arithmetic	Mean square deviation	Variation ratio	Correlation ratio
Clean (bar pull to the chest)				
Start of the prior acceleration phase, cm	2,6	1,5	57,7	–
End of the prior acceleration phase, cm	–14,3	6,8	47,6	0,59
Transition phase, cm	13,8	5,6	40,6	–
Final acceleration phase, cm	5,3	5,2	98,1	–
Jerk (dive and drive off the chest)				
Dive, cm	8,9	3,0	33.7	–
Drive, cm	2,5	2,1	84.0	–0,57

average. Then the direction is reversed with the pressure center shifted towards the heels by 14.3±6.8 cm (segment 0–1 on the Figure). The body mass center shifts to the heels, and the bar mass center moves toward the body. The pressure center movement at the end of the preliminary acceleration phase is point-centered (r=0.59).

In the transition phase (interval 1–2), the pressure center moves towards the toes by 13.8±5.6 cm, with the body mass center moved to the toes, with the bar mass center still moving towards the athlete's body. In the final acceleration phase (interval 2–M), the pressure center continues moving towards the toes by 5.3±5.2 cm on average, and the bar mass center moves from the athlete's body. It should be noted that the individual phase-specific test rates vary in a wide range.

In the jerk (dive and drive) phase, the pressure center moves towards the toes, with the largest shift of 8.9 ± 3.0 cm in the dive and slow-down phases. In the drive phase, the pressure center amplitude is much lower and negatively correlates with the clean-and-jerk competitive success rate (r = –0.59). That means that the higher skilled and successful athletes are less likely to shift to the toes in the jerk phase.

Conclusion. The study analyzes the key phases of the clean-and-jerk sequence versus the competitive success rates in the new clean-and-jerk style phasing system. The analyses made it possible to find additional informative dynamic characteristics to rate the individual technical and speed-strength fitness based on the ground response force rating tests. Absolute and relative vertical ground response force vectors were found to significantly exceed the forces applied to the bar in every movement phase. Thus the maximal horizontal bar force vector at the start of the final acceleration phase was tested almost six times higher than the ground response force gradient. Most of the system acceleration power rates were tested higher than the bar acceleration power, especially in the jerk phases. In the clean (pull on the chest) phase, the bar acceleration power is approximately the same as the whole system acceleration one. The pressure center travel trajectory pattern was virtually the same in the sample, with relatively wide individual variations in the phase-specific shifts of the pressure center. The pressure center shifts were tested the largest in the preliminary acceleration and transition phases.

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EFFECTS OF VERBAL INFORMATION ON THE PROCESS OF LEARNING ROUND-OFF – DOUBLE SALTO BACKWARD TUCKED DURING BEAM DISMOUNT

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Annotation

Abstract. Objective. To study the effects of two different types of verbal guidance in the process of learning a complex gymnastic routine known as round-off – double salto backward tucked during beam dismount (RDSBT).
Material and methods. Skilled female artistic gymnasts (n = 16) participated in the study. Their average indices of height, body mass and age ($x \pm \delta$) were as follows: 157.5 ± 2.85 cm; 51 ± 2.25 kg; 20 ± 2.35 years, respectively. Based on biomechanical measurements, the key elements of sports technique of RDSBT were determined. A pedagogical experiment was carried out to assess the efficiency of learning and refining RDSBT using two types of verbal guidance. The subjects (n = 16) were randomly divided into experimental (E) (n = 8) and control (C) (n = 8) groups. In the process of learning, female athletes from the experimental group (E) received immediate verbal information about faults committed in the key elements of the mastered motor task, whereas those from the control group (C) obtained the same type of information about all the errors made during the performance of round-off – double salto backward tucked during beam dismount.
Results. Statistically significant differences were revealed between average results of groups E and C ($F(2, 28) = 12.530$, $p < 0.05$) in all the tests in favour of group E. Differences between average results of each group both before and after the experiment as well as in the retention test were statistically significant ($p < 0.05$).
Conclusions. The obtained results demonstrate that a wealth of immediate verbal information conveyed by the coach about technical faults committed by female gymnasts negatively affects the process of motor task learning. At the same time, verbal information passed on to the gymnast by the coach concerning errors in the key elements of sports technique (critical signals) contributes to a more efficient solution of the motor task. The limitation of corrective actions only to the key elements of the motor task, which are designed to trigger a sequence of motor tasks, produces significantly better learning outcomes in a complex task.

Keywords: *female gymnasts, feedback, kinematic structure, sports technique, exercise phases, focal elements.*

Introduction. The current state of knowledge on learning and improving motor tasks, especially in disciplines with complex sports technique does not fully meet the needs of elite athletes [1, 4, 7, 10, 13, 14]. The complexity of performing single exercises and whole gymnastic routines has increased significantly in recent years, especially in artistic gymnastics. Many authors [1, 3, 5, 8, 11, 12, 14] point out the need for deep knowledge of technology fundamentals as well as modeling its individual forms and acquisition of skills necessary for efficient and stable participation in competitions. This necessitates constant transforming and improving exercise technique, designing individual elements and creating new variants of their execution. According to experts [1, 2, 6, 10, 12, 14], specific elements of performed exercises often go unnoticed during training sessions, whereas they are frequently the basis for performing exercises and routines with a greater degree of complexity. Recommendations are offered for a detailed study of the phase structure of gymnastic exercises and identification of their key elements [2,5,9,10,13]. This approach is confirmed by the results of the study by Gervaisa, Dunn [8]. The authors came to the conclusion that gymnasts, "feeling the limits of movement", achieved e.g. better results while performing a double salto backward dismount from parallel bars. King, Yeadon [9] also claim that while performing salto forward, it is more important to assume a proper body position (key element) precisely in time than to use maximum force when pushing off. The foregoing indicates the complexity of the issue of learning gymnastic routines [1, 2, 5, 6, 11, 12, 14]. It has been established that learning

gymnastic exercises with a complex coordination structure of movements should be carried out with an emphasis on biomechanical and didactic assessment of exercise phases (key elements) followed by subsequent development of learning and mastering technologies. Corrective actions of the coach being especially effective when individualized in relation to gymnasts may be considered as the most common means of optimization of motor learning in training settings. It is no less important that the volume of corrective guidance corresponds to the complexity of the motor task. The efficacy of motor learning is much higher when gymnasts receive immediate information about the quality of task execution. In sports training settings, corrective guidance is provided in a number of methodological procedures, among which verbal instruction occupies a central position. Determination of the content, form and speed of verbal information reception by gymnasts still remains the actual problem in learning and mastering complex gymnastic exercises [10]. Many authors have shown that limiting the amount of information to the quality of key element execution is more effective in the process of learning than providing a large amount of information. Too much information hampers the athlete from using intrinsic sources of information about the quality of the performed motor task. There is a scarcity of empirical data on the efficiency of various types of verbal guidance in learning and mastering gymnastic routines.

Objective of the research was to study the effects of two different types of verbal guidance in the process of learning a complex gymnastic routine, i.e. round–off – double salto backward tucked during beam dismount.

Tasks. 1. To measure biomechanical indices of the key elements of sports technique of round–off – double salto backward tucked during beam dismount.

2. To study the influence of two different types of verbal guidance in the process of learning round–off – double salto backward tucked during beam dismount.

Methods of study. Skilled and highly skilled female gymnasts took part in the study. Their average indices of height, body mass and age (x ± δ) were as follows: 157.5 ± 2.85 cm; 51 ± 2.25kg; 20 ± 2.35 years, respectively. They were randomly divided into experimental (E) (n = 8) and control (C) (n = 8) groups. Prior to the study, the differences between groups were insignificant ($p > 0.05$).

1. Performance of round–off – double salto backward tucked during beam dismount was video recorded with two digital video cameras JVS 6R–DVL 9800 NTSC (240 frames per second, 3% measurement error) in order to determine the key elements. The APAS 2000 computer program (Ariel Dynamics Inc.) was used to analyze joint angles of the gymnasts during round–off – double salto backward tucked during beam dismount with the task to perform steady landing, to determine velocities and accelerations of the ankle, knee, hip, shoulder, elbow and wrist joints as well as the GCM of the body, to analyze the supported and airborne body postures and positions and the duration of individual phases of round–off – double salto backward tucked during beam dismount.

2. The efficiency of using two types of verbal guidance was determined experimentally. After completing the task, subjects from group E received information about errors committed in key elements and how to correct them in a subsequent attempt. Other errors were ignored. Participants from group C received information about all committed errors in each attempt and how to correct them (100% feedback). The approach used in group C is typical under conditions of gymnastic training sessions. Each of the two options was assessed on the basis of three tests before and immediately after the training process, as well as 6 days after its completion. Three highly competent gymnastics judges (n = 3) evaluated technical fitness of the gymnasts. Consistency of experts' opinions was determined using concordance coefficient (r = 0.865). In the process of training, gymnasts made 240 attempts of round–off – double salto backward tucked during beam dismount. The procedures were designed and followed according to the Declaration of Helsinki, and they were approved by the Research Ethics Committee at Jyzef Piłsudski University of Physical Education in Warsaw.

The statistical analysis methods applied in the study, i.e. the normality of distribution and homogeneity of the deviation were verified with the Shapiro–Wilk test. Differ–

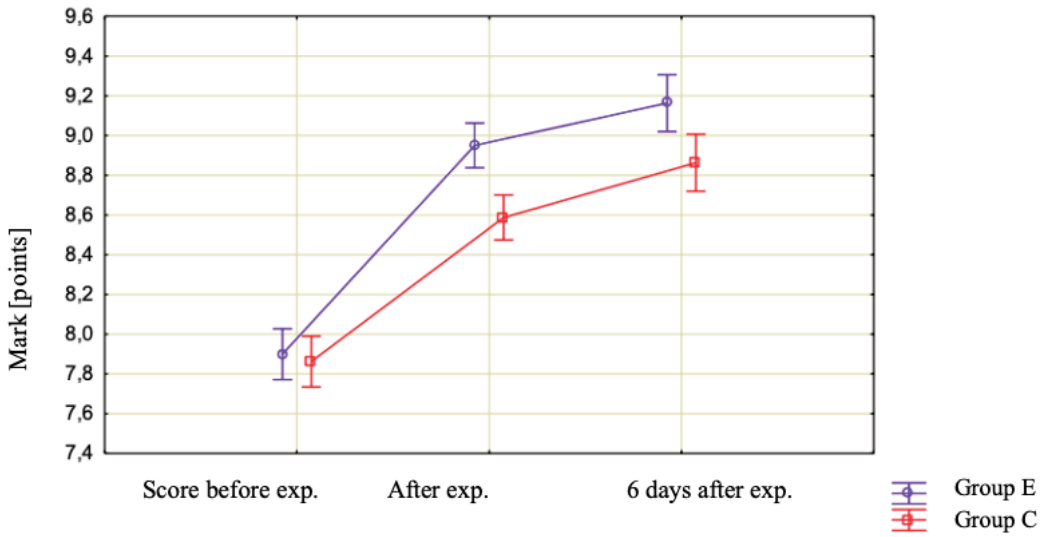

Figure 1. *Group average scores of round-off – double salto backward tucked during beam dismount*

Table 1. *Significance of differences*

Test	Group	{1} 7.9000	{2} 8.9500	{3} 9.1625	{4} 7.8625	{5} 8.5875	{6} 8.8625
Before	E		p<0.05	0.000000	0.662214	0.000000	0.000000
After	E	0.000000		0.000158	0.000000	0.000300	0.312672
6 days after	E	0.000000	0.000158		0.000000	0.000001	0.001814
Before	C	0.662214	0.000000	0.000000		0.000000	0.000000
After	C	0.000000	0.000300	0.000001	0.000000		0.000005
6 days after	C	0.000000	0.312672	0.001814	0.000000	0.000005	

ences in the application of the two types of verbal guidance were determined with ANOVA. The probability level $p < 0.05$ was used as critical. To reveal significant intergroup differences, the Fisher's test was employed. Statistical analysis of the results was carried out using the STATISTICA computer software package (version 12.0).

Results of study. Learning efficiency was determined on the basis of an average score of three experts. Differences in the effects of learning and mastering the performance of round-off – double salto backward tucked during beam dismount (Fig. 1) were revealed. Participants from group E received information only on those key elements in which they completed the task with technical errors (other errors were ignored within the acceptable range). Gymnasts from group C received information about all errors.

Statistically significant differences were revealed between the average results for groups E and C ($F(2, 28) = 12.530$, $p = 0.00013$) (Table 1).

It was noted that the differences in the average scores for motor task performance between both groups were statistically insignificant ($p > 0.05$) before the experiment. After the experiment, the differences between the groups in three tests were statistically significant ($p<0.05$) in favor of group E. This indicates that in the process of learning round-off – double salto backward tucked during beam dismount, highly skilled gymnasts require less information. Therefore, the coach and athletes should mainly focus on a proper execution of key elements of round-off – double salto backward tucked during beam dismount, i.e. the preparatory phase, the launching posture, the main phase, the multiplication of body postures, and the final phase (landing) [5,6]. It was the experimental group (E) that received verbal information about errors committed in key elements of sports technique only. Gymnasts from the control group (C) received verbal information on all errors in the performed task, which produced negative learning outcomes.

Conclusion. In the process of motor learning of a complex gymnastic routine, the impact of the coach's remarks on the athlete may lead to both positive and negative effects. One of the factors that influences learning efficiency is the knowledge of performance or the knowledge of results. According to the guidance hypothesis, 100% feedback leads to an improvement in performance immediately after completion of the learning process but it results in the deterioration of performance during the retention test, as opposed to those who received verbal guidance in a smaller volume [15]. The work of Niźnikowski, Sadowski [6] reveals fundamental biomechanical indices of the kinematic structure of round-off – double salto backward tucked during beam dismount and identifies the key elements in the exercise phases that serve the function of signaling postures, boundary body positions, which promote effective motor tasks, including motor connection or junction of exercise phases. In view of this, the objective of the work was to study the efficiency of learning this complex motor task with the utilization of two different types of verbal guidance. The first of them, used in the experimental group, was aimed at correcting errors committed by female gymnasts in the key elements of sports technique; the other type, which focused on correcting all technical errors, was used in the control group. A positive (significant) result was observed when the coach and gymnasts put an emphasis on the correction of technical errors in the key elements of the motor task. The results turned out to be better in the experimental group, in which the scope of verbal information was significantly limited compared to the control group. It seems that a large amount of information led to excessive irradiation of excitation and inhibition processes in the central nervous system, which reduced the quality of the formation of motor task kinematic structure. Our results confirm the guidance hypothesis [15]. In this regard, it is necessary to attract the attention of coaches, female athletes and specialists to the development of such training programs that allow accentuating performance stability of technique of key elements in the process of learning, since they are the foundation for qualitative fulfillment of an integral task. In the course of learning complex motor tasks by highly skilled female gymnasts, one should avoid too detailed information, the extent of which may exceed the athlete's ability to process it, thus resulting in hampering the learning process.

Conclusions

1. One of the ways of optimizing technical preparation of those engaged in artistic gymnastics is to increase the efficiency of learning gymnastic routines at the expense of reducing the amount of verbal guidance regarding errors committed in the process of motor task learning.

2. Verbal information about errors in the key elements of sports technique conveyed to a gymnast by her coach contributes to a more effective solution of the motor task aimed at improving the kinematic structure of round-off – double salto backward tucked during beam dismount. At the same time, the amount of verbal information provided by the coach about all the technical errors committed during exercise performance negatively affects the process of sports technique mastering, in particular the process of learning motor tasks.

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ACUTE INFLUENCE OF LOADED JUMP SQUAT TECHNIQUE ON KINETIC VARIABLES IN TRACK AND FIELD ATHLETES

UDC 796.012

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Annotation

Abstract. Muscle ability to generate a high amount of maximal power is of paramount importance for effectiveness across different sports. Although the jump squat is a common explosive exercise and well described in strength and conditioning literature, the issue of the technique of the consecutive jumps has been rarely discussed in the research. The present study compares the kinetic variables during the performance of the jump squat using two different jumping techniques. Ten male university semiprofessional athletes (aged 22.5±2.5 years; body weight 76.0±4.9 kg; body height 1.79±0.05 m) performed 1 set of 10 squat jumps with the barbell (20 kg) on their shoulders under two conditions in a counterbalanced order: jumps with the feet in a natural position in plantar flexion (NTO), and jumps with the feet in active dorsiflexion (ATO). The results demonstrated that the NTO created a significantly lower value of vertical force (p=0.001) when compared with the ATO condition. The NTO condition also resulted in significant (p=0.001) less peak power than the ATO. The findings suggest that the use of the jump with active dorsiflexion of the feet during the loaded jump squat may enhance the maximal force and power production.

Keywords: *power, impact forces, landing, explosive exercise.*

Introduction. It is well accepted that muscular ability to generate power output determines performance in many sports, especially in those which involve jumping or sprinting actions [1, 2]. Maximal power performance requires a composite of the number of components that may enhance the athletes' ability to force production during a given movement. A combination of heavy weight strength training and explosive exercises that involve higher velocity movements are suggested to be an optimal training modality [1]. The jump squat with an external load is an example of an explosive exercise that is widely used in optimizing a power output [3]. It typically consists of the single or multiple consecutive vertical jumps with a bar across the shoulder. It has been reported, that the value of the applied load in jump squat mostly ranges from 0% to 60% of one-repetition maximum [4, 5]. Other research focused on quantifying a landing technique, particularly in terms of the athlete's capability to absorb the ground reaction forces [6].

Jumping and landing strategies are particularly important in terms of power production and distribution. Even small differences in movement kinematics may affect a lower extremity stiffness, the efficacy of storage and utilization of elastic energy, and in consequences a power output [7]. In sports practice, execution of the jump squat is often limited to control the depth of the squat position or the tempo of the exercise. There is a lack of studies evaluating the optimal take-off technique of the jump squat in terms of power production. Researchers describe the optimal jump squat performance as a powerful knee and hip extension with a preferred landing technique i.e. toe landing first (forefoot) or heel landing (rear foot) first, depending on the jump type [7]. However, the studies on the jump squat seek crucial movement aspects in a single performance which are not followed by a consecutive jump, rarely focus on the take-off foot action.

Objective of the study: was to compare the effects of two jumping techniques on kinetic variables in athletes.

Research methods and organization. Ten male university athlete students (aged 22.5±2.5 years; body weight 76.0±4.9 kg; body height 1.79±0.05 m) were volunteered to participate in this study. All subjects were sprinters and jumpers with at least 4 years of experience in strength and power training. Before the start of the experiment, all subjects were informed of the purpose of the study, and their written informed consent was obtained.

Prior to the investigation, all subjects completed a familiarization session in which they have watched an instructional video and were instructed how to perform the jump squat exercise using two techniques. The first technique involved jumps with the feet in a natural position in

plantar flexion (NTO), and the second, consisted of jumps with the feet in active dorsiflexion (ATO). The video was presented in the sagittal and frontal planes and played back at slow and real speed conditions to pay attention to the key elements of the performance of these tasks.

A standardized 20–minute warm–up was allowed including general and specific exercises. After that participants completed 1 set of 10 squat jumps with the barbell on their shoulders (20 kg). The participants received an 8–minute passive break between the execution of the given condition. The order of the conditions was randomized and counterbalanced. All kinetic data were recorded using a piezoelectric force plate (Kistler 9281E, Switzerland) and collected with the BioWare software. The following dependent variables were analyzed: peak power, vertical ground reaction forces, and horizontal ground reaction forces. Normality was checked via the Shapiro–Wilk test. A Student t–test was conducted to assess the statistical significance of the differences between variables. The $p<0.05$ level of significance was set for the statistical analyses.

Results and discussion. The mean values of kinetic variables in the squat jump exercise for two conditions are presented in Table 1. We found significant differences in the vertical ground reaction forces and peak power between take–off techniques. The NTO created a significantly lower value of vertical ground reaction forces ($p=0.001$) when compared with ATO condition. The NTO condition resulted in significant ($p=0.001$) less peak power than ATO. No significant differences were observed between conditions in the horizontal ground reaction forces ($p>0.05$).

The vertical ground reaction forces and peak power during ten consecutive squat jumps in conditions are presented in Figure 1, and Figure 2, respectively. The significantly higher values of vertical ground reaction forces were observed at 4–6th, and 8–10th jump in ATO compared with the NTO condition. The peak power was significantly higher in ATO when compared to NTO at 6, 7, and 10th jump. Additionally, there was a tendency for greater reductions in vertical ground reaction forces, and peak power values after the performance of more than 7 jumps in each condition.

Conclusions. The results of this study indicate that the higher peak power during a loaded jump squat exercise may be achieved through the use of the jump with active dorsiflexion of the feet when compared to plantar flexion of the feet. This jumping technique also resulted in the greater vertical ground reaction forces relative to a condition where the feet are in a natural position in plantar flexion after the take–off. The jumps with the feet in a natural position in plantar flexion probably result in a softer landing where a hip and knee joints absorb ground reaction forces. Softer landing technique is considered to be more responsible for the kinetic energy dissipation of the lower extremities muscles [6]. In turn, jumps with the feet in active dorsiflexion are more similar to the heel–toe landing technique where an ankle joint dominance provides a stiffer landing [7]. In that regard, coaches and practitioners should rather choose a take–off technique with the feet in active dorsiflexion when an increase in power output is desired. However, this strategy should also be carefully applied due to a possible increase in muscle stiffness, which may induce a higher risk of the lower extremities injuries [8].

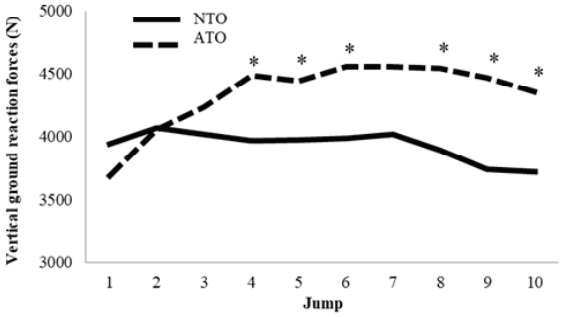

Figure 1. *Mean values (±SD) of vertical ground reaction forces during ten consecutive squat jumps in both conditions (ATO, NTO). *significant difference*

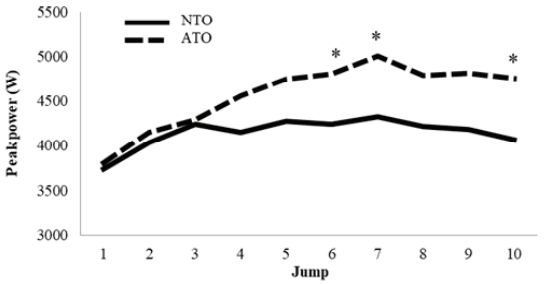

Figure 2. *Mean values (±SD) of peak power during the ten consecutive squat jumps in both conditions (ATO, NTO). *significant difference*

Researchers indicate that in the traditional set structure performance of the multiple repetitions of the loaded jump squat may affect a drop in the power output [4, 9]. Therefore, when attempting to maximize the development of power it is suggested to use less than 6 repetitions in a set [4,9]. We found that independently of the jump take–off technique applied in this investiga–

Table 1. *Kinetic measures (M ± SD) of vertical ground reaction forces (Fz), horizontal ground reaction forces (Fx), and peak power (Pz) in squat jump performance for both conditions (ATO, NTO).*

	Take-off technique		p value
Kinetic variable	ATO	NTO	
Fz (N)	4337.0±704.8	3936.20±843.4	**0.001***
Fx (N)	16.6±4.74	16.10±4.72	0.25
Pz (W)	4749.7± 801.3	4222.20±1141.0	**0.001***

*Significant differences between the NTO and ATO at $p\leq0.05$

tion, a performance of 7 repetitions in one set of loaded jump squat appears to be an optimal volume, which does not cause a reduction in the power production. However, this assumption should be viewed with caution because the presence of a decrease in peak power was not statistically significant.

Practical applications. Strength and conditioning coaches are encouraged to pay attention at the take-off technique during a consecutive loaded jump squats performance. The findings of this study showed that slight changes in flexion-extension action of the feet during jump may result in considerable changes in peak power, and ground reaction forces.

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VOLITIONAL SELF-CONTROL AS COMPETITIVE SUCCESS FACTOR IN TAEKWONDO

UDC 159.947

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Annotation

Objective of the study was to rate and analyze volitional self-control correlation with the competitive performance in the 11-12 year old taekwondo groups.
Methods and structure of the study. Sampled for the study were teenage taekwondokas (n=50) from Sports School No. 2 in Elabuga Municipal District, Republic of Tatarstan, split up into the actively competing Experimental Group (EG, n=25) including winners and runner-ups of the national and Republican competitions; and Reference Group (RG, n=25) of their non-competing although actively trained peers. The study was run using the following common research methods: theoretical analysis of the problem; and empirical test and survey methods including the T. Ehlers Motivation to Success Test; A.V. Zverkova and E.V. Aidman Volitional Self-Control Test method; C.D. Spielberger State-Trait Anxiety Inventory (with the state and trait anxiety tests in the Russian version adapted by Y.L. Khanin); plus a standard statistical test data processing toolkit.
Results and conclusions. The study data and analyses found the key volitional qualities including perseverance and overall self-controls being highly developed in the 11-12 year-old taekwondo sample, with insignificant (by the Student t-criterion) intergroup differences found between the actively competing and non-competing athletes; although the latter were tested with a insignificantly higher self-restraint qualities. Success motivations were tested higher in the actively competing group, although it was found more exposed to state anxiety – including the one triggered by the psychological test procedure. Active competitive schedule, as we found, appears to step up the competing group's success motivations albeit suppress the self-restraint capacity (r=0.46). It should be emphasized that adolescents are highly sensitive to emotional impacts due to the age-specific hormonal transformations, and this may be the reason why the individual volitional self-control qualities are still of little contribution to their competitive progresses. Their success motivations were found dominated by external factors of influence including the trainer's appreciation, support from families, peer recognition etc., rather than the background volitional self-control qualities as such.

Keywords: *volitional self-control, success motivations, competitive performance, taekwondoka.*

Background. Modern sports psychology ranks volitional self-controls among the key factors of influence on the competitive progress and accomplishments (G. D. Babushkin, 2012; A.V. Batarshev, 2014; V.A. Ivannikov, 2014; E.P. Ilyin, 2012; L.I. Lubysheva, 2010). Sporting careers in their turn are believed to facilitate the personality progress in social integration, self-assertion and willpower development aspects [5]. Willpower – that may be interpreted as the conscientious behavioral self-control capacity – contributes to the individual ability to meet challenges and make solutions on the way to success. Volitional self-control helps cope with the internal and external barriers for progress and take and implement the progress solutions. As defined by V.A. Ivannikov, volitional self-control is the independent personality self-regulation mechanism with the relevant behavioral control toolkit [2].

Volitional self-control is known to be age-specific, with the adolescent volitional self-control, as reported by G.D. Babushkin, fast progressing with age in every volitional quality, self-assertion and self-management aspect [1]. Furthermore, E.P. Ilyin considers every personality quality, including volitional control, a phenotypic characteristic of the individual available mental resource, a sort of alloy of the inborn and acquired qualities; with the inborn resource composed of the natural congenital abilities and the acquired resource of those developed in the individual ontogenesis based on the accumulated experience [3]. For a competitive progress in modern sports, one have to develop high perseverance, self-control, courage, psychological fitness with the must-win agenda and the ability to mobilize the individual resource to attain every progress goal [4].

Objective of the study was to rate and analyze volitional self-control correlation with the competitive performance in the 11–12 year old taekwondo groups.

Methods and structure of the study. Sampled for the study were teenage taekwondokas (n=50) from Sports

School No. 2 in Elabuga Municipal District, Republic of Tatarstan, split up into the actively competing Experimental Group (EG, n = 25) including winners and runner-ups of the national and Republican competitions; and Reference Group (RG, n = 25) of their non-competing although actively trained peers. The study was run using the following common research methods: theoretical analysis of the problem; and empirical test and survey methods including the T. Ehlers Motivation to Success Test; A.V. Zverkova and E.V. Aidman Volitional Self-Control Test method; C.D. Spielberger State-Trait Anxiety Inventory (with the state and trait anxiety tests in the Russian version adapted by Y.L. Khanin); plus a standard statistical test data processing toolkit.

Results and discussion. Tests of perseverance ranked among the key personality motivational-volitional components found insignificant intergroup difference ($p = 0.96$), with the EG and RG rated 84% and 88% high (and 16% and 12% low) on the perseverance scale, respectively. Dominance of the high perseverance test rates in both of the groups may be due to the coaches being equally demanding to every athlete in the willpower development aspects.

Furthermore, 32% and 12% of the EG and RG were rated low (and 68% and 88% high) on the self-restraint test scale, respectively, with the RG showing a statistically insignificant ($p = 0.048$) advantage. The somewhat lower standing of the EG may be due, as we believe, to the group being more exposed to the competitive stressors of detrimental effect on the volitional self-control standards. This assumption was verified by the strong correlation ($r = 0.46$) between the state anxiety and self-restraint in the sample on the whole ($n = 50$). The EG competitive progress was tested somewhat more sensitive to uncertain situations (thus the state anxiety in the EG was found increased by the psychological test procedure). The non-competing RG was tested less exposed to the state anxiety i.e. a bit higher on the self-restraint scale.

92% and 80% of the EG and RG were tested high (and 8% and 20% low) on the self-control test scale, with the intergroup difference being statistically insignificant ($p = 0.3$). The basically high standings of both groups on the scale may be due to the fact that modern taekwondo is the highly competitive full-contact sport discipline that requires perfect volitional self-controls and fighting spirit for competitive success.

On the motivation to success test scale, 56% and 20% of the EG and RG were tested high (and 44% and 80% low), with the intergroup difference rated statistically significant ($p = 0.011$). This means that the actively competing and winning athletes appear to be more motivated than the non-competing ones. Standing aloof from active competitions, the RG has little if any means to objectively test the own qualities, skills and resources in real bouts and, hence, its success motivations may show regress with time.

On the state anxiety test scale, 88% and 12% of the EG were tested with moderate and expressed state anxiety, respectively; and 0%, 56% and 44% of the RG with the expressed, moderate and no state anxiety, respectively; with the intergroup differences rated statistically significant ($p \leq 0,001$). It should be emphasized that the test process as such was found to spur up the state anxiety in the EG. As for the trait anxiety, it was tested moderate in 84% and 92% of the EG and RG, respectively, with the intergroup difference rated statistically insignificant.

We believe that willpower in the adolescent period is formed mostly in the training process and this is the reason why no significant differences could be found between the actively competing and non-competing athletes. Success motivations of the actively competing group are explainable by rather the external factors of influence than the congenital volitional self-control levels – as verified by the Pearson correlation analysis of the success motivations versus the willpower test rates. The study data appear to demonstrate the age-specific competitive progress agendas being determined mostly by the external factors of influence (including the trainer's appreciation, support from families, peer recognition etc.) than the background volitional self-control qualities as such.

Conclusion. The study data and analyses found the key volitional qualities including perseverance and overall self-controls being highly developed in the 11-12 year-old taekwondo sample, with insignificant (by the Student t-criterion) intergroup differences found between the actively competing and non-competing athletes; although the latter were tested with a insignificantly higher self-restraint qualities. Success motivations were tested higher in the actively competing group, although it was found more exposed to state anxiety – including the one triggered by the psychological test procedure. Active competitive schedule, as we found, appears to step up the competing group's success motivations albeit suppress the self-restraint capacity ($r = 0.46$). It should be emphasized that adolescents are highly sensitive to emotional impacts due to the age-specific hormonal transformations, and this may be the reason why the individual volitional self-control qualities are still of little contribution to their competitive progresses. Their success motivations were found dominated by external factors of influence including the trainer's appreciation, support from families, peer recognition etc., rather than the background volitional self-control qualities as such.

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FUNCTIONAL STATE OF MIDDLE-DISTANCE RUNNERS IN TERMS OF TRAINING CORRECTION

UDC 796.422.1

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Annotation

Objective of the study was to detect changes in the functional state of middle-distance runners in terms of correction of training influences.
Methods and structure of the study. Sampled for the study were 30 track and field athletes specializing in middle-distance running, who were divided into the Experimental (EG) and Control (CG) Groups, 15 people each. All athletes attended the sports school "Yar Chally" in Naberezhnye Chelny. The study was carried out in three stages: the first stage was conducted in September-October, second - in January-February of the winter competitive stage, third - in May of the pre-competitive stage. For the purposes of the study, we applied the hardware methods focused on the analysis of the athletes' functional state: autonomic nervous system (ANS), cardiovascular system, nervous and muscular systems, overall physical fitness and aerobic capacities, psychofunctional state.
Results and conclusions. The study revealed a positive trend in the subjects' functional state rates, manifested in a statistically significant increase in the following indicators: physical working capacity (PWC170 increased by 4.56% at the 3rd stage of the study), psychofunctional state (accuracy of the reaction to a moving object = 11.57±0.51 ms)), contractile and relaxation muscle properties (arbitrary relaxation rate increased by 31.55%, arbitrary contraction rate - by 12.45%), aerobic characteristics, functional and reserve capacities of the body (aerobic metabolic capacity improved by 2.52%, anaerobic metabolic capacity - by 2.43%), mechanisms of cardiac function regulation (tension index increased by 4.28%) and competitive performance rates (the result in the 800 m run improved by 3.24%, in the 1,500 m run - by 1.63%).
The compositional arrangement of training loads of different orientation leads to the effective functioning of the entire body system of the runners.

Keywords: *functional state, middle-distance runners, correction, training effects.*

Background. A considerable interest lies in the issue of improving the process of functional training of middle-distance runners. Specialists consider athletes' functional state as a basis of efficiency of their physical working capacity and potential capabilities of the cardiovascular system.

Yu.S. Vanyushin [1] studied the athletes' functional fitness through the types of adaptation of their cardiorespiratory system under the stepwise increasing load. Yu.V. Vysochin et al. [2] provided a physiological substantiation of the effectiveness of competitive activities of football players based on their functional indicators.

In cyclic sports, a number of authors associate runners' functional state with the typological characteristics of their blood circulation system; the need to implement a system of integrated assessment and control of their functional state in the training process; evaluation of the aerobic threshold and potential capabilities of the heart using interval exogenous respiratory hypoxic training [3,4–7].

Some authors conducted a series of studies to determine the effects of training of different intensity on the athletes' functional state. It was shown that high-intensity cyclic trainings increase the tone of the sympathetic division of the autonomic nervous system of highly-qualified athletes while simultaneously inhibiting the activation of the vagal tone in the autonomic nervous system, which is deemed neuroautonomic adaptation to increased physical loads [8]. These data are of some interest in optimizing individual training profiles.

Objective of the study was to detect changes in the functional state of middle-distance runners in terms of correction of training influences.

Methods and structure of the study. The study was carried out at the premises of Volga Region State Academy of Physical Culture, Sport and Tourism, Naberezhnye Chelny. Sampled for the study were 30 middle-distance runners, who were split into Experimental (EG) and Control (CG) Groups, 15 people each. The athletes' functional state

was diagnosed using the following devices and methods: electrocardiograph "Poly–Spectrum–8/EX", polymyography method, heart rate variability (HRV) analysis, PWC170 test, "Express diagnostics of human functional state" developed by S.A. Dushanin using "D&K–TEST" hardware and software complex, "Reaction to a moving object" (RMO) test using "Activaciometer AC–9K" hardware and software complex.

Results and discussion. At the 1st stage of the study, a complete diagnostics of the runners' functional state was carried out using the above–mentioned methods and devices. In the EG, the compositional arrangements of training loads were made: for the runners with the low functional fitness level, the aerobic load was increased to 65%, the mixed one – to 27%; for those with an average functional fitness level, the aerobic load was increased to 55%, the mixed one – to 22%. For the runners having a high functional fitness level, the aerobic load was increased to 35% and the mixed one – to 35%.

The estimation of the subjects' physical working capacity revealed a significant increase in the PWC_{170} test rates in the EG (Table 1).

Particular attention is paid to the peculiarities of heart rate recovery in the EG after the physical loads. The recovery period in both groups became shorter; however, it took the CG runners a longer time to recover from the physical loads.

The average Reaction to a Moving Object test rates are presented in Table 2. By the 3rd stage of the study, the difference between the CG and EG increased.

By the 3rd stage of the study, there was a gradual shift towards the tendency of the Reaction to a Moving Object to preactin the CG and its tendency to delay in the EG with a gradual reduction in the time of variation. This appears to be due to the predominance of excitation processes in the CG and inhibitory processes in the motor zones of the central nervous system in the EG.

By the 3rd stage of the study, the resting heart rate in the EG was less by almost 5% as opposed to the CG, the heart rate variability spectrum power indicators (VLF, LF, HF) decreased, and the total spectrum power increased (Table 3).

By the 3rd stage of the study, the tension index of the regulatory systems increased in the CG and decreased in the EG. Therefore, in the EG there was a gradual shift of the autonomic balance towards predominance of the parasympathetic division.

By the end of the experiment, the capacity characteristics in the EG increased statistically significantly as opposed to the CG: aerobic metabolic capacity (Stage 2 – by 13.32%, Stage 3 – by 2.52%), anaerobic metabolic capacity (Stage 2 – 9.01%, stage 3 – 2.43%), total metabolic capacity (Stage 2 – 11.85%, Stage 3 – 3.64%). The strength characteristics improved too: strength of the creatine phosphate energy supply mechanisms (Stage 2 – 13.42%, Stage 3 – 4.13%), strength of the glycolytic energy supply mechanisms (Stage 2 – 10.94%, Stage 3 – 6.55%), strength of the aerobic energy supply mechanisms (Stage 2 – 7.41%, Stage 3 – 3%), which testifies to the improvement in the aerobic and anaerobic mechanisms of energy supply.

The improvement of the functional state of the neuromuscular system of the EG subjects throughout the study was getting more and more pronounced from stage to stage and in relation to the entire study period.

The integrated assessment of the functional state in the EG at the 3rd stage of the study indicated a significant increase and improvement of the muscle contraction strength and speed with the maximum arbitrary muscle contraction strength increased to 10.33%, the arbitrary muscle contraction speed increased to 12.45%, while the speed of the arbitrary muscle relaxation decreased to 31.55%, as a result of which the overall functional state of the neuromuscular system (FSm, FSnms, FScns) improved.

Besides, we observed certain changes in the athletes' special fitness indicators. In the CG, the indicators improved: 800 m run test – by 3.1%, 1,500 m run test – by 0.81%, 10–fold standing long jump test – by 1.98%, 60 m run test – by 5.17%, standing long jump test – by 3.05%. In the EG, the increase was higher: 800 m run test – by 3.24%, 1,500 m run test – by 1.63%, 10–fold standing long jump test – by 1.37%, 60 m run test – by 3.69%, standing long jump test – by 1.76%.

Conclusion. The experimental technique was found beneficial for the runners' functional state, which was

Table 1. *Increase in physical working capacity rates at the 1st and 3rd stages of study, %*

Stages	PWC170		PWC_{170}rel		MOC		MOCrel	
	CG	EG	CG	EG	CG	EG	CG	EG
2nd	4.93	13.45	3.36	9.35	3.81	9.75	1.54	5.52
3rd	3.18	4.56	2.39	6.48	3.94	13.7	1.35	3.98

Note. MOC – maximal oxygen consumption.

Table 2. *Reaction to a moving object test rates at the 2nd and 3rd stages of study, ms*

Stages	RMO accuracy		Tendency of RMO to delay		Tendency of RMO to preact		Variation range	
	CG	EG	CG	EG	CG	EG	CG	EG
2nd	23.46±1.15	16.60±0.81	19.69 ±0.99	22.68±0.83	21.46 ±0.90	17.54±0.58	68.67±3.22	57.33 ±2.84
3rd	20.36±0.82	11.57±0.51	18.41±0.87	23.44±1.17	21.71 ±0.78	16.91±0.79	68.67±3.22	53.33 ±2.56

Table 3. *Increase in the Reaction to a Moving Object test rates at the 2nd and 3rd stages of study, %*

Stages	Resting heart rate		Total spectrum power		VLF		LF		HF		Tension Index	
	CG	EG	CG	EG	CG	EG	CG	EG	CG	EG	CG	EG
2nd	5.36	10.85	4.3	12.01	17.19	8.07	16.04	0.21	20.97	1.49	5.14	9.79
3rd	1.92	0.86	1.56	8.28	14.44	12.54	35.03	9.65	22.17	10.70	7.85	4.18

manifested in the statistically significant increase in their functional state rates, aerobic working capacity, psychofunctional state, contractile and relaxation muscle properties, functional and reserve capacities of the body, mechanisms of cardiac function regulation and competitive performance rates.

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BONE MINERAL STATUS OF YOUNG CYCLISTS

UDC 796.01:612

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Annotation

The aim of this work was to assess bone mineral content (BMC) and bone mineral density (BMD) in men practicing road cycling at peak bone mass in comparison with men at the same age not practicing sport. Road cyclists, representatives of youth cycling clubs (n=30) aged 21-22 and men of similar age who do not practice sports (n=45) took part in the research. BMC (g) and BMD (g/cm2) in the lumbar spine (L2-L4) were determined with the use of the DEXA method.The analysis of the results showed that the mean values of the determined bone parameters did not differentiate the studied groups. However, tendencies to higher values in the control group were observed. Excessive phosphorus intake was observed in both groups. On the basis of the results obtained it can be concluded that the examined cyclists do not constitute a group of increased risk of developing osteopenia in comparison with men who do not train.

Keywords: *road cyclists, bone mineralisation and density, physical activity, diet.*

Introduction. The majority of studies point to the fact that sports exert an extremely beneficial influence on bone tissue. Compared to adults with a sedentary lifestyle, sports people almost always display greater bone mass (sometimes even by 20–30%) [1,2]. Taking these facts into consideration, the impact of the type of loads on bone mineralisation seems to be the issue that needs further research. It is thought that not every type of physical activity affects BMD in the same manner [3].Based on the above considerations, it may be presumed that, compared to untrained population, athletes who do certain sports may constitute a group with increased osteoporosis risk.

Objective of the study is to make an attempt to answer the question: to what extent cycling is a sporting discipline promoting (or not) an increase in mineralization, in view of the existing controversy about the beneficial impact of cycling on bone tissue.

Material and methods. The study included 75 men in the period of reaching peak bone mass (21–22 years). The study group consisted of cyclists (n=30) and untrained men (n=45). Cyclists belonged to youth cycling clubs.

Body composition, BMC (g) and BMD (g/cm^2) were determined in the lumbar spine (L_2-L_4) with the use of Dual Energy X-ray Absorptiometry (DEXA) on the HORIZON Ci device (USA). Diet composition was assessed based on three individual questionnaire interviews regarding nutrition in the last 24 hours prior to the study. The interviews were carried out by trained interviewers on two weekdays and one day without classes (Sunday) [4]. The project was approved by the Ethics Commission of the University of Physical Education in Warsaw.

Statistical analysis was performed on the basis of one-way analysis of variance (ANOVA) and Tukey's post-hoc tests, where differences at the level of $p<0.05$ were regarded as significant.

Results. The groups under examination turned out to be very similar in body build and body composition. No significant differences were noted in any of the examined parameters. Average values of bone parameters did not differentiate the studied groups. However, tendencies to higher average values of these parameters in the control group were observed in comparison to the group of cyclists. There were no statistically significant differences between the studied groups in diet.

Discussion. Bone mineralisation examinations in athletes are crucial for two reasons. Firstly, such tests help to determine the effects of various sports on the skeletal system, thus contributing to more effective prevention of osteoporosis through identifying sports that exert the most beneficial influence on bone tissue. Secondly, when it comes to changes that may take place in bone tissue as a result of various risk factors, they may occur already at a young age and are most often irreversible [5,6]. Not every type of physical activity connected with doing particular sports exerts a positive influence on bone mass. Activities performed in a sitting position (weight-supporting activities) such as cycling are considered to predispose to the development of bone pathology. It was observed that in the case of road cyclists the bone mineral density was

Table 1. *General characteristics of the examined men ($\bar{x} \pm SD$)*

GROUP	Age (years)	Body Mass (kg)	Body Height (cm)	Fat-Free Body Mass (kg)	Muscle Mass (kg)	Fat Tissue (%)
Cyclists (n=30)	22.1±0.8	76.7±8.9	177.2±5.2	60.3±5.7	62.1 ± 5.7	18.2 ± 5.6
Control group(n=45)	21.7±1.3	81.8±8.5	182.2±5.7	61.1±5.9	60.4 ± 5.7	20.4 ± 4.6

Table 2. *Data related to sports careers of the examined men ($\bar{x} \pm SD$)*

GROUP	Age of training commencement (years)	Length of training experience (years)	Weekly training loads (hours)	Weekly training loads (days)
Cyclists (n=30)	16.2±1.6	5.9±4.2	9.0±2.6	4.2±0.7

Table 3. *Characteristics of bone parameters of the examined men ($\bar{x} \pm SD$)*

	Cyclists (n=30)	Control group (n=45)
BMC (g)	77.52±7.69	80.58±11.58
BMD g/cm2	1.062±0.07	1.100±0.109
BMD compared to age (%)	92.15±7.05	95.2±9.86

Table 4. *Mean intake of energy, protein, magnesium, calcium and phosphorus in the examined men ($\bar{x} \pm SD$)*

GROUP	Energy (kcal)	Protein (g)	Magnesium (mg)	Calcium (mg)	Phosphorus (mg)	Ca : P
Cyclists (n=30)	2786±664	126.2±42.3	451.7±155.7	877±418	1942±519	1 : 2.2
Control group (n=45)	2964±552	131.4±36.1	425.6±163.2	821±299	2023±488	1 : 2.5

almost 10% lower than in the control group. In some highly susceptible parts, the difference was as high as 18%. [7]. The above observations were notrecorded in our own studies, the average values of the determined bone parameters in the group of cyclists were lower, although they were not statistically significant in relation to the examined men in the control group. In addition to physical activity, a diet (including adequate calcium intake) is also responsible for proper bone mineralisation and density. 99% of body calcium can be found in bones. Its role is to build the skeleton and to strengthen it when its mass loss occurs. Moreover, vigorous physical activity enhances this process. A number of studies point to a beneficial correlation between calcium intake and bone mineralisation [8]. However, it should be remembered that the process of calcium absorption in bone tissue is correct if the ratio of calcium to phosphorus in the body is 1:1. If there is too much phosphorus in a diet, it causes hyperthyroidism and increased calcitonin secretion. Calcitonin stimulates calcium secretion from bones, thus leading to their weakening [9]. The findings of the present study did not show any significant differences between the examined groups with regard to nutrition. The values of the parameters in the groups fell within the norms for age and physical activity. It was only in the case of phosphorus that a disturbing trend towards its excessive intake was noted. In all the groups under investigation, a considerably higher norm of phosphorus intake was observed, which resulted in a substantial increase in the ratio of calcium to phosphorus in the diets of all the examined men.

Conclusions

The analysis of the results of the tests (BMC, BMD) allows us to believe that the cycling training did not negatively influence the mineral density of the bones of the examined athletes.

The results obtained do not suggest that cyclists are at increased risk of osteopenia in their further sporting careers, provided that special is paid attention to diet.

Acknowledgements

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BIOLOGICAL FEEDBACK TESTS ASSISTED EMOTIONAL CONTROL SKILL TRAINING IN CHILDREN'S BADMINTON

UDC 159.91

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Annotation

Objective of the study was to analyze benefits of the biological feedback test assisted emotional balancing skill trainings in children's badminton.
Methods and structure of the study. A total of 34 primary schoolchildren attending the badminton section at the Municipal Budgetary Institution "Olimp" Sports School of the Elabuga municipal district of the Republic of Tatarstan and 30 non-sporting primary schoolchildren were involved in the study. When determining their level of emotional self-regulation, we applied the biological feedback method, which implied two practical courses conducted in a psychoemotional state correction center: muscular training and thermal training. The diagnostics of emotional regulation using the biological feedback toolkit was carried out before and after the badminton training session.
Results and conclusions. The analysis of the muscular training results revealed that the level of muscle tension at the end of the training session, as compared to its beginning, fell. The children in their second year of training in the badminton section were found to have a muscular relaxation level of 678 μW at the end of training, as opposed to those in the first year of training (967 μW). Proceeding from the findings, we may conclude that long-term badminton training contributes to the formation of a muscle relaxation skill. By the end of the training session, the children improved the efficiency of performance of Jacobson's exercises, which consists in alternating muscle tension and relaxation. The statistical analysis revealed a statistically significant difference in the performance of Jacobson's exercises at the beginning and at the end of the training session. The thermal training showed no statistically significant differences in the peripheral temperature control before and after the training session.

Keywords: *badminton, biological feedback test, muscle tension, muscle relaxation, peripheral temperature, emotional control skills.*

Background. Modern training systems need to be reasonably designed and managed to secure good progress for competitive success in its every element including physical training components, diets, training equipment, rehabilitation methods and, of course, mental conditioning/ stress coping aspects [6]. Many analysts consider modern badminton practices beneficial for health as they claim and develop a wide range of motor skills and volitional qualities.

Modern badminton theory and practice cover a few technical, tactical and physical training domains, whilst the excellence trainings give a high priority to the psychological conditioning trainings with the theoretical/ intellectual progress securing aspects [2]. A special emphasis in the practical badminton training systems is made on speed qualities viewed as critical for success. Thus O.V. Zhbankov and B.V. Glebovich found that the sharper (in the optimal range) is the muscle elasticity in the movement inhibition phase, the faster is the switchover from the yielding to overcoming action phases and the higher is the muscle contraction power and speed [1]. N.V. Kazantseva, E.V. Glazova and A.A. Malevanny analyzed the badminton technique biomechanics to find the key role being played by the shooting qualities and abilities – influenced by many factors including the anatomical specifics of the joints and muscles, muscle strength levels, individual movement coordination qualities; and logics of the movement biomechanics in general [2].

A.V. Turmanidze believes that the strength maximizing trainings should be dominated by the top-intensity dynamic, static and mixed static-dynamic practices [5]. Sport-specific muscular activity may vary in a wide range albeit it is natural for the athletes to perceive mostly active/ movement-driving muscle tension whilst the psycho-emotional stress related muscle tension often remain below the perception threshold. Special trainings to master the muscle tension coordination and control skills may be beneficial, particularly in cases when the muscle tone

control and management sensations and skills are under-developed, inhibited or invalidated to a degree.

Thermoregulation mechanism may be defined as the constant body temperature maintaining physiological function that balances the bodily heat production and consumption processes [4]. One of the stress response mechanisms is the blood circulation centralization by contraction (spasm) of peripheral vessels associated with the blood pressure growth and peripheral temperature fall. Therefore, fluctuations of the body temperature may be used as indicators/ markers of changes in the sympathetic vasoconstrictor system operation in transitions from stress to quiescent state. This mechanism is particularly expressed in children and adolescents i.e. in the intensive body growth and cortical brain structure maturing period.

Objective of the study was to analyze benefits of the biological feedback test assisted emotional balancing skill trainings in children's badminton.

Methods and structure of the study. We sampled for the study Experimental Group (EG, n = 34) of 8–11 year old badminton players from Olimp Sports School in the Elabuga Municipal District of the Republic of Tatarstan; and Reference Group (RG, n = 30) of 7–11 non-sporting year-olds from the Children's University Education Project at Kazan Federal University's Elabuga Institute.

The sample was tested by a biological feedback test digital test system at the Psycho-emotional State Correction Lab equipped with the muscle training and temperature training and functionality test units. The EG was subject to the muscle/ temperature trainings and functionality tests prior to and after every badminton training session. The muscle training/ test service included an muscle tension test; trapezius muscle training exercises; Jacobson muscle training practices; and trapezius muscle relaxation practice. And the temperature training/ test service included the muscle tension tests and autogenic muscle tension training practices. The functionality test data were processed by a standard mathematical statistics toolkit with the Student t-criterion.

Results and discussion. The pre-training muscle tension in the EG was tested to average 1723 mkW – versus 3487 mkW in the RG; and the post-training muscle tension in the EG was tested to average 886 mkW, with the pre- and post-training test data difference being significantly different ($t = 2.86$ at $p \geq 0.01$) – that means that the muscle training and relaxation service was beneficial for the trapezius muscle function. Every training session was started by a warm-up practice to stretch up and condition muscles making them fit for the workloads. Success of the badminton technicalities mastering practices is known to depend on how well the shoulder girdle is relaxed for freedom and perfect control of the carpal joint movements – due to the hand movement controls playing a key role in the badminton techniques.

It should be emphasized that the muscle relaxation skills in the second-year EG subgroup were tested much better than in the first-year EG subgroup, with the post-training muscle tension averaging 678 mkW and 967 mkW, respectively.

Furthermore, the Jacobson exercise performance accuracy tests showed a significant growth of the post- versus pre-training accuracy ($t = 2.96$ at $p \geq 0.01$) in the EG – versus the RG where 67% and 16% were tested low and high on the Jacobson exercise performance accuracy test scale. Generally the RG was tested capable to control the trapezius muscle tension rather than relaxation. The tests found that the lab muscle trainings in the EG facilitated progress in the speed qualities, movement coordination abilities and strength, with special improvements in the muscle tone controls, particularly in the controlled shoulder girdle tension and relaxation skills.

As for the temperature training practices in the EG, 68% and 72% showed high muscle tension controls in the pre- and post-training tests, respectively; 28% and 29% were tested with moderate muscle tension control in the pre- and post-training tests, respectively; and 4% and 0% were tested with low muscle tension controls in the pre- and post-training tests; with the differences in the muscle tension test data arrays found statistically insignificant.

Conclusion. The study data and analyses showed benefits of the biological feedback tests assisted emotional balancing skill trainings in children's badminton as verified by progress in the muscle relaxation skills in the EG. Special muscle tension and temperature control trainings helped the junior badminton players master the controlled tension and relaxation of shoulder girdle in the speed, movement coordination and strength training process. The second-year EG subgroup was tested better on the muscle relaxation skills test scale than the first-year EG subgroup and showed high progress in the controlled muscle tension/ relaxation, emotional balancing and focused muscle relaxation skills. The young badminton players were also tested higher on the muscle tension control skill test scale than their non-sporting peers.

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PSYCHOLOGICAL ASPECTS OF DESIGN AND IMPLEMENTATION OF TRAINING MODEL IN JUDO

UDC 796.01:159.9

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Annotation

Objective of the study was to lay fundamentals for and test benefits of a goal-setting model for the judo basics mastering groups.
Methods and structure of the study. At the theoretical level, the developed goal-setting skills building model was described: methodological basis of goal-setting; model implementation provisions; structure and content of the training sessions as forms of goal-setting skills building; effective goal-setting techniques. We designed our experimental goal-setting skills training service model on the above key provisions and piloted it at the Y.K. Koblev Olympic Reserve Judo Sport School and Republican Sport Excellence School in Maykop city, Republic of Adygea. 126 athletes from the judo basics mastering groups were sampled for the model testing experiment. The sample progress in the goal-setting skills training course was tested by the N.M. Peysakhov Self-control Skills Test version for teenagers. N.M. Peysakhov classifies the self-control skills as follows: analysis of contradictions; forecast; goal-setting; progress planning; progress rating criteria; decision making; progress self-management; and correction; with all these components jointly referred to herein as the goal-setting procedure.
Results and conclusions. The results of approbation of the goals-setting skills building model constituted objective evidence of the increase of the level of development of the judokas' goal-setting skills (from low to medium level) at the basic training stage. The results of testing carried out upon completion of training indicated the statistically significant changes on all scales of the "Self-management Capacities" test by N.M. Peysakhov. As a result of trainings, the athletes acquired the skills of modeling and forecasting the results of targeted activities; the basics of the analysis of the compliance of the achieved result with the planned goal.
We proved the effectiveness of training sessions as a form of goals-setting skills building in the athletes. The presented model, as well as the program of training sessions, can be of interest to specialists and will be applied in the athletic training.

Keywords: *goal-setting skills training (GST) model, judo basics.*

Background. As demonstrated by analysis of the national sports research literature, goal-setting trainings still fall largely beyond the fields of interest for most of the national research community despite their growing relevance for sports. There are only a few national studies of these issues by S.V. Dmitriev, 2010; Z.A. Sagova, 2012; and S.K. Bagadirova, 2015, 2016, 2017, 2018; whilst the Western sport science shows a great and growing interest in these issues and has come up with many goal-setting skills training methods and technologies that are being increasingly popular for application in practical training systems.

It should be mentioned, however, that the goal-setting issues has been addressed by a few national fundamental studies including: study of the volitional control mechanisms in terms of their mobilization and operation versus the individual progress goals (Y.T. Glazunov, N.A. Ivannikov, V.K. Kalin, V.V. Medvedev, A.T. Puni, P.A. Rudik, V.I. Selivanov, K.R. Sidorov, R.Z. Shaikhtdinov et al.); behavioral self-control model analysis with the progress goal viewed as one of its elements (O.A. Konopkin, V.I. Morosanova); study of progress motivations with goal-setting elements (V.G. Aseev, L.S. Vygotsky, B.I. Dodonov, E.P. Ilyin, D.B. Elkonin, A.N. Leontyev, S.L. Rubinstein, E.A. Savonko, et al.); study of sport progress aspirations and the relevant goal-setting elements (L.I. Bozhovich, L.V. Borozdina, N.L. Kolominsky, V.N. Myasishchev, V.S. Merlin, E.A. Serebryakova, K.R. Sidorov et al.), etc. Nevertheless, the shortage of theoretical and practical analyses of the relevant issues seriously complicates the efforts to train goal-setting skills within the traditional sport training systems. The growing demand for the goal-setting skills training methods needs to be recognized and addressed by the national sport research community.

Objective of the study was to lay fundamentals for and test benefits of a goal-setting model for the judo basics mastering groups.

Methods and structure of the study. We have developed the following goal-setting skills training model. *Methodological basis* for the goal-setting skills training model was formed of the following elements: key provi-

sions for sport activity offered by L.S. Rubinstein and A.N. Leontiev; the L.S. Vygotsky's interiorization idea; the O.K. Tikhomirov's concepts of goal-setting mechanisms; and the V.D. Shadrikov's professional goal setting provisions for the concept of system genesis.

Model implementation provisions were geared to: facilitate the individual progress agenda by the goal-setting skills training model; improve theoretical and practical competences of the trainers in the goal-setting skills training domain; contribute to the multiannual theoretical and practical training systems; effectively customize the goal-setting skills training toolkit to the personality ontogenesis; and phase the goal-setting skills training service by a progress algorithm to secure a gradual harmonized transition from a trainer-provided goal-setting skills training service to the trainer-assisted and supervised goal-setting skills and then to the independent/self-reliant goal-setting skills by the trainee.

Having analyzed the ontogenetic progress in terms of the goal-setting ability, we found the adolescentage being the most sensitive period when a child makes a transition from the adult-assisted and instructed living to the self-reliant behavioral models with the self-assertion components and personality progress agenda inspired by the primary goals-setting needs and attempts [2]. We believe in this context that the judo basics mastering period is most favorable for the goal-setting skills in the subject sport discipline training, with the goal-setting skills training elements designed to prudently complement the regular training sessions. The goal-setting skills training service will be geared to help the trainees: model and forecast their own progress path in the sport discipline; and analyze and rate the interim progress stages versus the final goals.

We designed our experimental goal-setting skills training service model on the above key provisions and piloted it at the Y.K. Koblev Olympic Reserve Judo Sport School and Republican SportExcellence School in Maykop city, Republic of Adygea. 126 athletes from the judo basics mastering groups were sampled for the model testing experiment. The sample progress in the goal-setting skills training course was tested by the N.M. Peysakhov Self-control Skills Test version for teenagers. N.M. Peysakhov classifies the self-control skills as follows: analysis of contradictions; forecast; goal-setting; progress planning; progress rating criteria; decision making; progress self-management; and correction; with all these components jointly referred to herein as the goal-setting procedure [4].

Results and discussion. The pre-experimental goal-setting skills tests using the N.M. Peysakhov Self-control Skills Test toolkit unsurprisingly rated the sample low on every of the above the self-management and goal-setting scales – since it is only natural that the teenage judo basics mastering group is still immature and unable to match its own progress ambitions with the real capacities and resource: see Table 1.

Training stage of the new goal-setting skills training model testing experiment was designed to complement the regular judo trainings with the goal-setting skills training service elements. The goal-setting skills training trainings were run at both of the above sport schools in two subgroups for four days. The goal-setting skills training trainings were designed to address and analyze the past progress and future constructed events and ambitions. The group trainings with analyses of the past events were dominated by the regression analysis to help every trainee analyze the past goal-setting efforts, wins and failures to effectively track every step. And the group trainings with the future progress constructions were dominated by a symbolic self-expression method to help every trainee clearly visualize the progress goal; plus an operational progress design method to model the progress path on the way to the specific goals and thereby visualize the future events [1]. Each goal-setting skills training session included the following three parts:

1. Introductory short lecture on the theoretical aspects of the goal-setting skills training session;

2. Core part of the training session with specific practices as dictated by the current training goals spelled out in a training workbook. The workbook gives goal setting tips and guidelines to help produce a roadmap for the upcoming competitive season with the progress tracking and goal attaining methodology, plus practical guidelines for the trainer with a special attention to the key points of the goal-setting practices; and

3. Reflection part at the end of each class, to have analyzed the progress made in the training session and highlight the problems every trainee and group on the whole face, to contribute to the group progress rating.

The goal-setting skills training model cannot be described herein in detail due to the limited space of the article, so we would offer an overview of its structure (see Table 2) further described with workbooks in our monograph [4, p. 222-244].

The pre- versus post-experimental tests showed statistically significant progress of the sample in the goal-setting skills from the low to moderate level on every test

Table 1. *Pre-experimental test data: N.M. Peysakhov Self-control Skills Test, points*

Self-control skills	$\chi \pm \sigma$
Analysis of contradictions	2,54±0,38
Forecast	2,51±0,37
Goal-setting	2,55±0,38
Planning	2,59±0,38
Progress rating criteria	2,55±0,38
Decision making	2,54±0,38
Progress self-management	2,6±0,39
Correction	2,58±0,38

Table 2. *Goal-setting skills training program*

Mission of the goal–setting skills training course is to develop goal–setting skills and knowledge in the trainees. Goals: 1. Give knowledge of the goal–setting skills theory, basic goal–setting skills supported by due progress motivations. 2. Expand the goal–setting training skill set for the progress planning and programming. 3. Excel the focused goal–setting skills, progress modeling and progress self–testing and analyzing skills.
Session 1: Short– and long–term goals Lecture: How to set the short– and long–term goals Practice 1: Define the time limits for achieving the goal. Practice 2: Go from the mission to the prime goal. Practice 3: Progress steps. Practice 4: Make the dream come true. Practice 5: Launch your rocket to the stars. Session 2: Final and interim/ process goals. Lecture: How to set the final and interim goals. Practice 1: Set goals for the specific upcoming competitions. Session 3: Team and individual goals Lecture: How to set the team and individual goals Practice 1: Team/ group/ individual goal setting procedure Session 4: Progress rating on the way to the goal Lecture: How to test progress on the way to the goal Practice 1: Set a progress goal for today

Table 3. *Pre- versus post-experimental data: N.M. Peysakhov Self-control Skills Test*

Self-control skills	χ ±σ		p
	Pre-experimental	Post-experimental	
Analysis of contradictions	2,54±0,38	3,49±0,52	<0,05
Forecast	2,51±0,37	3,48±0,52	<0,05
Goal–setting	2,55±0,38	3,7±0,55	<0,01
Planning	2,59±0,38	3,4±0,51	<0,01
Progress rating criteria	2,55±0,38	3,4±0,51	<0,01
Decision making	2,54±0,38	3,6±0,54	<0,05
Progress self–management	2,6±0,39	3,49±0,52	<0,05
Correction	2,58±0,38	3,51±0,52	<0,05

scale. As a result of the goal–setting skills training experiment, the athletes made good progresses in their own sport career modeling and progress forecasting skills versus their individual goals, and in the progress analyses: see Table 3.

The questionnaire survey of the trainers and trainees showed their progress in the goal setting and correction in the training system design, progress planning and management domains. They particularly appreciated the goals prioritizing and variation abilities that, in their opinions, facilitated their training and competitive progresses [1].

Conclusion. The study data and analysis showed benefits of the new goal–setting skills training model as verified by the pre– versus post–experimental tests. We would recommend the new goal–setting skills training model with its versatile training toolkit for application in the practical sport trainings systems.

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8-10 YEAR-OLD FENCERS' AGGRESSION AND RESPONSE SPEED RATING ANALYSIS

UDC 159.947

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Annotation

Objective of the study was to rate correlations between the personal aggression and response rate in the 8-10 year old beginner (first-year) fencers – proceeding from the assumption that it is natural for this age group to rely on the immature uncontrolled personal aggression rather than on the still growing tactical skills.
Methods and structure of the study. The experimental study was run at the Kazan Federal University's Elabuga Institute under Children's University Project that sponsors a beginner fencing group at Secondary School #39 in Naberezhnye Chelny city. We sampled the 8-10 years-old (8.7 years on average) beginner (first-year) fencers (n=38). The children's proneness to uncontrolled aggression was tested by the T.N. Kurbatova's version of the E. Wagner's Hand Test run on an individual post-training basis.
Results and conclusions. The simple sensorimotor response to personal aggression correlation analysis found a strong positive correlation of the personal aggression with the post-training bout simple sensorimotor response (r=0.48) and a weaker (trend-level) positive correlation with the pre-training bout simple sensorimotor response (r= 0.36). The fact that the pre- and post-training bout simple sensorimotor response rates are fairly close may be explained by the still poor age-specific behavioral self-controls in the beginner (first-year) fencers at the very start of the response speed training process. We also found that the clear correlation of the personal aggression and simple sensorimotor response tend to grow with the training bout experience – and this finding confirms our prior assumption on the natural aggression being of facilitative effect on the simple sensorimotor response progress in the beginner groups. Generally the higher is the natural aggression rate, the higher are the response rates in the beginner fencers.

Keywords: *simple sensorimotor response, personal aggression, 8-10 year-old fencers, training bout.*

Background. Modern fencing may be defined as the sport discipline including three competitive scenes (foil, epee, and saber) with the rivals competing in swordsmanship [4] i.e. in the art of offense (to stab the opponent) and defense (to fend off the opponent's stabs). Modern fencing is often ranked among the non-aggressive intellectual sports that require excellent physical fitness, success motivations, good willpower, strategic thinking and perfect mental controls for success. Some national researchers, however (Ilyin, 2016; Markelov, 2017), tend to rank controlled aggression among the key success factors for the modern competitive fencing. Sports psychologists commonly interpret aggression as the persistently attacking/ dominant behavioral style that may be highly beneficial and successful when well controlled and managed.

Sports as one of the social activity domains make it possible for the athletes to vent their natural aggression in a controlled and socially acceptable manner, with the aggression transformed by the sublimation, substitution and projection mechanisms to reinforce the athlete's self-assertion and dominance agenda. The modern socially welcomed forms of the sports-limited aggression effectively contribute to and shape up the constructive competition-specific behavioral models [5].

Thus E.P. Ilyin rates aggression among the key progress components of the sporting lifestyles albeit argues that it should be encouraged only in forms of a healthy *sporting fury* – that he defines as the reasonably controlled form of competitive encounters geared to mobilize the individual mental and physiological resource for success. The sporting fury in this context may also be interpreted as the natural aggression management format tolerated by the sport discipline within the frame of the competitive rules, settings and traditions [3].

Y.V. Alexandrov, N.S. Sigal, V.A. Shtykh (2014), K. Krishnaveni and A. Shahin (2014) offer a different definition for the sporting aggression. They believe that aggression cannot be ranked among the competitive performance boosting factors since it normally overexcites the athlete and may be of distractive, defocusing effect on the performance with the potential 'non-constructive'/ uncontrolled outbursts, attacks and even injuries. Such unsportsman-like behaviors quite common for some psychological types should under no circumstances be tolerated by the sport

communities [1, 2]. It should be mentioned that sporting aggression tend to change with age, with junior immature/ uncontrolled aggression being transformed with age and growing experience into well-controlled sporting fury (healthy fighting spirit) driven by the must-win mindset.

We believe that modern fencing as a close-contact sport discipline offers excellent opportunities for the immature junior personal aggression to be timely and safely transformed into the constructive sporting fury. This progress will be facilitated by the sport culture that favors cool-blooded swordsmanship equally successful in offense and defense, with the blade action often being bullet-fast and precise for success. A successful fencer should demonstrate good strategy to timely and effectively respond to every fight situation by the best solution and tool from the highly versatile individual skill set. It should also be emphasized that the sensorimotor response rate tends to slow down with age, with the primary school period (7-11 years of age) known to be the most sensitive and favorable time for the response speed trainings, with many children making progress in such trainings [6].

Objective of the study was to rate correlations between the personal aggression and response rate in the 8-10 year old beginner (first-year) fencers – proceeding from the assumption that it is natural for this age group to rely on the immature uncontrolled personal aggression rather than on the still growing tactical skills.

Methods and structure of the study. We run our experimental study at the Kazan Federal University's Elabuga Institute under Children's University Project that sponsors a beginner fencing group at Secondary School #39 in Naberezhnye Chelny city. We sampled the 8-10 years-old (8.7 years on average) beginner (first-year) fencers (n=38). The children's proneness to uncontrolled aggression was tested by the T.N. Kurbatova's version of the E. Wagner's Hand Test run on an individual post-training basis.

The simple sensorimotor response was rated by an online Response Test & Trainer system, with the subjects pressing a button as soon as possible in response to the color signal on the screen. Each tests were run prior to and after the training bouts, with five attempts given to every subject to fix the response and compute the average response rate in milliseconds (ms).

Results and discussion. The T.N. Kurbatova's version of the E. Wagner's Hand Test rated the average aggression of the sample at 10.97 points, with the average standard deviation of 7.7.

The pre- training bout simple sensorimotor response averaged 333.63 ms with the mean standard deviation of 41.52 ms; and the pre- versus post-training bout simple sensorimotor response difference was found statistically insignificant ($p=0.23$).

The simple sensorimotor response to personal aggression correlation analysis found a strong positive correlation of the personal aggression with the post-training bout simple sensorimotor response ($r=0.48$) and a weaker (trend-level) positive correlation with the pre-training bout simple sensorimotor response ($r=0.36$). The fact that the pre- and post-training bout simple sensorimotor response rates are fairly close may be explained by the still poor age-specific behavioral self-controls in the beginner (first-year) fencers at the very start of the response speed training process. We also found that the clear correlation of the personal aggression and simple sensorimotor response tend to grow with the training bout experience – and this finding confirms our prior assumption on the natural aggression being of facilitative effect on the simple sensorimotor response progress in the beginner groups. Generally the higher is the natural aggression rate, the higher are the response rates in the beginner fencers.

This progress is apparently due to the training process format that encourages transformations in the nervous system performance including the excitation/ inhibition process control and balancing skills, with the clear benefits for the response speed. Progress in the simple sensorimotor response is secured by improved coordination of bodily functions with the growing synchronization of the timing and spacing processes and improved coincidence of excitation rhythms in the nerve cells [7]. The neurophysiological processes behind the response speed training are commonly explained using the notion of *latent period* i.e. the time between action triggering stimulus and the actual *motor response* [6]. Since the beginner fencers are still largely innocent and unskillful in the fight control techniques, they tend to offset this shortage by the response speed plus expressed uncontrolled aggression.

Conclusion. The study data and analysis showed a direct correlation of the expressly aggressive behavioral models with the response speed in the beginner (8-10 year-old first-year) fencers – that may be due to the age-specific emotional imbalances, particularly in the stressful competitive settings. The response speed mobilizing skills and fight tactics of this age group are still immature for the fully-fledged competitive performance with attacks, defenses, footwork, counterattacks and counter-defenses. These deficiencies and weaknesses cannot but provoke, as we believe, uncontrolled aggressive outbursts in the beginner fencing bouts; and we recommend the coaches keeping an eye on and controlling the personal aggression manifestations in the training bout to facilitate the aggression being transformed in the most healthy way for competitive progress. It is important to brief the beginner fencers in the trainings on the need to support the technical progress with the growing control of the natural personality aggression so as to develop a healthy 'sporting fury' (fighting spirit) combined with the response speed improvements for good competitive progress.

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MODERN FOOTBALL CONTRIBUTIONS TO YOUTH SOCIAL CAPITALS: REGIONAL SPECIFICS

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Annotation

Objective of the study was to analyze the regional specifics of the modern football contributions to the youth social capitals.
Methods and structure of the study. We analyzed information from foreign sources devoted to the results of relevant studies conducted in various regions of the world. We used the results of a specific sociological study "The 2018 FIFA World as viewed by the young people", which had been initiated and implemented by the Russian Society of Sociologists in November-December 2017. The data array totaled 4,703 profiles of students from 50 universities in 25 cities of Russia, including 250 students from Astrakhan.
Results and conclusions. It was shown that Astrakhan students play football more often than those throughout the Russian Federation. Therefore, football occupies a special place in the structure of social capital of the natives of Astrakhan, but the regional sports infrastructure potential is lower than in the whole country.

Keywords: *football, social capital, student community, region, questionnaire survey*

Background. Football is ranked the most popular mass team sports and as such heavily contributes to the social capitals of different population groups across the regions. P. Bourdieu, one the authors of the social capital concept, interprets it as the cluster of social connections that may be prudently used for the cost–efficiency and investment luring initiatives (Bourdieu, 2002). Football culture may provide resource for the social capital and generate income flows for investments. As provided by R. Putnam, social capital includes the relevant social standards, social networks, and trust building aspects (Putnam, 1995). Football may heavily contribute to the social capital by its social networks of professional/ amateur players and supporters united by the mutual trust, respect and specific rules and codes of conduct that naturally develop in their communities. In addition, this mass popular team sport greatly contributes to the physical health protection and building culture that, as provided by R. Rose, forms a basis for the social capital (Rose, 2000). Foreign researchers emphasize that sports and mass media organizations have long served as the national identity building drivers. Even defeats of the national teams (e.g. the loss of Australia to Germany in the 2010 World Cup) are known to give new impetuses for the national progress in the production, design and national identity cementing aspects with support from the mass media (Nicholson, Sherry, Osborne, 2016).

Many analysts underline the positive influences of the popular football clubs (e.g. Barcelona Football Club and Catalonia Football Club in Spain) on the national identity and generation–specific political values. Thus an analysis of correlations between the Barcelona Football Club progress and national identity related sentiments showed that the seniors tend to consider 'Barca' as an emergency stress release valve when it comes to the Catalan nationalism and political freedoms; whilst the young generation, on the contrary, tends to stick to the good old tradition leaving aside the political values historically rooted in the Barca image (Barcely, Clinton, Sery, 2015).

An amateur football club in northeast England was taken by researchers for the case study of how different forms of social capital are being accumulated, with the club's transformative resource analyzed in the context of the shareholders' interactions in spatial and temporal terms. The P. Bourdieu's concepts of cultural fields, cultural capital, social capital and symbolic capital we used to analyze the individual gains of the players in terms of the "legitimate capital" of special importance for them; plus the capital employment methods applicable by the coaches and team managers (Tucker, 2016; Potrac, Nelson, O'Gorman, 2016).

Football plays a special role in the youth social capital accumulation aspects the world over as it offers ample opportunities for socializing, communication and grouping. Even the role of a football fan who enthusiastically sup–

ports his team with the crowd helps a young person make progress in the natural socializing needs, find its descent place in the social group and effectively contribute to the group interests and social agenda.

Objective of the study was to analyze the regional specifics of the modern football contributions to the youth social capitals.

Methods and structure of the study. We used for the purposes of the study findings of the online questionnaire survey '2018 World Cup: young peoples' opinions' run by the Russian Society of Sociologists in November–December 2017. We singled out the survey data for two southern cities of Astrakhan (n = 250) and Volgograd (n = 839) on the whole and responses to the question "Do you play football and how often? in particular (with the following options: "I play professionally", "I play periodically", "I play occasionally", "Almost never", "I played it before", "Never", "I hate football"). The survey findings cannot be rated representative albeit the large-scale sample (as is the case for every survey by RSS) gives grounds to consider the conclusions fairly informative (see, e.g. Kargapolova, Dulina, Kargapolov, Mironova, 2019).

Results and discussion. Foreign researchers have shown a growing interest in studies of contributions of modern football in the youth social capitals across the world. Thus M. Mauro emphasizes the trans-cultural nature of football in his analyses of the roles played by football in the immigrant youth lifestyles and subcultures in the industrial districts of Dublin city in Ireland. "Football grounds could be used for recreation, competitions and socializing. More importantly, they could be places where one can develop a feel of unity with the local community and gain access to national sports cultures. Football can also generate some forms of exclusion and discrimination ... A youth football club plays a special role as a self-identification logo for the local community. It is not unusual for teenage players of different African backgrounds to face a variety of inclusivity related challenges. They may either accept the local cultural codes of the football community, or opt for different forms of "resistance" to emphasize their own racial standing in the Irish society. On the whole, this diversity only demonstrates the importance of the grassroots football culture as a domain for the intercultural youth dialogues" (Mauro, 2016).

J. Esson analyzes the progress options and expectations of the young males in Western Africa that strive to make success in professional football. A professional football career is generally perceived by them as a high-income and self-assertion progress field (in the situation of the ever failing neoliberal reforms and growing impoverishment) that makes it possible to do without education which is believed to contribute to unemployment and dilute the labor market. The sports capital accumulated by a young football professional offers ample opportunities to assert his maturity, masculinity, resourcefulness, and demonstrative wealth. This is the behavioral model dubbed by the young Ghanaians as the 'X-Way', i.e. the life path for a self-made man (Esson, 2016).

As for the modern Russia, the success made by the national team at the FIFA 2018 World Cup was found to give a great boost to the national and patriotic sentiments. The local professional football players also are not shy to demonstrate their demonstrative wealth and consumerism – , as is the case for the countries of global South. It should be noted in this context that football is popular the world over largely due to the local football celebrities from the leading national clubs – whilst the Russian clubs are still lagging behind in the match attendance statistics, with the wide gaps in the popularity, when some matches gather full arenas and the others only a few thousand fans – that may be indicative of the sagging popularity of the national football in modern Russia.

We designed this study to analyze the modern football net of the passive forms of social capital measurable by the match attendance statistics, self-identifications with football fan communities and variations of the passive informational preferences. We instead concentrated on the active forms of the football-related social capital including active football trainings and competitions. Football is reasonably considered (Bolter, Kipp, Johnson, 2018) as a human capital building factor with its sport excellence aspects that are ranked high on the lists for priorities by the school physical education system and many youth sports organizations. We have analyzed the popularity of active football in the modern Russian student communities – viewed by many as the vanguard of society (Dulina, Kargapolova, Strizoe, 2017) actively accumulating its social capital (Koshkin, Novikov, 2018). Of special interest for us are the contributions of modern football to the regional social cultures across Russia (with the Astrakhan communities taken for the case study).

Our analysis of the Astrakhan subsample of the online questionnaire survey '2018 World Cup: young peoples' opinions' found only 2% of the subsample (and 2% of the Russian sample) engaged in professional football. One of ten in the subsample was found to play football periodically; one of six in the Russian sample and one of four in the Astrakhan subsample was found to play football occasionally. One of six-seven in the Russian sample and one of five in the Astrakhan subsample reported playing football before. On average, 47% and 36% in the Russian sample and Astrakhan subsample reported 'virtually never' playing football; and 8% and 5% 'definitely never', respectively; i.e. the Astrakhan students play football more often than the Russian average on the whole. This may be the reason why that the supporter community is wider in Astrakhan than the Russian average (28% versus 17%).

Furthermore, 41% and 30% of the Russian sample and Astrakhan subsample, respectively, believe that their hometown gives every opportunity for playing football. Approximately one of four in both of the samples believes that the local progress options for football are short of some services or aspects. Those in the Astrakhan subsample and Russian sample who believe that the hometown offers little or no opportunities for progress in football were estimated at 20% and 12% (little) and 7% and 4% (no), respectively.

Conclusion. Modern football holds great shares in the youth social capitals in the Russian regions, as demonstrated by the survey of the Astrakhan student community – that was tested to include only 4% of professional

football players and, hence, the future professional careers of the local subsample have little to do with its high interest in football. The interest, as we believe, is explained by the generous socializing opportunities and contributions of the modern football to the social capitals of the Astrakhan subsample, all the more that one of four local students was raised in villages and little towns with their traditional sporting cultures (versus only 18% in the Russian sample). Football was widely popular in the Soviet times, and this popularity is still high in the post-Soviet socio-cultural countryside settings even when they are abandoned, dilapidated, with the former stadiums and football clubs turned into marketplaces – despite all that the local amateur football remains the most popular pastime for many local young people. This may be the prime reason why the Astrakhan youth subsample was tested more supportive of and more active in playing football. It should be mentioned, however, that the Astrakhan football infrastructure still lags behind the national average and, hence, less facilitating for the local social capital accumulation agenda.

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DIETARY MODELS FOR PHYSICAL HEALTH AND DEVELOPMENT: HISTORICAL ANALYSIS AND CURRENT SITUATION

UDC 94:796

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Annotation

Objective of the study was to analyze the medieval food cultures and traditions and their historical heritage in the modern dietary models.
Methods and structure of the study. The authors used a comparative historical analysis to identify and compare medieval eating patterns in Europe and Russia. An ascertaining experiment was conducted to determine the nutritional habits of modern Russians and their dependence on the level of motor activity. Sampled for the questionnaire survey were 20-30 and 45-60 year-old individuals (n=96 including 40 youngsters and 56 middle-aged people) residing in Krasnodar, Naberezhny Chelny, Elabuga. The method of descriptive statistics was applied to analyse the data obtained.
Results and conclusions. The authors identified the effects of man's eating pattern on his physical development, both from the historical perspective and at present. The balanced meal composition depends on individual characteristics that were not taken into account in the medieval period, which, combined with the lack of dependence between the eating pattern and level of motor activity, led to early physical depreciation. The analysis of the results of the questionnaire survey of modern Russians showed that their eating patterns have changed significantly and are increasingly seen as a way to support physical health. This manifests itself in the individualization of eating patterns, expansion of the diet, "soft" attitude to fasts, introduction of a balanced diet, desire to consider the motor activity indicators.

Keywords: *dietary models, medieval period, nutrition, food culture, physical health.*

Background. National food cultures and traditions are many centuries old and still retained to some extent in the modern dietary models the world over. We overviewed herein the medieval Western European and Russian dietary traditions to track their heritage in the modern food cultures. Studies of that kind are increasingly relevant for the health theory and practice since the modern dietary models are given a special attention by the physical health, intellectual activity and healthy lifestyle advancement initiatives.

Objective of the study was to analyze the medieval food cultures and traditions and their historical heritage in the modern dietary models.

Methods and structure of the study. We used for the purposes of the study historical analysis and comparative analysis to identify and rate the Western European and Russian dietary models and track their heritage in the modern food cultures. A special priority was given to the medieval and modern food behavior and traditions, foodstuffs and diets. We run a questionnaire survey to profile modern diets of the Russian population age groups and classify their food priorities and preferences in the context of the historical food cultures. We sampled for the survey 96 respondents grouped into the 20–30 year-old Group 1 and 45–60 year-old Group 2. It is a common knowledge that the medieval able-bodied population was dominated by the 20–45 year-olds, and this was the prime reason for the sample grouping with a certain retrospective emphasis. We analyzed for the purposes of the study the relevant medieval historical literature including notes by Caesar, Mauritius Strategist, Charlemagne, and medieval Russian 'Domostroy' – to reconstruct the medieval food cultures.

Results and discussion. It was rather habitual and traditional since the early Middle Age to unconsciously train the body for military purposes rather than physical fitness and health needs as such. Western Europe in the early medieval period was invaded by barbarian groups with their war-driven cultures. Male warriors of that period hardened by the harsh lifestyles with constant trainings and battles may be viewed a historical model of a physically healthy and harmonic individual. Y. Caesar wrote:

"They rely mostly on the livestock than bread in their foods; and they hunt a lot" [4, p. 59]. It should be mentioned that the medieval West European diets were generally income-dependent and not necessarily healthy enough. "Tell me what you eat and I will tell you who you are" states a medieval German proverb. On the whole, dietary models of that period may be grouped into the rather limited and primitive for the general population and privileged for the aristocracy.

An analysis of the "Capitulary of estates" gives an idea of how the aristocratic diets looked like in the early 9th century. For the royal family food supply, the estates kept a livestock of pigs, cows, sheep, goat, poultry (chickens, geese, pheasants, partridges and ducks); with a special priority given to the quality and freshness of the food served for the emperor's table.

The ordinary people's diets were designed to secure rather endurance than a sheer physical strength for the hard endless work. The European commoners were content with cereals and stews of grain. As noted by F. Braudel, "the trinity of grain, flour and bread" dominated in the-then food cultures across Europe, and this trinity was in fact a number one priority for the municipalities, governments, merchants and other people for whom "eating your own bread" was synonymic to living [1, p. 158]. It was rather seldom for peasants and artisans to eat meat or poultry at that time. Their diets included mostly beans, turnips, peas, onions and garlic, with very limited shares of fruits and virtually no sugar until the XVI century.

Medieval Russian food supplies were secured by gathering, fishing and hunting, harvests of wild cereals, berries, nuts, mushrooms, wild honey etc. With progress of agriculture and cattle breeding, the peasants' food traditions were gradually changed by the growing supplies of bread, cereals, dairy products, eggs, fish, meat and honey [3, p. 253–257]. The top nobility could afford plentiful feasts – for example, Prince Vladimir held weekly feasts for the noblemen including 'boyars' (war commanders) and the best combatants.

Since the Christianity came to Russia with its fasting traditions, the consumption of meat, milk, and eggs was limited. "Domostroy" describes in detail the Russian *dietary models* of the 16th century giving many dietary recommendations both to the aristocracy and commoners. Thus it gives instructions on the servants' meals for non-fasting periods with detailed portions of sieve bread, cabbage soup, liquid porridge with ham, porridge steamed with bacon, meat for lunch, milk or porridge; and meals for the fasting days including cabbage soup, modest cereals, peas, baked turnip, oatmeal, pickles, and tops for dinner. "Serve on Sundays and holidays for dinner some kind of cake or thick porridge, or vegetables, or herring porridge, pancakes and jelly ..." [2, p. 156–157].

On the whole, both the European and Russian medieval diets were fully determined by the social ranks rather than the actual needs of the group physical or intellectual labor. Typically the food supplies were insufficient in quality and quantity, with meals taken at most twice a day. The diets were further imbalanced by frequent fasts, usual shortages of readily digestible foods, and overeating on holidays. The *dietary models* have been changed with time under influence of many social and economic factors to evolve into the modern diversity of food cultures and dietary models, as demonstrated by the following findings of our questionnaire survey.

The question "How many meals a day do you prefer?" was responded as follows: in Group 1, 90% prefer 3 meals a day and 10% two meals a day; and in Group 2, 88% reported 3 meals a day; and 22% fractional diets with up to 5 meals a day. The question "Do you fast on religious grounds?" was responded positively by only 11% and 36% of Groups 1 and 2, respectively.

When comparing the historical and modern diets in the context of motor activity, it is important to realize that the medieval physical activity was dominated by hard labor and military service; whilst the modern physical activity is dictated mostly the health and physical development agendas. Thus the question "What is your physical activity and weekly physical trainings?" was responded as follows. In Group 1, 60% reported being physically active, with 70% trained 3–4 times a week; 20% 2–3 times a week; and 10% every day. In Group 2, 40% reported being physically active and trained 2–3 times a week.

Conclusion. The study data and analyses showed an imbalanced nutrition being of influence on the physical development both in the medieval period and nowadays. The medieval diets were basically determined by the social statuses and income levels within the social strata; and limited by one or two meals per day. They were heavily imbalanced by the religious fasts, shortages of food supplies, with the diets generally being too poor to satisfy the needs of the hard physical labor and, therefore, resulted in the premature aging, health issues and incapacities. A questionnaire survey of the modern able-bodied population groups showed the modern food cultures and dietary models being dictated mostly by the physical health and development agendas. These priorities are manifested in the high individualization of the modern nutritional habits, wide range of the foodstuffs available on the market, generally negligent attitudes to the religious fasts, growing awareness of the healthy balanced *dietary models* and sensitivity to the physical health and development related contexts of the modern diets.

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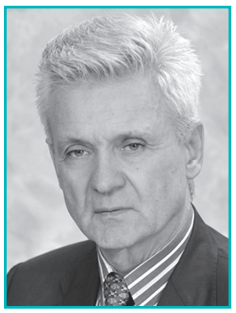
CIRCUIT TRAINING METHOD TO TRAIN STUDENTS FOR GTO COMPLEX TESTS

UDC 796.011.3



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Annotation

Objective of the study was to experimentally test benefits of a circuit training model to make the students fit for the GTO Complex tests.
Methods and structure of the study. Sampled for the study were the 1st-4th-year students, who had passed the registration and had been admitted to participate in the testing. Training for the Physical Culture and Sports "Ready for Labour and Defence" (GTO) Complex tests was carried out during the academic year, for 8 months. The Control Group students (n=30) were trained according to the standard physical education program, while the Experimental Group ones (n=30) were offered a circuit training method.
Results and conclusions. It was proved by experiment that the use of a complex approach to university student training for Stages V-VI Physical Culture and Sports "Ready for Labour and Defence" (GTO) Complex tests, based on the circuit training method with the use of the long-term continuous exercises, is most appropriate since it increases their physical fitness level. Reaching the qualifying Physical Culture and Sports "Ready for Labour and Defence" (GTO) Complex standards and qualifying for the GTO badges is a labour-intensive and time-consuming process. To solve this problem, the authors recommend inviting experts from the Physical Culture and Sports "Ready for Labour and Defence" (GTO) Complex Testing Center of Moscow Sports Committee.

Keywords: *Physical Education and Sports "Ready for Labour and Defence" (GTO) Complex, physical education and sports, students, circuit training, academic Physical Education curriculum, test system, GTO Festival, Physical Culture and Sports Center of South-West Administrative District.*

Background. Pursuant to the Presidential Decrees of May 2012, the Russian Government will ensure by 2024 a significant growth of popular healthy lifestyles with the systemically sporting population group expected to grow to at least 55% of the total. The ambitious goal for the national physical education and sports sector was confirmed by the Presidential Decree #204 of 05.07.2018 "On National Goals and Strategic Progress Missions of the Russian Federation for the period up to 2024" that requires the sporting university student population to grow by around 80% of the total till that time, with the GTO Complex test system ranked high among the physical education and sports methods and tools applied for these purposes [1, 2, 12].

Many analysts argue that the valid academic Physical Education curriculum makes no provisions for the students' trainings for the GTO Complex tests [13]. This issue was seriously tackled, for instance, by the International Sports Forum "Russia – a Sports Power" (October 2014, Cheboksary), when President V.V. Putin urged the national physical education and sports sector to consider changes and amendments to the Federal State Educational Standards to have them harmonized with the GTO Complex test standards and requirements.

Objective of the study was to experimentally test benefits of a circuit training model to make the students fit for the GTO Complex tests.

Methods and structure of the study. We selected for the purposes of the study 9 out of 13 GTO Complex Class V/ VI tests including 4 mandatory and 5 optional tests that may be easily run in the regular academic physical education service with qualifications for the GTO silver/ bronze badges [2]. We sampled for the study Experimental Group (EG, n=30) and Reference Group (n=30), with the EG trainings dominated by the indoor circuit training practices with long continuous exercises [10]. The circuit training trainings was designed to include seven stations, with every station securing fitness for a specific GTO test, and with the first warm-up and conditioning station at the beginning of every training session for the whole group. After the warm-up phase, the EG was split up into subgroups of 5 people each, with every subgroup running three

stations per class, then three next stations in the next class etc. In 4 weeks the subgroups run 2 circuits; in 8 weeks – 3 circuits per class; and in 12 weeks, the trainings were back to one circuit with the number of stations per class increased by one every 4 weeks (plus 1, 2 and 3 stations after weeks 4, 8 and 12, respectively). As a result, the total training workload came to as many as 7 stations per every training session: see Table 1.

The EG/ RG progress was rated by the post–experimental tests after 32 week training program at the end of the academic year and timed to the GTO Complex Festival, with every student willing to test his skills welcomed to the GTO tests.

Results and discussion. The pre–versus post–experimental EG/ RG tests found 100% of the EG fully fit for the 9 GTO Complex tests at the GTO Festival – versus 80% in the RG. It should be noted that some RG students were unwilling or incapable to pass 1–2 GTO tests – mostly due to their relatively lower motivations: see Table 2.

The tests found the EG and RG to make progresses in qualifications for the GTO silver/ bronze badges. The RG and EG qualified for 2+4+7 and 5+7+9 GTO gold, silver and bronze badges, respectively: see the Figure 1 here–under.

Conclusion. The circuit training model testing experiment showed benefits of the new circuit training model for the GTO Class V/VI test qualifications as verified by the following group physical fitness progress test data:

(a) Gold–badge qualifications in the EG grew up by 30% in the 100m sprint test; 24% in the shuttle sprint and standing long jump test; 12% in the supine pull–ups test; 10% in the 2/3km track race and 3/5/km cross–country race tests; 35% in the 1min supine–to–sits test; 20% in the 700/ 500g object throw test; and by 24% in the bench standing bents test;

(b) Training intensity was tested to grow by 80–85% in the EG due to the improved physical training work/ relaxation process management efficiency;

Table 1. *Stations and their missions in the experimental circuit training model*

Station	Mission
1	General warm–up and conditioning practices
2	Training for the 2/3km track race and 3/5km cross–country race tests
3	Training for the 3x10m shuttle sprint test
4	Training for the 100m sprint and standing long jump tests
5	Training for the pull–ups, 16kg kettlebell snatch, supine pull–ups and prone push–ups tests
6	Training for the 500/ 700g object throw and 1min supine–to–sits tests
7	Training for the bench standing bents test

Table 2. *Post-experimental EG (n=30) and RG (n=30) physical fitness test data*

	Tests	Group	Test rates				p
			Males		Females		
			$\bar{x}\pm\sigma$	Δ	$\bar{x}\pm\sigma$	Δ	
1	100m sprint, s	EG	14,10±1,2	0,22	17,10±0,9	0,17	≤0,05
		RG	14,9±1,9	0,35	17,9±1,0	0,18	≤0,05
2	2km track race, min	EG	–	–	11,40±1,0	0,18	≤0,05
		RG			12,10±1,30	0,24	≤0,05
	3km track race, min	EG	13,00±1,10	0,2	–	–	≤0,05
		RG	13,40±1,45	0,26			≤0,05
3	Pull–ups, count	EG	13,5±3,5	0,64	–	–	≤0,05
		RG	12,0±4,5	0,82			≤0,05
	Supine pull–ups, count	EG	–	–	14,5±4,5	0,82	≤0,05
		RG			12±5,5	1,0	≤0,05
4	Bench standing bents, cm	EG	12±3,5	0,64	14±2,5	0.46	≤0,05
		RG	10±4	0,73	10,5±5,5	1,0	≤0,05
5	3x10m shuttle run	EG	7,7±0,8	0,15	8,9±0,7	0,13	≤0,05
		RG	8,0±0,9	0,17	9,1±0,8	0,15	≤0,05
6	Standing long jump, cm	EG	235±15	2,74	177±15	2,74	≤0,05
		RG	232±17	3,11	170±20	3,64	≤0,05
7	1min supine to sits test, count	EG	44,5±5,5	1,0	40±3,5	0,64	≤0,05
		RG	42,5±8,5	1,55	37±7,5	1,37	≤0,05
8	700g object throw, m	EG	32,5±6,5	1,19			≤0,05
		RG	29,5±8,5	1,55			≤0,05
	500g object throw, m	EG			18,50±3,5	0,64	≤0,05
		RG			16,5±3,0	0,55	≤0,05
9	3km cross–country race	EG	–	–	18,30±2,10	0,38	≤0,05
		RG			19,30±2,30	0,42	≤0,05
	5km cross–country race	EG	25,30±3,35	0,61		–	≤0,05
		RG	26,30±4,35	0,79			≤0,05

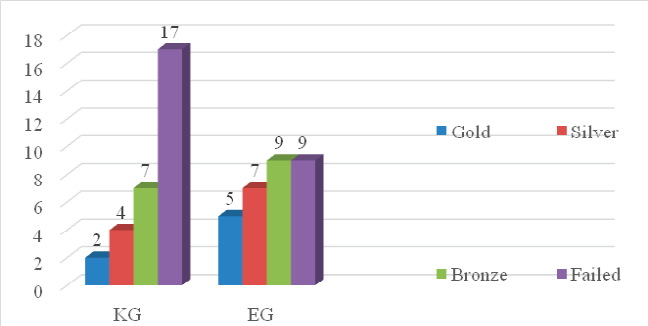

Figure 1. *EG and RG qualifications for the GTO badges*

(c) Improvements in the functionality tests supported by the digital logbooks for the individual training system management purposes and exercise–specific progress analyses that greatly contributed to the trainees' motivations for the progress and GTO Class V/ VI qualifications; with 100% of the EG making success in 9 tests versus 80% in the RG.

It should be emphasized that the GTO trainings and qualifications require hard work, endurance and determination from the trainees. We recommend the trainings being supported by experts of the Moscow Sports Committee's GTO Complex Test Center that are always in position to help and consult on applications from the interested educational establishments to their local physical education and sports offices.

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