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Theory and Practice of Physical Culture

Coronavirus as new reality of sports-specific discourse

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Abstract

Objective of the study was to analyze the contents of the narratives (in German, English, Polish, Italian and other languages) devoted to the sports-specific discourse and expansion on the coronavirus topic in different aspects.

Methods and structure of the study. The methodological basis for the study involved system description of the factual material (more than a hundred sources, including interviews with the athletes, coaches, managers, and sports experts, blogs, sports fans' diaries, contributions of the representatives from academia, etc.) based on the cognitive and discourse analysis of the selected contexts. The study aims at the identification of the current markers and projections of introspection of the discourse participants belonging to a different culture on the organization of own (first and foremost) professional activities in a new environment, in terms of new challenges and threats.

Results and conclusions. The article is devoted to the analysis of COVID-19 as a new reality of sports-specific discourse in different countries (Russia, Germany, Austria, Poland, Italy, France, etc.), the way it influences the order of discourse organization, as well as the cognitive, emotional, social, professional, communicative and other activities of the subjects of sports activity. The results of the study, newly emerged experience and practices are focused on a deeper understanding of the problem of the sports-specific discourse, identification of the points of bifurcation triggered by the crisis, and promotion of the search for solutions to the identified dissonance.

Keywords: *coronavirus, new reality, sports-specific discourse, communication in sports.*

Background. Sport is a popular, complex, voluminous, multifunctional, and multi-structural social phenomenon that occupies a special place in the life of most nations. Its exceptional status on the cognitive, emotional, linguistic, and cultural worldview scales (individual and collective) is mentioned in the works of many domestic and foreign specialists representing different scientific fields [1-7 et al.].

Apropos communication. Sport, endowed with such valuable existential characteristics, is inevitably reflected in speech, language, discourse through various communicative practices. Cf.: "Sport is first and foremost a communication effect; it is communication that its significance is revealed through" [7]. Among the conventional communicative practices that organize the "order" of the sports-specific discourse is communication between the participants (athletes, coaches, consultants, etc.) of the discourse on professional topics (training, preparation for competitions, analysis of performances at sports events, etc.).

The spectators and participants of the sports industry, who are both emotionally and materially dependent on the quality of competitions, should also be borne in mind.

The agenda has now been forcedly transformed; the distribution of the dangerous virus - coronavirus - around the world has caused most major sports events, including international competitions, to be postponed or canceled altogether.

It should be emphasized that it is the first time in contemporary history this has happened due to an

epidemic. Previously, major international competitions, such as the Olympic Games, were canceled only due to the events related to the world wars.

The rate of the late changes is also a defining feature of the situation: as early as in February 2020, all sports events were held with no restrictions all over the world, except for China. Two months after, a blanket ban on all sports events was instituted basically in all parts of the world (except for Belarus and Tajikistan).

This new reality, which has rushed into our life (including the sports sector), determines the vector of deployment of the entire sports-specific discourse: the "Coronavirus" concept has become its main communicative profile, the actualization of which, according to our observations, takes place in different, sometimes quite non-standard projections.

Objective of the study was to analyze the contents of the narratives (in German, English, Polish, Italian and other languages) devoted to the sports-specific discourse and expansion on the coronavirus topic in different aspects.

Methods and structure of the study. The methodological basis for the study involved system description of the factual material (more than a hundred sources, including interviews with athletes, coaches, managers, and sports experts, blogs, sports fans' diaries, contributions of the representatives from academia, etc.) based on the cognitive and discourse analysis of the selected contexts. The study is to identify the current markers and projections of introspection of the discourse participants belonging to a different culture on the organization of own (first and foremost) professional activities in a new environment, in terms of new challenges and threats.

Results and discussion. Let us define the key projections in the organization of the sports-specific discourse, built around the subject area "Coronavirus".

– **Cognitive dissonance** (the main purpose of physical education and sports activities is not fulfilled). According to D. Kul'man (a physical education teacher): "That sounds paradoxical, but it is true now. People get involved in sports to do something for their health. Now, they have to give it up since their health is at stake. What is more, we go to athletic associations to meet other people and even measure up in the chosen sport. But nowadays it is impossible due to the need to respect the distance" [8].

– **Professional dissatisfaction.** Anna Sen', the Olympic handball champion: "Most athletes will agree with me - this is terrible news [the postponement of the Olympics] for those who have been training for many years. Since I won the Olympics once, I know what it is. I imagine what athletes are feeling now - total disappointment" [17].

– **Psychological fear.** Ekaterina Fikil' (a basketball player competing on the Bundesliga team "Herner"): "It's a disaster, I'm afraid of getting completely broke. My contract expires in July this year, and no one can tell me what happens next" [9].

– **Emotional crisis.** D. Hamann (a sports expert): "For athletes themselves, this situation can get quite difficult. Running a football match in the stadium without the audience, without the right atmosphere, without the fans chanting is somewhat unusual. This resembles an apocalypse. It will be rather difficult for pro athletes to adjust themselves to a "competitive mode" [10].

– **Violation of the usual "professional" routine of the athlete.** A. Mitchell (a basketball player in the Italian professional league): "You're used to playing with fans, that's the practice. I don't know if the word "creepy" is correct here when talking about matches without an audience, but quietly - that's for sure" [11].

– **Reappraisal of values and paradigm shift** (rejection of multimillion-dollar contracts, reduction of wages, withdrawal from commercialization, etc.). G. Gebauer (a sports philosopher): "Mr. Gebauer, let us dip into the future. What lessons will elite sports learn from this crisis? - First of all, we must stop glorifying football. We must stop the dangerous development of sports. Today, problems of sports are nothing compared to what the coronavirus epidemic causes people" [12].

– **Financial losses to the organizers of the competitions all over the world as well as to bookies.** Igor Stolyarov, Deputy CEO for Marketing of the Russian betting company "Liga Stavok": "It is commercial leagues making money off this that will be affected first, as well as clubs raising revenue. There are four key pillars of the sports marketing market - sponsorship rights, media rights, ticket rights, and merchandise. Some sponsorship contracts will likely be suspended because there is nothing to sponsor, they can be put on hold, revalued, or even terminated. The sports channels' economy will also be affected. Gate receipts will surely be reduced to zero, and they will have to compensate all spectators who, for example, bought a pass. If judge on all four revenue streams, I think the industry has lost 50% as of now".

The co-founder of Sports.ru website, Dmitriy Navosha: "We feel it in the audience that people want a sports show right now due to the quarantine and the need to stay home. People want to get away from bad thoughts and bad news, people want to finally see something interesting. Every day, we are losing partners and contracts developed for specific tournaments are being avoided" [18].

– **A threat to the principles of "fair play"** (less doping control tests etc.). F. Zergel' (an anti-doping expert): "Doping objectors have problems, too, as medical personnel is understandably being called upon for other purposes. Since sports events are now

forbidden, most of the doping tests are frozen. And this difference in the intensity of doping testing in different countries will only increase in the following weeks" [13].

– **Endangering the national sports heritage** (cancellation or postponement of events that form the nation's cultural identity). Yves Leonard (a sports history expert): "The Tour de France cycling race is like a national anthem or flag for the French. This is a precedent phenomenon. In July, there was no life in France because of this cycling race. And now..." [14].

Last, but not least. Our review will be incomplete without analyzing the communicative behavior of sports fans.

Since football is still a world's top sport, let us turn to the discourse on football fans.

In our analysis, we noticed how quickly the consciousness of the representatives of this sub-culture had changed in the face of the crisis. If we take Germany as an example, it can be emphasized that the discourse of football fans has just been in the grip of the conflict with the owner of the Bundesliga club "Hoffenheim" D. Hopp (the club has bluntly circumvented the "sacred" rule "50+1", and this decision has caused strong protests from fans of different clubs); now, these problems no longer seem so global for worldviews of fans.

It is obvious that many people want to resume the Bundesliga matches, and this was shown by the recent opinion poll held by the WDR public TV channel (more than half of the respondents declared for continuing the championship).

It can be assumed that even in this case, "Homo fanaticus" (in the terminology of the German specialists R. Copitsa and G. Brinka) are guided exclusively by irrational rather than rational: fans whose behavior is largely regulated by their emotions need proper "fuelling", while everything else takes a back seat. The text placed on the fanzine's digital platform "schwatzgelb" is highly indicative in this respect. The fan of the "Borussia Dortmund" appears to be speaking on behalf of a multimillion-dollar army of football fans, re-tuning their coordinate system and ready to make many sacrifices to return to the usual fan practices: "And despite that, I'm looking forward to going to the stadium for the first time since the crisis. And if before the "corona" I dreamed of a vacation in the Caribbean with palms, supposedly magnificent sandy beaches, now, my dream has radically "shrunk" in terms of physical distance - now, to feel like I'm on vacation, it will be enough to travel a 5 km distance from my house to see the familiar stadium poles painted in the colors of the favorite club" [15].

The new reality forces sports fans to temporarily change the "pool" of addressees - they share words of encouragement and solidarity rather than verbal aggression: they address them to the medical staff being at the forefront of the fight against the epidemic, cf.: "When you have no strength left, just remember that the whole city is with you! - was written on the banner in Darmstadt. In Berlin, the "Union" fans expressed their solidarity as follows: "Every day, you fight for our lives, whether in hospital, nursing homes, or medical centers. Thank you»; the fans of the FC «Osnabrück» summed up "You are real heroes!" [16].

In concluding consideration of coronavirus pandemic as the new reality of the sports world, one should note a positive point too. The number of the affected top-class athletes is very low and is most likely due to their discipline, responsible attitude towards self-isolation, which, in the context of the healthy diet, individual trainings and supervision by the doctors in charge make them less susceptible to coronavirus.

The recorded cases of infection (for example, the football players of Italian "Juventus" Dybala and Rugani) occurred during the period when the number of social contacts with athletes was maximal due to their participation in the matches and communication with their fans.

Conclusion. The concept of "Coronavirus" has become an integral part of communication in sports, "spread" to the majority of its sections and the "sore" subject practically for everyone who is directly or indirectly involved in sports narratives. At this stage of "being" of the sports-related discourse, most conventional discursive scenarios (training, evaluation and self-evaluations of sports performance rates, etc.) have become obscure. Anxiety and apprehension become the dominant feeling, and every social group is characterized by its own, "intra-collective" feeling: athletes worry about their future professional career, they fear to lose emotions and motivation; sports management sees the risk of financial stability of the entrusted companies, organizations, clubs, etc.; fans worry about the forced "downtime" and impossibility to realize their collective practices; philosophers, sociologists warn about changes in the axiological, personal, communicative paradigm in sports, etc.

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Changes in maximum muscle torque of knee joint extensor muscles depending on various forms of warm-up in the training microcycle

UDC 796.015

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Abstract

Objective of the study was to determine the changes of maximum muscle torque of knee joint extensor muscles under static conditions in the training microcycle using different protocols of warm-up exercises. The study included 5 training units in the preparatory period. The test procedure included 2 measurements during one training unit. The first measurement was taken before the warm-up, the second after the end of the warm-up, and before starting the proper part of the training. During the performance of individual training units, specific warm-up protocols were applied to 15 weightlifters.

A statistically significant ($p<0.05$) increase in the torque of knee joint extensor muscles between the measurements taken before and after warm-up was observed in the second (II) ($p=0.001$), fourth (IV) ($p=0.04$) and fifth (V) ($p=0.001$) measurement day, when dynamic exercises were used in the protocol. Average values after the application of vertical jumps in place caused an average increase in value by 7.52%. The results of the conducted analyses confirm the validity of dynamic exercises often used in practice after a long waiting time for an approach during the competition in weightlifting. Carrying out such measurements may be a guide for the trainer to select the exercises during the programming of the competition warm-up.

Keywords: *warm-up, exercises, strength, knee joint, weightlifting.*

Introduction. A generally accepted and recommended method of preparing the body for intensive activity is a 5 to 10 minute warm-up in the form of low and medium intensity exercises [6]. It is recommended to perform an appropriate form of warm-up before exercise to improve later results through changes in physiological and mental status [1]. The warm-up usually includes general and specific components [7], which are intended to increase muscle temperature [3]. In the general component, low impact exercises are recommended, such as aerobic exercises for 5-15 minutes at moderate intensity [1]. A specific component is realized by performing specific repetitions [7], used to prepare the nervous system and increase muscle activation [8]. Barnes (2016) found that thrust force when performing weightlifting exercises improved by at least 10% when an element specific for the movement was incorporated into the warm-up.

Studies have shown that dynamic stretching effectively increases elasticity, maximum muscle strength, sprint performance and vertical jump performance [10]. Studies were also conducted on the changes in muscle temperature under the influence of various forms of warm-up [7]. So far, no studies have been conducted to determine the influence of individual exercises used in the warm-up on the maximum muscle torque under static conditions. In weightlifting, the torque is used to evaluate the applied training loads [5,9]. Therefore, the aim of this study was to determine the changes in the maximum values of the muscle torque of knee joint extensor muscles in static conditions of athletes practicing weightlifting, with the administration of different warm-up exercises in the training microcycle.

Material and test methods. In the training microcycle from 26-30.08.2019 changes in the muscle

torque of the knee joint extensor muscles of 15 competitors in Olympic weightlifting (Table 1) were recorded with the administration of different warm-up protocols.

Table 1. *Anthropometric data of the studied group of competitors*

	n	Age [year]	Body weight [kg]	Body height [cm]
x	15	20,1	79,1	176,5
SD	-	2,3	17,2	4,9

The study included 5 training units in the preparatory period. The test procedure included 2 measurements during one training unit. The first measurement was taken before the warm-up, the second after the end of the warm-up, and before starting the proper part of the training. During the execution of individual training units, specific warm-up protocols were applied:

I- general exercises + continuous run for 10 min, II- general exercises + jumps on the gearbox 5x5, III- general exercises + continuous run for 15 min, IV- general exercises + vertical jumps 5x5, V- general exercises + double-legged multi-jumps in 5x5 series. The general exercises in each protocol included the same set of shaping exercises. All participants or their parents have given their written consent to participate in the study. Participants were provided with information on the test procedure and the possible risks and benefits of participating in the test. 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. The values of the maximum muscle torque of the knee joint extensor muscles under isometric conditions were determined at the angle of 90 degrees. The measurements were carried out at the measuring station LR2-P (JBA Zb. Staniak, Poland) [5]. During the test, the subjects performed three repetitions of the straightening process no longer than 3 seconds. Torque values were displayed and recorded by the dynamometer and the best result was used in the analysis.

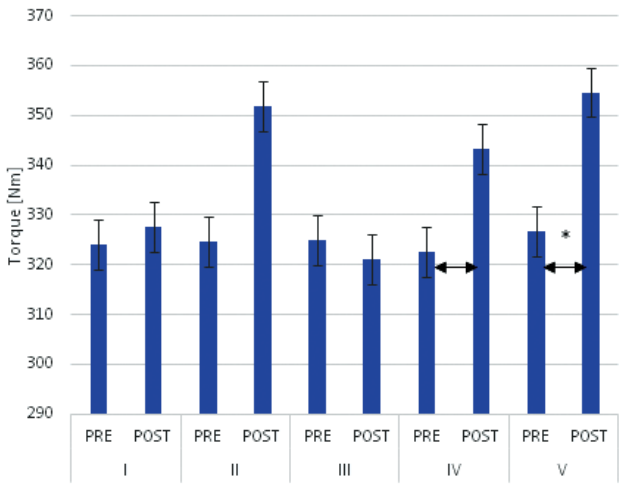

Figure 1. *The values of maximum moments of muscle strength under static conditions of knee joint extensors before and after warm-up in subsequent measurement days.*

Results of studies. The changes in the maximum muscle torque of the knee joint extensor muscles of the weightlifters with the administration of different variants of the warm-up exercises are presented in Figure 1.

A statistically significant ($p<0.05$) increase in the maximum muscle strength moments of knee joint extensors between the measurement before and after warm-up was observed in the second (II) ($p=0.001$), fourth (IV) ($p=0.04$) and fifth (V) ($p=0.001$) measurement day. Average values after the application of vertical jumps in place caused an average increase in value by 7.52%. The highest d Cohen effect was confirmed for the V attempt (0.48). After applying the continuous run for 15 minutes, the maximum muscle torque of knee joint extensor muscles decreased by 3.96 Nm among the studied group of competitors. Minor changes of 1.07% were observed in the 10-minute continuous run (I).

Summary and conclusions. The aim of the study was to determine the changes of maximum muscle torque of knee joint extensor muscles under static conditions in the training microcycle using different protocols of warm-up exercises. The measurement of the maximum torque of knee joint extensor muscles in weightlifting athletes should be preceded by a dynamic warm-up, because after these exercises we have observed a significant increase in the torque of knee joint extensor muscles compared to the pre-warm-up measurements (Figure 1).

The literature review indicates that this part of the training should lead to changes in physiological and mental state [1], as well as change muscle temperature [3]. The research indicates that it is important to use exercises with a similar structure as the exercises in the proper part of the training in order to increase the strength capabilities of the competitor by as much as 10% [2]. However, no studies were conducted to determine the changes in strength capabilities under the influence of the use of different exercises in the warm-up.

The results of our analyses correspond to those of scientists observing the influence of dynamic stretching during warm-up on the strength parameter [4]. The authors suggest that dynamic stretching is an effective technique for increasing muscle performance, but the mechanism by which dynamic stretching improved leg strength is not clearly defined. Based on the results of this study and according to data presented by Church (2001) and Yamaguchi (2005), it is assumed that muscle performance has improved by increasing muscle temperature or amplifying activation caused by the contractions of the target muscles' antagonists. Carrying out such measurements may be a guide for the trainer to select the exercises during the programming of the competition warm-up. The results of the analy-

sis also confirm the validity of dynamic exercises often used in practice (e.g. vertical jumping upwards) after a long period of waiting for an approach during weightlifting competitions.

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Effects of attentional focus on flying disc throwing accuracy in terms of lateralization and throwing technique

UDC 796.015

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Abstract

An external focus of attention rather than internal focus has been found an effective instruction in enhancing motor performance and learning in sport. Previous research has mostly investigated the effects of using attentional foci on task performance, however not including lateralization of movement. The aim of this study was to examine the use of external, internal and neutral focus of attention on forehand and backhand throwing accuracy in respect of functional lateralization. Eighteen male students (21.8±0.7 years, body mass 77.2±8.1 kg, body height 1.78±0.06 m) performed ten bilateral backhand, and forehand Frisbee throws in the counterbalanced order. Data were evaluated by ANOVA with repeated measures followed by Tukey's test and the level of significance was set at $p<0.05$. The results found that the throwing accuracy was greater ($p<0.05$) when the participants were instructed externally compared to focusing internally during the performance of the forehand and backhand throws by dominant and non-dominant arm, respectively. The results support the constrained action hypothesis and provide a practical suggestion to use external instructions rather than internal ones when executing bilaterally forms of throw, particularly when the task is difficult.

Keywords: *external focus, internal focus, motor control, Frisbee, forehand, backhand.*

Introduction. From the practical point of view, the verbal instructions and attentional focus are primary ways of communication used by coaches while guiding an athletes' attention during practice and competition [1]. The body of evidence shows benefits of using an external rather than an internal focus of attention in motor learning and performance [2]. This idea is based on the constrained action hypothesis [2], which provides a brief explanation of the effects of attentional foci on the process of movement control. According to this hypothesis directing one's attention externally i.e. on the effect of movement, may result in better performance due to improvement in automatization of motor behavior, whereas directing attention internally i.e. on the technical aspects of movement, may constrain conscious control of movement, decreasing automaticity, and limiting performance.

In sports events, which involve throwing or shooting tasks, the performance can be maximized by an increase in distance or accuracy of task performance [3]. In this regard, an external focus has been shown to be more beneficial than an internal focus of attention. For instance, Makaruk et al. [4] found an improvement in shot put throwing distance when participants received an external focus instruction versus an internal focus instruction. Similarly, an enhancement in distance was seen in the study of Zarghani et al. [5], when the discus throwers were instructed externally compared to focusing internally. In respect of movement accuracy, the benefits of adopting an external focus of attention were found in darts shooting [6] and basketball free-throws [7].

Most research in this area involves the use of attentional foci of the dominant limb in motor tasks. However, in many sports events, game conditions require to use also non-dominant limbs for successful

performance. The Ultimate Frisbee is an example of a team sport which involves a variety of movements, primary based on passing and throwing skills. The game rules precisely define that moving toward has to make through passing the flying disc between players [8]. Depending on the position of defender the backhand and forehand throws are recognized as the most basic and frequently used technique for passing between teammates [9]. However, forehand throw seems to be a more technically demanding than backward throw [10]. This indicates that throwing and passing accuracy is one of the most important skills influencing game effectiveness in this sport. Therefore, it seems to be important to see whether adopting an external focus of attention could be an effective strategy to enhance throwing performance irrespective of functional laterality and technical abilities.

Objective of the study: was to identify an attentional factor that had a positive influence on forehand and backhand throwing accuracy of the dominant and non-dominant arms. The control condition was used as a reference to examine the enhancing or depressing effects of instructions given to the subjects.

Research methods and organization. The participants (n=18, 21.8±0.7 years; body mass 77.2±8.1 kg; body height 1.78±0.06 m) were male students of the University of Physical Education with amateur experience in Ultimate Frisbee competition. The inclusion criterion for this study was that participants were able to technically perform the forehand and backhand throw. Prior to data collection in the experiment, all participants signed an informed consent.

The study used a within-participant design. The order of conditions was randomized and counterbalanced across participants to avoid potential order effects. Each participant completed 10 backhand and forehand throws with a dominant and non-dominant hand under three attentional conditions: external focus (EXF), internal focus (INF), and neutral focus (NEF). The EXF instruction was: "Focus on the target and throw the disc as accurately as possible". The INF instruction was: "Focus on the proper position of the upper arm while making a throw". The NEF instruction was "Throw it the best you can". The target was a 55 cm x 70 cm rectangle placed at a height of 1.25 cm, and 4 meters in front of the participants. It was assumed that this height would be representative as the most common space in which Ultimate players catch and throw the disc during a match. To determine the effectiveness of throw accuracy, the accuracy indicator (AI) was calculated using the following formula: AI = SA/TA, where, SA – successful attempt, TA – no. of attempts made. A one-way ANOVA with repeated measures was used to evaluate differences in throwing accuracy between the experimental groups (EXF, INF, NEF). When significant effects were observed, Tukey's post-hoc tests were conducted. The level of significance was set at $p<0.05$ for all analyses.

Results and discussion. Figure 1 presents differences in throwing accuracy of the forehand and backhand for a dominant arm under three conditions. For the forehand throw, the results of the analysis showed a significant difference between groups, $F(2.34) = 4.36$, $p<0.05$. The post hoc analysis indicated that the EXF group was more accurate than the INF group when they were performing a forehand throwing. However, there was no significant interaction for the backhand throw, $F(2.34) = 1.63$, $p=0.22$.

The mean values of the forehand and backhand throwing accuracy for the non-dominant limb in all groups are presented in Figure 2. The analysis of variance revealed a significant interaction between groups, $F(2.34) = 3.32$, $p<0.05$, when the backhand throw was performed. The Tukey test found that under

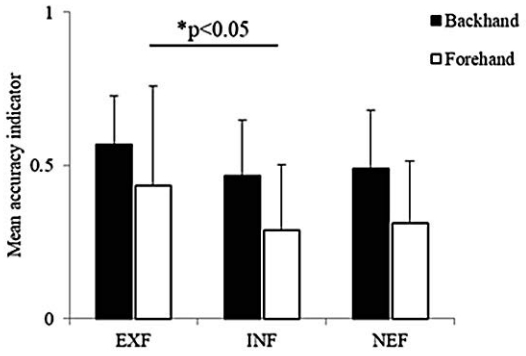

Figure 1. *Mean values of the forehand and backhand throwing accuracy for the dominant limb in the external focus of attention group (EXF), internal focus of attention group (INF), and neutral focus of attention group (NEF)*

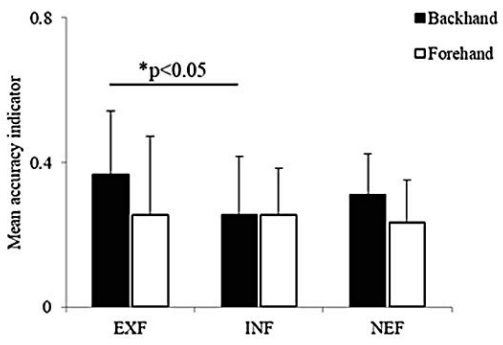

Figure 2. *Mean values of the forehand and backhand throwing accuracy for the non-dominant limb in the external focus of attention group (EXF), internal focus of attention group (INF), and neutral focus of attention group (NEF)*

the EXF group backhand throw accuracy was higher than in the INF group. The analysis did not show significant difference, $F(2.34) = 0.15$, $p=0.86$, under the forehand condition.

The main finding of this investigation was that an external focus of attention resulted in an increased throwing accuracy compared to an internal focus of attention for the dominant and non-dominant arms, respectively. The current results support the constrained action hypothesis [2] indicating that an external focus of attention promotes better movement automatization than an internal focus of attention. Simultaneously, this is consistent with other findings [4, 5, 7] which suggests that internally focusing on one's own movements constrains the motor system and leads to less accurate throwing performance.

For both dominant and non-dominant conditions, we did not observe differences in throwing accuracy when participants were focusing externally or internally compared to neutral instruction. There were also no differences between adopting a neutral and internal focus during the task performance. These results indicate that not directing focus on anything during the performance of the task may reduce the load of the motor system through the release in conscious control of movement. Therefore, focusing on the movement of throwing arm requires more attentional capacity than an external or neutral focus of attention, which significantly hinders performance.

Conclusions. The results of the present study provide novel insights on how an external focus of attention could enhance motor performance. Firstly, increasing movement accuracy as a result of adopting an external focus seems to be laterality independent. Therefore, in sports events that are bilateral in their specificity, the athletes should be instructed externally rather than internally in order to promote a throwing accuracy and improve proficiency of both upper limbs. Secondly, it appears that an external focus of attention may support a more effective movement execution when the more technically demanding and challenging task is being performed. This may suggest the use of external focus instructions as a good strategy in motor learning to help a learner in an adaptive process to a new or more difficult task.

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Effect of dry-land resistance training with resistance rubber bands on speed and swimming parameters

UDC 796.015

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Abstract

The aim of the study was to determine the effectiveness of dry-land upper limb resistance training with the use of resistance rubber bands on the speed and parameters of the front crawl arm technique. The study involved (n = 34) students of physical education, age: 21.2 ± 1.5 years, body weight: 77.8 ± 1.1 kg, body height: 180.0 ± 2.5 cm. The subjects were randomly divided into two experimental groups (D and P) and one control group (K). Group D (n = 12) trained with resistance rubber bands, while group P (n = 12) performed resistance training in the form of arm stroke swimming. Group K (n = 10) participated in the initial and final measurements. An eight-week pedagogical experiment was conducted. On dry land, resistance training was carried out with resistance rubber bands (6 sets x 50 seconds of performance with a ten-second break), whereas in water, freestyle arm stroke swimming of similar volume and intensity was performed.

Keywords: *resistance (strength) training with resistance rubber bands, arm stroke swimming.*

Introduction. Optimization of sports preparation in swimming requires multifactor biomechanical, physiological, psychological, pedagogical and biological research [1, 7, 8, 9]. One of the most important problems is the development of effective dry-land motor ability training programs. The effectiveness of dry-land resistance training for swimmers varies depending on the training means used. The improvement in power developed on dry land usually ranges from 5 to 40% [1, 3, 5, 6, 7, 9]. However, the transfer of power developed on dry land to the aquatic environment differs in size and direction of changes [1, 4, 6, 7]. This is due to the fact that the training means and devices used in the training of swimmers do not always correspond to the structure of swimming. It must be remembered that strength developed by a swimmer during dry-land training undergoes three phases before being "transferred" to the competition-like exercise. Resistance rubber bands are quite commonly used in power dry-land training of swimmers. However, there is a lack of scientific justification for the purposefulness and effectiveness of their use in swimmers training.

Study aim. The aim of the study was to determine the effectiveness of dry-land upper limb resistance training with the use of resistance rubber bands on the speed and parameters of the front crawl arm technique.

Research material. The study involved (n = 34) physical education students who were randomly divided into three groups, i.e. experimental group D (n = 12) age: 20.3 ± 0.9 years, body weight: 77.7 ± 7.5 kg, body height: 181.3 ± 3.0 cm (resistance training with resistant rubber bands), experimental group P (n = 12) age: 20.4 ± 1.0 years, body weight: 76.8 ± 7.0 kg, body height: 181.7 ± 3.0 cm (resistance training in the form of arm stroke swimming only), and control group K (n = 10) age: 23.0 ± 1.5 years, body weight: 79.0 ± 7.4 kg , body height: 177.1 ± 4.3 cm.

Research methods. An eight-week experiment was carried out. In group D, standard swimming training

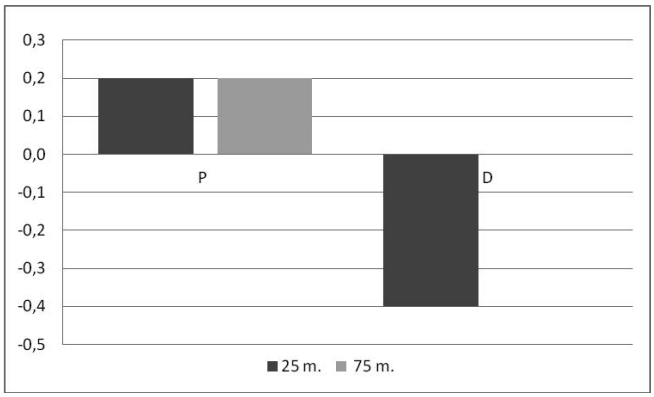

Fig. 1. *Changes in the FC at a distance of 25 m and 75 m before and after the experiment (ES).*

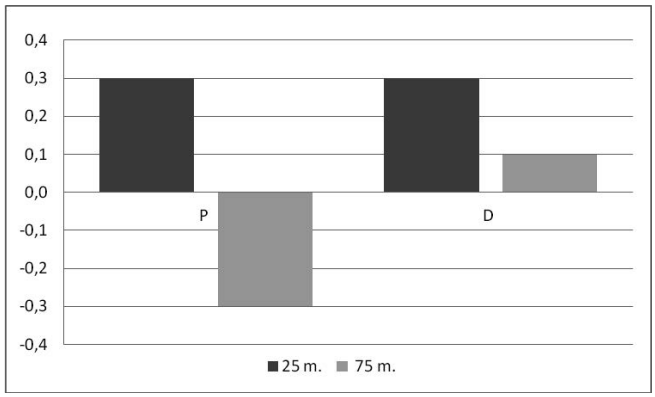

Fig. 2. *Changes in the LC at 25 m and 75 m before and after the experiment (ES).*

was combined with dry-land resistance training with resistance rubber bands. Group P performed standard swimming training combined with resistance arm stroke swimming training (the volume of work in resistance arm stroke swimming training was similar to the volume of work in dry-land resistance training with resistance rubber bands performed by group D). The volume of performance in groups D and P was 300 seconds of work with resistance during each training session. The training consisted of 6 sets of 50 seconds of work and 10 seconds of rest. Video analysis was used when swimming at a distance of 25 m and 75 m. Swimming speed V (m/s), arm frequency FC (cycles/min) and length of the motor cycle LC (m) were measured. During each training session, the FC was recorded, based on which the amount of resistance was controlled [3]. After exceeding 60 cycles (per minute) of arm performance, the amount of rubber band resistance was increased by 10%. Group K as well as groups D and P participated in two control measurements before and after the experiment. 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.

The effectiveness of training was assessed using the effect size (ES) according to Cohen [2].

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

ES – standard effect of training,

SD – standard deviation before the experiment.

The computer program Statistica 13.3 was used for the calculations.

Results. During the experiment, the volume of performance in water was 45175 m. The efforts made in the oxygen zone constituted the largest share in the total volume of performance (77.14%). The efforts in the mixed zone accounted for 17.49%, anaerobic efforts constituted 3.43%, whereas sprint loads came to 1.94%.

The effects of resistance rubber band training on the FC showed that group P achieved low training effects at 25 m and 75 m. In group D. there were also low effects with negative values at a distance of 25 m, whereas at 75 m there were no training effects. In group P, an increase in the FC was observed, while in group D a decrease was noted (Fig. 1).

The results of the LC in groups P and D at a distance of 25 m are different. Also, a small but different direction effect of changes depending on the distance was noted. In group P, there was an increase in the LC at a distance of 25 m and a decrease at a distance of 75 m. In group D, a slight increase in the LC was observed at both distances (Fig. 2).

The effect of increasing the V at a distance of 25 m in group P was medium, whereas in group D no improvement was noted. However, at a distance of 75 m in groups P and D, the ES came to 0.1 only, (Fig. 3).

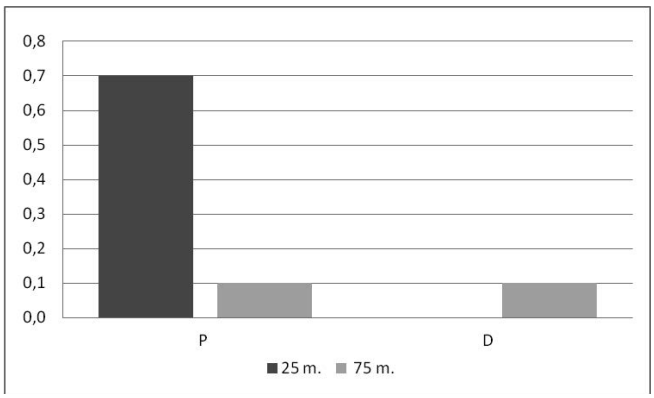

Fig. 3. *Changes in V at a distance of 25 m and 75 m before and after the experiment (ES).*

This means that the transfer of the effect of resistance training performed with the use of resistance rubber bands was low. It seems that the use of the load and duration of tests in the experiment did not bring about the desired changes. Perhaps the duration of the experiment was too short, which did not al-

low the effect to be transferred from dry land to water. In the future, similar research should be carried out extending the duration of the experiment or increasing the training load on dry land.

Conclusions

1. It was found that an eight-week swimming training program supplemented with dry-land resistance rubber bands training caused multidirectional changes in the length of the motor cycle and the frequency of arm performance.

2. The effectiveness of an eight-week resistance training program with resistance rubber bands was low, as evidenced by the ES values.

3. In sports training of swimmers, it is recommended to use dry-land resistance training as a supplement to training in water. Training means used on dry land with their specificity (force vs. time, frequency of arm performance) should be closer to swimming-specific parameters.

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Speed and speed-strength fitness of athletes specializing in various sports games

UDC 796.012

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Abstract

Objective of the study was to substantiate and conduct a comparative analysis of the speed and speed-strength qualities of athletes specializing in various team sports at the stages of sport mastery excellence from Class III to Master of Sport.

Methods and structure of the study. For the study purposes, we tested 128 volleyball players, 136 basketball players, 127 goalball players, 140 football players, and 118 rugby players qualified from Class III to Master of Sport. The following methods were applied during the study: theoretical analysis; pedagogical observations; testing; mathematical statistics methods.

Results and discussion. The experiment made it possible to determine the quantitative indicators of the speed and speed-strength preparedness of volleyball players, basketball players, handball players, football players and rugby players with different skill levels. Thus, advanced training (Class I - Master of Sport) in football was accompanied by a significant increase in the speed-strength rates in the "Counter movement jump" test: 55±0.96; 60.1±0.69; 64.5±0.78 cm. It was found that Masters of Sport in football (3.91±0.01 sec) and handball (4.18±0.02 sec) had the highest level of development of speed qualities, while the volleyball (76.4±0.57 cm) and basketball players (73.6±0.92 cm) had the highest speed-strength rates.

In parallel with the substantiation of the quantitative characteristics, we conducted a comparative analysis of the speed and speed-strength qualities of the players specializing in various sports games at the stages of sport mastery excellence from Class III to Master of Sport. The findings confirmed the authors' data on the close correlation between the growth of sport skills in team sports and the improvement of the players' speed and speed-strength qualities. At the same time, skills enhancement was accompanied by a significant increase in the speed and speed-strength rates. It is recommended that the data obtained be used to control the amount of training tools used in the skills improvement process.

Keywords: *speed, correlation, fitness, speed-strength qualities, sports games.*

Background. The analysis of the latest study reports showed that the training process quality improvement in team sports is still a relevant problem [1-6]. According to the latest scientific research, the structure of the speed and speed-strength fitness of players specializing in various sports games should also be included among the poorly studied issues, in the process of sport mastery excellence from Class III to Master of Sport (MS) [2-4]. Besides, there is little evidence in the modern literature on the comparative analysis of the speed and speed-strength abilities of representatives of various team sports [3]. The above has led to a series of studies aimed to substantiate and compare the speed and speed-strength qualities of athletes specializing in various sports games at the stages of sport mastery excellence from Class III to Masters of Sport.

Objective of the study was to substantiate and conduct a comparative analysis of the speed and speed-strength qualities of athletes specializing in

various sports games at the stages of sport mastery excellence from Class III to Masters of Sport.

Methods and structure of the study. For the study purposes, we tested 128 volleyball players, 136 basketball players, 127 handball players, 140 football players, and 118 rugby players qualified from Class III to Masters of Sport. According to the study, the level of development of the speed qualities was evaluated using the generally accepted sport-related methods [2, 3, 5]: in volleyball - "Herringbone" running, in basketball - 20 m run from standing start, in handball, football, and rugby - 30 m run from standing start. The speed-strength rates were obtained in the following tests [1, 5, 6]: in volleyball - counter movement jump and height of the vertical jump with reach, in basketball - counter movement jump, in handball - counter movement jump and standing triple jump, in rugby - standing long jump and standing triple jump.

Results and discussion. As the table shows, the results of the "herringbone" running test, which characterize the level of development of speed qualities in volleyball players, improved ($p<0.05$) during when progressing from Class III to Masters of Sport:

Similar improvement of the athletes' speed qualities was observed in the rest of the representatives of team sports - basketball players, handball players, football players, and rugby players.

The speed-strength tests (see the table) revealed the same pattern of development of the corresponding qualities as in the speed tests: all the indicators in the surveyed athletes improved unidirectionally from Class III to Masters of Sport ($p<0.05$). For example, the players' skills improvement process (Class III- Masters of Sport) in football is accompanied by a statistically significant increase in the speed-strength qualities of the players:

1) the dynamics of changes in the "Counter movement jump" test 46.0±0.71; 49.2±0.94; 55±0.96; 60.1±0.69; 64.5±0.78 cm;

2) the results of execution of the control exercise "standing triple jump": 671.5±3.72; 712.2±3.46; 762.1±5.17; 790.8±4.78; 821.4±5.64 cm.

The comparative analysis revealed that the football and handball players had the highest level of development of speed qualities, while the volleyball and basketball players had the highest speed-strength rates.

Conclusions. The data obtained help control the amount of sports-specific training tools to be used in the skills improvement process.

Among the participants of the study, the football and handball players demonstrated the highest level of development of speed qualities, while the volleyball and basketball players had the highest speed-strength rates. The prospects for further research need to be attributed to research and comparative analysis of the features of other motor qualities in different team sports.

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Table 1. *Speed and speed-strength rates in athletes of different specializations and qualifications*

Sports game	Control exercise	Qualification					
		Masters of Sport		Candidates Master of Sport		Class I	
		$\bar{\chi}$	m	$\bar{\chi}$	m	$\bar{\chi}$	m
Volleyball	«Herringbone» running, sec	23.8	0.03	24.5	0.04	25.2	0.06
	counter movement jump, cm	76.4	0.57	70.1	0.48	67.5	0.61
	Height of vertical jump with reach, m	3.09	0.01	3.01	0.01	2.96	0.02
Basketball	20 m from standing start, sec	3.18	0.02	3.22	0.01	3.28	0.03
	counter movement jump, cm	73.6	0.92	69.2	0.97	64.1	0.98
Handball	30 m from standing start, sec	4.18	0.02	4.23	0.01	4.48	0.03
	standing triple jump, cm	803.9	3.12	779.8	4.07	748.3	5.74
Football	30 m from standing start, sec	3.91	0.01	4.04	0.01	4.11	0.02
	counter movement jump, cm	64.5	0.78	60.1	0.69	55.0	0.96
	standing triple jump, cm	821.4	5.64	790.8	4.78	762.1	5.17
Rugby	30 m from standing start, sec	4.21	0.02	4.30	0.01	4.43	0.03
	Standing long jump, cm	259.7	0.57	246.3	0.66	240.1	0.71
	standing triple jump, cm	789.9	4.65	769.7	4.69	737.5	4.95

27.8±0.09; 26.5±0.05; 25.2±0.06; 24.5±0.04; 23.8±0.03 sec.

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Competitive performance results of different national teams at european armwrestling championships

UDC 796.093

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Abstract

Objective of the study was to rate the competitive performances of the national armwrestling teams at the 2015-2019 European Armwrestling Championships.

Methods and structure of the study. We basically used the formal competitive reports to rate the competitive performances of the national armwrestling teams at the 2015-2019 European Armwrestling Championships, with a special priority to the medal standings on the men/ women team scoreboards in the right/ left hand events and total medal standings.

Results and conclusions. The analysis revealed Europe's top national armwrestling teams: men's, women's, and in the overall standing. We studied the dynamics of the number of prizes won by the top three countries – leaders of the team classification: among women – Russia, Ukraine, and Slovakia; among men - Georgia, Russia, and Bulgaria; in the overall standing – Russia, Georgia, and Bulgaria. There was a positive dynamics in the number of prizes won in 2019 versus 2015 - Russia, Georgia, and Armenia, and a negative dynamics - Bulgaria and Ukraine. The best positive trend was observed among the national teams of Armenia - in 2019 as opposed to 2015 and Georgia – in 2016 as opposed to 2015. Turkey demonstrated the greatest negative dynamic in 2017 as opposed to 2015.

Medals of the 2015-2019 European Armwrestling Championships were won by 20 nations, with the top titles won by 9 of them. The Russian women's national armwrestling team has been ranked among the top-tree and the first in the total medal standings for these 5 successive years. Georgia men's and women's teams have been ranked the first and 8th, respectively for the period, with the women's team winning only 8% of the total medal stock; as compared to the Slovakia, Sweden and Lithuania women that won 100%, 87.5% and 78.5% of their national medal stocks; and in contrast to Romania and Armenia with their 100% and 75% men's medal stocks for the period.

Keywords: *armwrestling, international competitions, European Armwrestling Championship, medal standings, prizes*

Background. Medal standings at the top-ranking international sports events are traditionally ranked by the national Sports Federation among the key efficiency indicators for the sports development programs in our country. As far as the modern amateur armwrestling is concerned, its top-ranking events are the annual World and European Championships. The sports community applies a set of the event-specific and consolidated competitive performance indicators to rate the individual/ team successes in the national sports progress analyses [3, 4].

As mentioned by Shikh (2018), sports progress data and analyses are getting increasingly comprehensive, diverse and commonly accessible [6] albeit some key data arrays may still be difficult for instant access and analyses. The national teams' competitive performance analyses made on an annual basis with a special priority to the top-ranking international competitions may provide highly valuable data for the Sports Federation in its efforts to address the progress bottlenecks and make timely corrections to the key action plans, goals and solutions [1, 2].

Objective of the study was to rate the competitive performances of the national armwrestling teams at the 2015-2019 European Armwrestling Championships.

Methods and structure of the study. We basically used the formal competitive reports to rate the competitive performances of the national armwrestling teams at the 2015-2019 European Armwrestling Championships, with a special priority to the medal standings on the men/ women team scoreboards in the right/ left hand events and total medal standings.

Results and discussion. The 2015-2019 European Armwrestling Championships were run in 18 individual events with the successes consolidated to arrive at the final team standings in 7 and 11 weight classes for women and men, respectively [2], with classification into the left/ right hand events. Every championship offered 14 and 22 sets of medals for women and men, respectively till 2019 when 90 kg weight class was introduced in the women armwrestling with the women medal stock expanded to 16 medals. Given in Table 1 are the total medal standings of the men/ women national teams at the 2015-2019 European Armwrestling Championships.

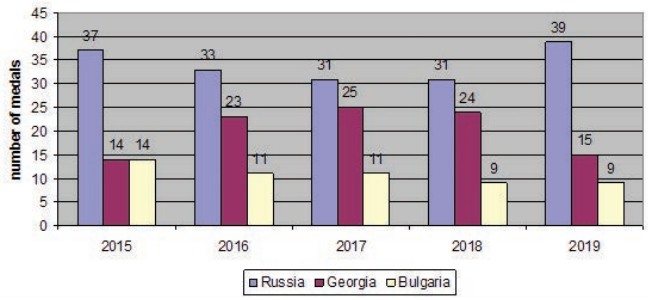

Figure 1. *Progresses of the world leading teams in the medal standings at the 2015-2019 European Armwrestling Championships: total men/ women's left/ right-hand events*

Russia has held the lead on the medal standing scoreboard for the last 5 years, followed by Georgia (minus 70 points); Bulgaria and Ukraine sharing the third place; and Turkey and Armenia ranked 6th ad 7th. On the whole, 20 nations have won medals for the study period, with Russia, Georgia and Armenia demonstrating progresses versus regresses of Ukraine and Bulgaria in the 5-year medal standings. Best progress in 2019 to 2015 was scored by Armenia (7 to 0 medals, respectively), Georgia in 2016 to 2015 (23 to 14 medals, respectively (Figure 1); whilst

Table 1. *2015-2019 European Armwrestling Championships: total left/ right-hand men/ women's team standings*

Place	Nation	2015			2016			2017			2018			2019			Total
		G	S	B	G	S	B	G	S	B	G	S	B	G	S	B	
1	Russia	11	17	9	10	12	11	16	8	7	9	15	7	20	14	5	171
2	Georgia	3	5	6	11	4	8	9	8	8	6	10	8	4	6	5	101
3	Bulgaria	6	5	3	5	5	1	2	4	5	3	3	3	5	1	3	54
4	Ukraine	7	2	4	1	6	3	2	6	5	5	0	4	0	4	5	54
5	Turkey	3	1	5	4	1	2	1	1	1	3	3	2	2	5	2	36
6	Armenia	0	0	0	2	1	1	0	3	1	3	1	1	2	0	5	20
7	Slovakia	1	1	1	1	1	0	0	1	1	1	0	2	2	3	1	16
8	Sweden	2	1	0	0	0	1	0	1	1	2	2	3	0	0	3	16
9	Lithuania	2	0	1	2	0	0	3	0	0	2	1	1	2	0	0	14
10	Latvia	0	2	1	0	1	2	0	1	0	2	0	1	1	1	1	13
11	Hungary	0	0	2	0	2	2	2	0	0	0	0	1	0	1	2	12
12	Romania	0	0	1	0	2	2	1	0	2	0	0	0	0	0	2	10
13	Byelorussia	0	1	2	0	0	1	0	0	3	0	0	0	0	2	1	10
14	Poland	0	0	0	0	1	1	0	2	2	0	0	0	0	0	0	6
15	Azerbaijan	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	3
16	Italy	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	3
17	Germany	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
18	Moldova	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	2
19	Finland	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2
20	Israel	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1

Note: G gold, S silver, B bronze

Table 2. *2015-2019 European Armwrestling Championships: women's team standings, left/ right hand totals*

№	Nation	2015			2016			2017			2018			2019			Total
		G	S	B	G	S	B	G	S	B	G	S	B	G	S	B	
1	Russia	6	8	2	6	6	7	7	5	5	4	9	2	11	8	3	89
2	Ukraine	1	1	1	1	3	0	1	3	4	3	0	3	0	2	4	27
3	Slovakia	1	1	1	1	1	0	0	1	1	1	0	2	2	3	1	16
4	Sweden	2	0	0	0	0	1	0	1	1	2	1	3	0	0	3	14
5	Turkey	2	1	2	2	0	1	0	0	0	2	2	1	0	0	0	13
6	Lithuania	2	0	1	2	0	0	2	0	0	2	0	0	2	0	0	11
7	Hungary	0	0	2	0	2	1	2	0	0	0	0	1	0	1	1	10
8	Georgia	0	0	0	1	0	1	2	0	0	0	2	0	0	0	2	8
9	Byelorussia	0	1	2	0	0	0	0	0	2	0	0	0	0	2	1	8
10	Bulgaria	0	1	1	1	0	0	0	1	1	0	0	0	1	0	0	6

Note: G gold, S silver, B bronze

Turkey made the lowest regress in 2017 to 2016 (3 to 9 medals).

Given in Table 2 are the women national team standings at the 2015-2019 European Armwrestling Championships leaded by Russia, Ukraine and Slovakia (3rd place); whilst Georgia and Bulgaria were only the 8th and 10th on the women medal standings scoreboards.

The world leading teams made the following progresses in 2019 to 2015: Russia plus 5 medals; and Ukraine and Slovakia plus 3 medals each. Given in Table 3 are the men national team standings at the 2015-2019 European Armwrestling Championships.

Leading on the men team standings scoreboards for the period has been Georgia, with Russia ranked the second, Bulgaria the third; and Ukraine, Turkey and Armenia ranked the 4th to 6th. It should be mentioned that Russia has won the highest stock of gold medals (33) for the period followed by Georgia (30). The best progress in 2019 to 2015 was scored by Turkey (plus 5 medals) and Armenia (plus 7 medals), whilst Ukraine made the lowest regress (minus 7 medals) for the period.

Conclusion. Medals of the 2015-2019 European Armwrestling Championships were won by 20 nations, with the top titles won by 9 of them. The Russian women's national armwrestling team has been ranked among the top-tree and the first in the total medal standings for these 5 successive years. Georgia men's and women's teams have been ranked the first and 8th, respectively for the period, with the women's team winning only 8% of the total medal stock; as compared to the Slovakia, Sweden and Lithuania women that won 100%, 87.5% and 78.5% of their na-

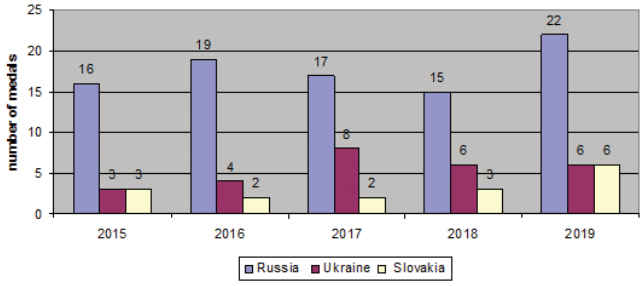

Figure 2. *Progresses of the leading women's teams in the medal standings at the 2015-2019 European Armwrestling Championships: left/ right-hand totals*

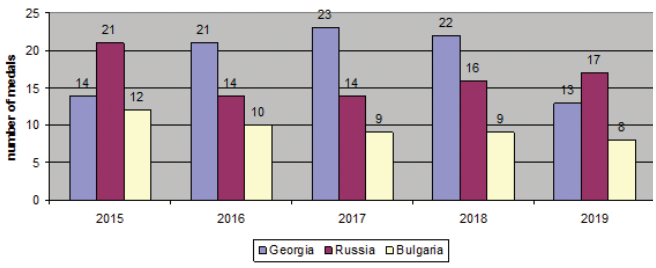

Figure 3. *Progresses the leading men's teams in the medal standings at the 2015-2019 European Armwrestling Championships: left/ right-hand totals*

Table 3. *2015-2019 European Armwrestling Championships: men's team standings, left/ right hand totals*

№	Nation	2015			2016			2017			2018			2019			Total
		G	S	B	G	S	B	G	S	B	G	S	B	G	S	B	
1	Georgia	3	5	6	10	4	7	7	8	8	6	8	8	4	6	3	93
2	Russia	5	9	7	4	6	4	9	3	2	5	6	5	9	6	2	82
3	Bulgaria	6	4	2	4	5	1	2	3	4	3	3	3	4	1	3	48
4	Ukraine	6	1	3	0	3	3	1	3	1	2	0	1	0	2	1	27
5	Turkey	1	0	3	2	1	1	1	0	1	1	1	1	2	5	2	22
6	Armenia	0	0	0	2	1	1	0	3	1	0	0	0	2	0	5	15
7	Romania	0	0	1	0	2	2	1	0	2	0	0	0	0	0	2	10
8	Latvia	0	1	0	0	0	1	0	1	0	2	0	0	1	1	1	8
9	Lithuania	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	3
10	Azerbaijan	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	3

Note: G gold, S silver, B bronze

tional medal stocks; and in contrast to Romania and Armenia with their 100% and 75% men's medal stocks for the period.

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Biomechanical characteristics of v1 skate technique of elite Nordic combined skiers

UDC 796.922

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Abstract

Objective of the study was to analyze the V1 skate ski double poling competitive techniques of the world Nordic combined elite.

Methods and structure of the study. We analyzed the video recordings of ski techniques of 20 Nordic combined skiers, who had demonstrated the best results in the ski race by the Gundersen method at the world championship. We determined the speed of movement, stride length and frequency, angular and spatial characteristics of ski technique in the 10 km pursuit race, as well as the dynamics of indicators on the four distance laps.

Results and conclusions. The study found the following specifics of the skate ski double poling techniques of the leading Nordic combined competitors: the lower leg to the surface angle is kept under 60° to facilitate the body center of mass push forward at the sub-squatting moment; asymmetric double poling move by arms and legs to maintain the run speed by rather a wider stride than special kick-off efforts; shoulders are turned when leaning on the poles towards the support leg for the stride effectiveness at some sacrifice for the poling effort efficiency; relatively even pace on the distance with the speed acceleration on the last lap mostly due to the pace being increased; and the cross-country skiing race time was found largely determined by the run speed on ascends and stride on every lap. The study data and findings are recommended to be taken into account by the Russian Nordic combined training system updating projects. Further comparative studies of the world strongest Nordic combined competitors' racing techniques are recommended.

Keywords: *Nordic combined, V1 skate ski double poling, kinematics, biomechanics, ski jumping, cross-country skiing, body center of mass.*

Background. Nordic combined events include different cross-country skiing formats with the athletes' positions determined by the prior ski jumping results. Traditionally, special attention is given to the ranking ski jumping events, whilst the cross-country skiing techniques are rated second and, hence, still underexplored [1]. Traditional cross-country skiing training in Nordic combined largely mimics modern cross-country skiing techniques in spite of the fact that the Nordic-combined-specific motor skills and fitness requirements are significantly different from the classical cross-country skiing.

As reported by some Scandinavian researchers, annual training time of highly skilled Nordic combined competitors average 836 hours with 52%, 3% and 5% of the low-, moderate- and high-intensity cross-country skiing and 40% of the strength, speed and ski jumping skills trainings [3]. Most of the Nordic combined and cross-country skiing trainings are kept within Intensity Zone I as required by the popular 75-5-20 "polarized training" system [4]. It should be noted that total aerobic trainings in the modern cross-country skiing sport average much higher than in the Nordic combined: 646 hours versus 435 hours.

Russian sources provide little if any data on the training workloads of the Nordic combined elite. Thus Sergeev et al. report the total cyclic training workloads varying under 60% for the cross-country skiing elite, with the

Table 1. *Averaged skate ski double poling technique biomechanics of the top-20 Nordic combined competitors on the 10 km pursuit cross-country skiing scoreboard, n=20*

Lap	Value	Speed, m/s	Stride, m	Cycle time, s	Pace, cycles/ min	Kick-off time, s
1	Average	2,95	3,40	1,16	51,99	0,32
	δ	0,25	0,19	0,07	2,92	0,04
2	Average	3,04	3,45	1,14	52,80	0,31
	δ	0,25	0,18	0,05	2,56	0,04
3	Average	2,88	3,20	1,12	54,10	0,31
	δ	0,24	0,22	0,08	4,13	0,04
4	Average	3,33	3,40	1,03	58,80	0,29
	δ	0,43	0,25	0,11	6,67	0,04

low-intensity and short aerobic workloads estimated at only 23-40% of the cyclic training workloads [2].

Furthermore, Nordic combined training systems assign much time to the ski jumping trainings with a special stringent requirements to the body mass indices and diets. Presently the valid FIS rules set a low-limit threshold for the body mass index – and this is only one of the reasons why the cross-country skiing techniques in Nordic combined have their specifics. We believe that an analysis of the cross-country skiing techniques biomechanics of the world Nordic combined elite may be helpful for the national Nordic combined training systems excelling purposes.

Objective of the study was to analyze the V1 skate ski double poling competitive techniques of the world Nordic combined elite.

Methods and structure of the study. The study data were collected at the 2019 World Championships in Seefeld (Austria). In the Individual Gundersen cross-country skiing event, the athletes run 10 km (four 2.5 km laps) pursuit in free style, with the starting numbers and time disadvantages ranked according to the ski jumping scores. We captured the cross-country skiing techniques on the key 370 m long 4°ascend by a Sony HDR730 video camera fixed on top of the slope perpendicular to the track; plus the same side-view moving video camera for the skate ski double poling technique recording and analyzing purposes. The skate ski double poling technique biomechanics were then processed and analyzed by Dartfish Pro Sute 7 software toolkit.

Results and discussion. The cross-country skiing techniques of the Nordic combined elite were tested to rate the momentary speed on ascend, movement frequency (pace), stride (elementary length of a movement cycle), kick-off time; and the joint angels in the low point (sub-squat phase) of the cycle. Given in Table 1 hereunder are the averaged cross-country skiing technique biomechanics of the top-20 competitors on the cross-country skiing event scoreboard.

Run speed of the top-20 competitors on the ascend was found to average 2.95 m/s on Lap 1, slightly grow on Lap 2, then somewhat fall on Lap 3 (versus the Lap 1), and come to the maximum of 3.33 m/s (12.9% growth versus Lap 1 with $p<0.01$) on Lap 4. On the whole the athletes demonstrated fairly even and economic speed management on the distance with expressed finishing spurts. The final-lap skate ski double poling technique was different in the shorter and sharper kick-offs up to leaps in the finishing acceleration phase.

The speed sag on Lap 3 was associated with the stride length falling (Figure 1), although the pace was tested to gradually grow on the whole distance, especially in the finish spurt phase. Such correlation of the stride length with pace is generally typical for a growing muscular fatigue offset by the higher-intensity pacing efforts. Of special interest for analysis was the correlation of the pursuit race technique biomechanics

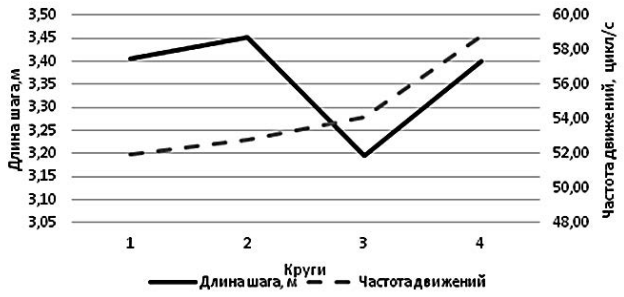

Figure 1. *Stride to pace correlation curve for the 10 km pursuit cross-country skiing event*

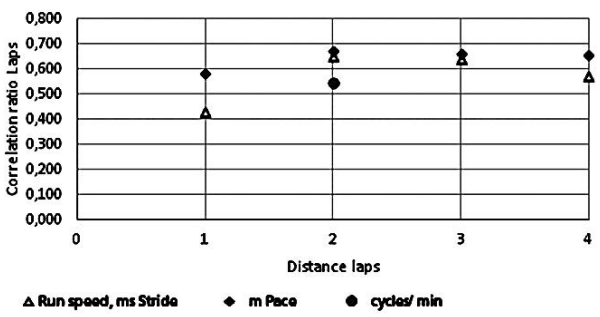

Figure 2. *Correlations of the laps-specific race speeds, strides and paces with the total race times for the top-20 competitors*

Table 2. *Average joint angles in the sub-squatting point in the 10 km pursuit race, degrees*

Lap	Value	Knee joint angle	Ankle joint angle	Thigh joint angle
1	Average	112,63	57,59	92,55
	δ	5,23	3,20	4,78
2	Average	109,34	56,79	90,04
	δ	6,02	3,61	5,12
3	Average	112,94	56,58	89,84
	δ	4,98	3,24	5,17
4	Average	109,99	54,59	82,11
	δ	5,36	3,36	5,24

with the pure race times. Given on Figure 2 are the correlations of the laps-specific race speeds, strides and paces with the total race times. We found that the most successful in the race were the athletes with the highest run speeds on ascend and longest strides, whilst the movement pace was in a significant correlation with the race time on the whole (it was tested significant for Lap 2 only).

The skate ski double poling technique biomechanics tests included joint angles metering with a special priority to the lowest point (sub-squatting) positions when the body mass and shin (knee position versus the toe) are shifted forward. Given in Table 2 are the joint angles in sub-squatting phase for the top-20 cross-country skiing competitors on every lap. The shin-to-ground angles were found to vary under 60° to facilitate the body center of mass pushing forward by the knee joint is in the top-flexion position. The Nordic combined elite knee and ankle joint angles were found to have no significant differences with the cross-country skiing elite. The torso to thigh angle was found to depend on the torso tilt angle and thigh position. The thigh angle was found to significantly (by 11.3%) fall on the final lap, with the torso tilt growing – that may be indicative of the high fatigue.

Having analyzed the top-20 Nordic combined competitors' cross-country skiing technique biomechanics, we found the following technical specifics. The double poling movement was found asymmetric, although arm bent remains virtually the same when the poles touch the ground to avoid losses. The shoulders remain turned to somewhat reduce the pressure on poles and facilitate the poling move at some sacrifice for its effectiveness. The lower is the individual strength the higher is the torso twist. Legs make a wide stride (lunge) with the lower leg highly tilt to facilitate the body center of mass being moved forward. The lead leg kick-off was tested active and strong with the other leg kicking off smoothly, without a special effort. The cross-country skiing race leaders were found to keep the movement technique stable all over the distance to save resource for the movement pace and kick-off strength increase in finishing acceleration phase.

Conclusion. The study found the following specifics of the skate ski double poling techniques of the leading Nordic combined competitors: the lower leg to the surface angle is kept under 60° to facilitate the body center of mass push forward at the sub-squatting moment; asymmetric double poling move by arms and legs to maintain the run speed by rather a wider stride than special kick-off efforts; shoulders are turned when leaning on the poles towards the support leg for the stride effectiveness at some sacrifice for the poling effort efficiency; relatively even pace on the distance with the speed acceleration on the last lap mostly due to the pace being increased; and the cross-country skiing race time was found largely determined by the run speed on ascends and stride on every lap. The study data and findings are recommended to be taken into account by the Russian Nordic combined training system updating projects. Further comparative studies of the world strongest Nordic combined competitors' racing techniques are recommended.

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Anthropometric profiles and body composition of elite polish senior Greco-roman wrestlers

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Abstract

Many findings indicate that anthropometric features and body composition can play an important role in assessing important aspects of competition preparedness in Greco-Roman wrestlers. The purpose of this study was to develop the anthropometric and body composition profiles of elite Greco-Roman wrestlers with respect to their weight category and the level of performance. In studying anthropometric variables, their relationship with other factors (physiological, fitness, and technical) that can determine the athlete's success should be considered most of all.

Keywords: *anthropometric features, Greco-Roman style.*

Introduction. Many studies of wrestling present the analyses of factors determining successful performance in the sport, including wrestlers' anthropometric features that, individually or together with other factors, enable the assessment of athletes' readiness for competition (Platonov, Nikitienko 2019, Gierczuk 2019).. Studying wrestlers' anthropometric features and body composition can also be a way of determining the anthropometric characteristics of a model wrestler. Wrestlers' anthropometric features and body composition provide valuable measures of their preparedness for competition due to their association with other success factors. For instance, fat-free body mass has been found to be strongly correlated with athletes' mean power on the Wingate test. An association has also been demonstrated between the performance of lightweight Greco-Roman wrestlers and the sum of skinfolds and arm circumference (Gierczuk 2019). The authors of another study who investigated wrestlers' anthropometric features in relation to their performance on various tests have reported a significant correlation between percentage body fat and VO2max (aerobic capacity) (Melki, Bouzid, and Fadhloun 2019). The purpose of this study was to determine the anthropometric and body composition profiles of elite Greco-Roman wrestlers taking account of their weight category and sport achievements.

Materials and methods. The study was conducted with 49 Greco-Roman wrestlers divided into lightweight (from 59 to 75 kg) and heavyweight (from 80 to 130 kg) athletes. Athletes in each weight category were additionally divided into those who won medals at the Poland Seniors Championships (successful) and those who took places from 5th to 8th (less successful) (Tab. 1.)

The anthropometric features of the study participants were determined by measuring their height, mass, and BMI, the length of the upper and lower limbs, the width of the shoulders, the width of the pelvis, the resting circumference of the arm, forearm, thigh and calf, as well as the thickness of the pectoral, biceps, subscapular, suprailiac, abdominal, medial calf and chin skinfolds (seven in total)). The hypothesis that in neither of the two weight categories did the values of the selected parameters differentiate successful from less successful wrestlers was tested by

Table 1. *Wrestlers' characteristics (mean(SD))*

Group	Weight category	Age (years)	Experience (years)
successful	lightweight heavyweight	22.36(1.43) 22.36(1.74)	8.45(1.91) 10.45(3.29)
less successful	lightweight heavyweight	20.54(1.51) 21.51(1.83)	6.63(0.81) 6.75(1.13)

one-way ANOVA at a level of significance of $p<0.05$. Its results for the successful wrestlers were normalised to means and standard deviations of the results obtained for the less successful athletes.. Lastly, a logistic regression model was built using parameters that significantly differentiated successful from less successful wrestlers.

Results. The anthropometric features and body composition proved more important for **t**he successful performance of the lightweight Greco-Roman wrestlers. Although differences in the mean values of the analysed parameters occurred both among lightweight wrestlers and among heavyweight wrestlers, only in the first group the differences were significant. The near significance of arm circumference in the heavyweight wrestlers and a relatively high value of its effect size (omega square) indicated, however, that the parameter can be important for wrestlers' ability to win medals regardless of their weight category (tab.2,3; fig. 1,2).

The logistic regression model showed that the analysed variables have some role in a wrestler's ability to win a medal, but overall it was not significant and its variables explained only 9% of the variance.

Discussion. The importance of anthropometric features and body composition in modelling the successful Greco-Roman wrestler is highlighted in many studies that differ from ours in the research approach. High standard deviations obtained in the study of the anthropometric features of the elite Azerbaijani wrestlers (Rahmani, Mirzaei, et al. 2019) for athletes' height and BMI indicate that its authors excluded weight categories from the analysis. Even so, their findings are consistent with ours in that they too point to a high proportion of fat-free body mass and a low percentage of fat in the participants. Similar findings **(**especially regarding athletes' fat mass content) were reported by researchers studying the Italian national wrestling team (Zaccagni 2012), who estimated that the male wrestlers' fat mass percentage was at the minimum level of ca. 5%, i.e. less than in our study**.** The results obtained by the Colombian authors (Ramirez-Velez et al. 2014) are similar to ours for most parameters analysed (mainly circumferences and linear dimensions). The authors of a case study comparing the anthropometric and body-composition parameters between a four-time world champion in Greco-Roman wrestling and other wrestlers in the same weight category (B.

Tab. 2. *Comparison of successful and less successful wrestlers (heavyweight)*

Variable	Group		P (omega square)
	successful	less successful	
Body height (cm)	178.27(8.37)	182.08(4.12)	>0.1(-0.04)
Body mass (kg)	90.16(16.69)	87.25(14.46)	>0.1(0.00)
BMI (kg/m2)	28.00(3.52)	26.23(4.43)	>0.1(-0.01)
Fat content (%)	13.65(2.83)	11.78(6.61)	>0.1(-0.04)
Muscle mass (kg)	73.70(11.10)	72.32(6.03)	>0.1(0.07)
Water content (%)	59.55(3.60)	62.12(3.91)	0.07(0.10)
Length of lower limbs (cm)	99.39(5.70)	103.63(5.00)	0.09(0.08)
Length of upper limbs (cm)	72.87(4.04)	76.84(6.37)	>0.1(-0.03)
Shoulder width (cm)	46.81(2.60)	47.33(1.29)	>0.1(-0.04)
Pelvis width (cm)	35.91(2.14)	36.25(2.27)	>0.1(-0.04)
Arm circumference (cm)	34.18(2.73)	31.92(2.62)	0.06(0.12)
Forearm circumference (cm)	28.16(3.36)	27.79(4.37)	>0.1(0.01)
Thigh circumference (cm)	58.46(5.49)	56.17(4.79)	>0.1(-0.04)
Calf circumference (cm)	38.67(3.69)	38.32(3.21)	>0.1(0.00)
Sum of 7 skinfolds (cm)	65.67(22.55)	76.67(28.36)*	>0.1(-0.04)

*mean(SD)

Tab. 3. *Comparison of successful and less successful wrestlers (lightweight)*

Variable	groups		P (omega square)
	successful	less successful	
Body height (cm)	174.64(4.54)	172.36(3.20)	>0.1(0.04)
Body mass (kg)	69.46(4.99)	67.67(5.28)	>0.1(-0.02)
BMI (kg/m2)	22.68(1.63)	22.78(1.90)	>0.1(-0.05)
Fat content (%)	7.91(2.62)	7.60(2.04)	>0.1(-0.04)
Muscle mass (kg)	60.57(2.41)	59.35(3.71)	>0.1(-0.01)
Water content (%)	63.91(3.19)	65.55(2.29)	>0.1(0.04)
Length of lower limbs (cm)	96.60(2.84)	94.50(2.06)	0.06(0.12)
Length of upper limbs (cm)	69.70(2.34)	70.91(3.54)	>0.1(0.00)
Shoulder width (cm)	42.71(2.58)	44.60(2.43)	0.09(0.09)
Pelvis width (cm)	34.28(1.12)	34.00(2.26)	>0.1(-0.04)
Arm circumference (cm)	*31.28(2.85)*	*28.77(2.09)*	*<0.05(0.17)*
Forearm circumference (cm)	26.20(1.80)	25.38(1.39)	>0.1(0.02)
Thigh circumference (cm)	53.00(2.94)	53.25(3.52)	>0.1(-0.05)
Calf circumference (cm)	34.95(1.62)	36.73(2.65)	0.07(0.11)
Sum of 7 skinfolds (cm)	*47.98(9.14)*	*59.82(12.51)**	*<0.05(0.20)*

*mean(SD)

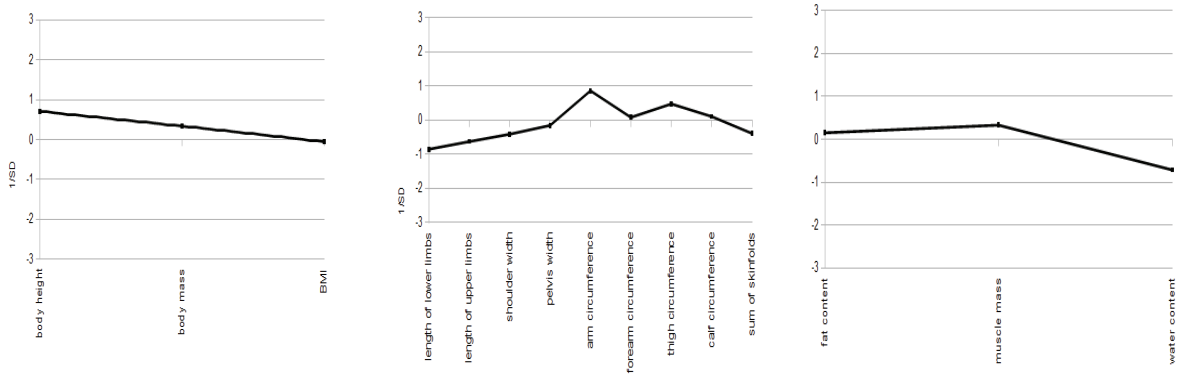

Fig. 1 *Normalized anthropometric features and body composition (heavyweight wrestlers)*

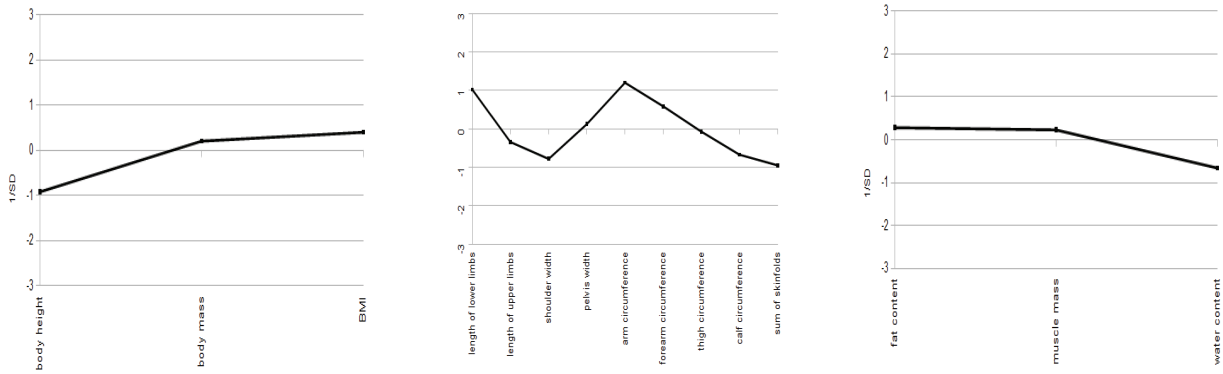

Fig. 2. *Normalized anthropometric features and body composition (lightweight wrestlers)*

Tab. 4. *Results from the logistic regression model (lightweight wrestlers)*

Variable	Parameter estimate/std error	t value/p
Arm circumference	-0.46/0.26	-1.73/0.09
Sum of 7 skinfolds (cm)	0.10/0.05	1.86/0.07

Adjusted R squared 0.09 /F statistic 0.11

Mirzaei et al. 2011) did not find them to be significantly different. The findings of this study are similar to ours only with respect to the heavyweight wrestlers, because the lightweight wrestlers in our study proved to differ significantly in the values of several parameters. The authors of another study (Casals et al. 2017) observed that wrestlers' anthropometric features and body composition are specific to their weight category. The observation is entirely consistent with our findings, which also show that the anthropometric features are more important for the success of the lightweight wrestlers. The knowledge of this is of vital importance and should be made use of in the early stages of developing training programmes for athletes (including wrestlers). It is important to note that the significance of the above findings goes beyond wrestling as they also extend to other combat sports (see, for instance, Reale et al. 2019).

Conclusions. The wrestlers' anthropometric features and body composition contribute to a very limited extent to their ability to win medals, mostly in the lightweight categories.

In studying athletes' anthropometric parameters, the main focus should be on their relationship with other success factors (physiological, fitness, and technical).

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Commitment to physical education and sports: schoolchildren's physical activity motivations and priorities survey

UDC 37.062.5

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Abstract

Objective of the study was to rate the schoolchildren's physical activity motivations and preferences for the physical education and sports commitment encouragement purposes.

Methods and structure of the study. The study was based on a mass anonymous questionnaire survey of the 11, 13 and 15 years old school population under the international 2017-18 Health Behavior in Schoolchildren (HBSC) Project research initiative – under supervision of the St. Petersburg Scientific Research Institute of Physical Culture (SPSRIPC) as the Health Behavior in Schoolchildren Project leader for the Russian Federation [4]. The SPSRIPC Health Behavior in Schoolchildren Project team developed a special data processing and analytical software toolkit for the Health Behavior in Schoolchildren survey data with a Russian version of the international questionnaire survey form and a cloud database for the Project.

For further analysis of the schoolchildren's physical education and sport / physical activity motivations, the authors formed two 11-year-old groups of both sexes based on their weekly physical activity / physical education and sport rates above the physical activity threshold of 1 hour per day – namely MVPA3 and MVPA7 groups with the reported 3-day (moderate) and 7-day (highly) weekly physical activity, respectively.

Results of the study and conclusions. The survey data and analyses demonstrated that the schoolchildren with the moderate physical education and sport commitment (MVPA3) make an emphasis on the optimal physical health keeping motivations and preferences. It should be noted that only 25.8% and 25% of the boys and girls in MVPA3 group (respectively) self-rated own health "excellent"; versus 64.7% and 44.7% in MVPA7 group. The intergroup difference on this scale was found significant ($p<0.01$ for the boys and $p<0.05$ for the girls). The highly-physical-education-and-sport -committed group (MVPA7) was also tested notably higher on the social self-assertion motivations rating scale.

Keywords: *schoolchildren, physical education and sports, commitment, motivations and preferences, physical activity.*

Background. Schoolchildren's physical activity motivations and preferences (need to be analyzed and taken into consideration by the school physical education service and other physical activity encouragement initiatives [3, 5]. Knowing that, the physical education and sport service and research community gives a special priority to the schoolchildren physical activity motivations and preferences studies and analyses for the school physical education and sport service customization and healthy systemic physical activation initiatives [1, 4].

Objective of the study was to rate the schoolchildren's physical activity motivations and preferences for the physical education and sports commitment encouragement purposes.

Methods and structure of the study. The study was based on a mass anonymous questionnaire survey of the 11, 13 and 15 years old school population under the international 2017-18 Health Behaviors in Schoolchildren (HBSC) Project research initiative – under supervision of the St. Petersburg Scientific Research Institute of Physical Culture (SPSRIPC) as the Health

Behavior in Schoolchildren Project leader for the Russian Federation [4]. The SPSRIPC Health Behavior in Schoolchildren Project team developed a special data processing and analytical software toolkit for the Health Behavior in Schoolchildren survey data with a Russian version of the international questionnaire survey form and a cloud database for the Project [4].

The schoolchildren commitment to physical education and sport and physical activity was rated on the MVPA (moderate-to-vigorous physical activity) test scale, with the minimal healthy physical activity threshold for the age group set at one hour per day – as the bottom physical health-securing physical activity level [2]. The schoolchildren physical activity motivations were tested on a 3-point scale by a question on their leisure-time physical activity importance with "very important", "quite important" and "unimportant" options plus further optional reasons (see Table 1).

Table 1. *Reported schoolchildren's motivations for the leisure-time physical activity*

1. Have fun
2. Succeed in sports
3. Be a winner
4. Make friends
5. Improve health
6. Meet my friends
7. Keep good fitness
8. Look nice
9. Enjoy the feel of my body under control
10. Please my family
11. Be cool
12. Control my weight
13. It's exciting

Results and discussion. For further analysis of the schoolchildren's physical education and sport / physical activity motivations, we formed two 11-year-old groups of both sexes based on their weekly physical activity / physical education and sport rates above the physical activity threshold of 1 hour per day – namely MVPA3 and MVPA7 groups with the reported 3-day (moderate) and 7-day (highly) weekly physical activity, respectively: see Table 2.

Table 2. *11-year-old sample grouping for the survey*

Group	Boys	Girls
MVPA3	130	140
MVPA7	154	112

Given hereunder are the reasons for the high (and 'very important') leisure-time physical activity ranked by importance in descending order.

Figure 1. *MVPA3 boys' physical activity motivations and priorities*

The MVPA3 boys reported the following key physical activity motivations and preferences: improve health (58.4%), keep good fitness (49.2%) and look nice (42.6%). Note that the social needs, self-assertion and communication related motivations and preferences were rated meaningfully lower by this subgroup.

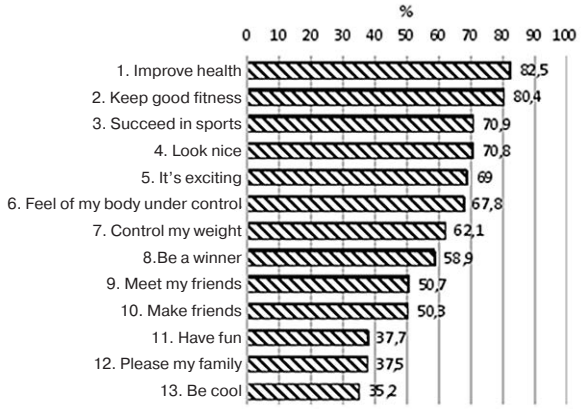

Figure 2. *MVPA7 boys' physical activity motivations and priorities*

The MVPA7 boys reported the following key physical activity motivations and preferences: improve health (82.5 %), keep good fitness (80.4 %) and succeed in sports (70.9%).

The MVPA3 girls reported the following key physical activity motivations and preferences: improve health (56.6 %), keep good fitness (50%) and look nice (47.1%).

The MVPA7 girls reported the following key physical activity motivations and preferences: improve health (84.3%), keep good fitness (84%) and look nice (72%). Note that the percentages of these motivations were reported notably higher by the MVPA7 girls versus their peers.

Conclusion. The survey data and analyses demonstrated that the schoolchildren with the moderate physical education and sport commitment (MVPA3) make an emphasis on the optimal physical health

Figure 3. *MVPA3 girls' physical activity motivations and priorities*

Figure 4. *MVPA7 girls' physical activity motivations and priorities*

keeping motivations and preferences. It should be noted that only 25.8% and 25% of the boys and girls in MVPA3 group (respectively) self-rated own health "excellent"; versus 64.7% and 44.7% in MVPA7 group. The intergroup difference on this scale was found significant ($p<0.01$ for the boys and $p<0.05$ for the girls). The highly-physical-education-and-sport -committed group (MVPA7) was also tested notably higher on the social self-assertion motivations rating scale.

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Motivations for school physical education and sports activities: family contribution survey

UDC 37.062.5

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Abstract

Objective of the study was to analyze family contributions to the schoolchildren's physical education and sports motivations and values.

Methods and structure of the study. The study was designed to complement the international Health Behavior in School-aged Children (HBSC) Project [1]. The HBSC Project team of Saint Petersburg Research Institute of Physical Culture has developed a Russian version of the HBSC website with a questionnaire survey form and a cloud database plus a special survey data processing and analyzing software toolkit [2]. The 11, 13 and 15 year old sample was tested for the physical education and sports motivations influencing family climate aspects (communication, moral support, joint physical education practices, joint discussions and solutions etc.). For further analysis, the sample was split up into two physical activity (moderate to vigorous physical activity) groups reportedly trained 3 and 7 days a week – MVPA3 and MVPA7, respectively. Significance of the intergroup survey data differences was rated by the nonparametric Mann-Whitney U-test.

Results and conclusions. The survey data and analyses showed that the schoolchildren's physical activity is largely dependent on the family climate, support, attention to the children's problems, constructive discussions and role models provided by the adults – jointly referred as the family contribution to the school physical education and sports motivations. In this context, we recommend giving a special priority to innovative technologies focused on the joint physical education and sports services for schoolchildren and their families.

Keywords: *schoolchildren, physical education and sports, family relations, motivations and values, physical activity, Health Behavior in School-aged Children.*

Background. Common knowledge verified by modern research indicates that the schoolchildren health standards are largely determined by the family contributions dependent in their turn on the income level, family relationship, healthy/ bad habits of the adult family members etc. [4, 5]. Families are known to form the children's behavioral models since the adults serve as the main role models for them [3, 6]. The school physical education and sports research in this context should give a special priority to the family climate on the whole and family contributions to the children's physical education and sports motivations and preferences in particular.

Objective of the study was to analyze family contributions to the schoolchildren's physical education and sports motivations and values.

Methods and structure of the study. The study was designed to complement the international Health Behavior in School-aged Children (HBSC) Project [1]. The HBSC Project team of Saint Petersburg Research Institute of Physical Culture has developed a Russian version of the HBSC website with a questionnaire survey form and a cloud database (http://hbsc-ru.com) plus a special survey data processing and analyzing software toolkit [2]. The 11, 13 and 15 year old sample was tested for the physical education and sports mo-

tivations influencing family climate aspects (communication, moral support, joint physical education practices, joint discussions and solutions etc.). For further analysis, the sample was split up into two physical activity (moderate to vigorous physical activity) groups reportedly trained 3 and 7 days a week – MVPA3 and MVPA7, respectively. Significance of the intergroup survey data differences was rated by the nonparametric Mann-Whitney U-test.

Results and discussion. The MVPA3 and MVPA7 groups were tested significantly different on the family behavioral stereotypes rating scales: thus MVPA7 reported more frequent sporting practices; joint morning exercises/ gymnastics/ jogging etc. (see Figures 1, 2); family discussions and joint solutions; better moral support from and better communication in their families.

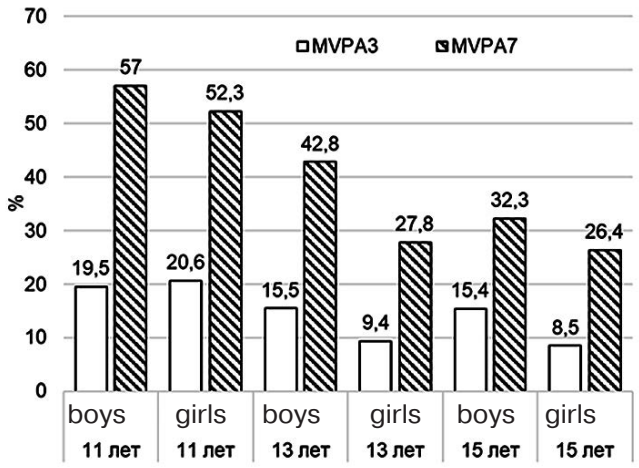

Figure 1. *Family sporting practices reported by the MVPA3 and MVPA7 groups*

The MVPA7 reported more frequent family sporting practices than MVPA3. Thus the MVPA7 11-year-old boys and girls were 57% and 52.3% (respectively) positive on this scale versus 19.5% and 20.6% in their MVPA3 peers (p <0.05); the 13-year-old MVPA7 boys and girls were 42.8% and 27.8% (respectively) positive on this scale versus 15.5% and 9.4% in MVPA3 group (p <0.05); and the 15-year-old MVPA7 boys and girls were 32.3% and 26.4% (respectively) positive on this scale versus 26.4% and 8.5% in MVPA3 group (p <0.05).

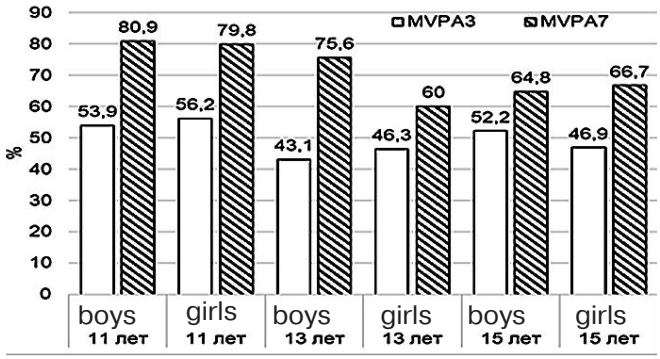

Figure 2. *Family morning exercises/ jogging/ gymnastics reported by the MVPA3 and MVPA7 groups*

On the family morning exercises/ jogging/ gymnastics rating scale, the MVPA7 group was also tested higher than the MVPA3 group. Thus the 11-year-old MVPA7 boys and girls were 80.9% and 79.8% (respectively) positive on this scale versus 53.9% and 56.2% in MVPA3 group (p <0.05); MVPA7 13-year-old boys and girls were tested 75.6% and 60% (respectively) positive on this scale versus 43.1% and 46.3% in MVPA3 group (p <0.05); and MVPA7 15-year-old boys and girls were 64.8% and 66.7% (respectively) positive on this scale versus 52.2% and 46.9% in the MVPA3 group (p <0.05).

On the joint family discussions and solutions rating scale, the MVPA7 group was also tested higher than MVPA3 group. Thus the MVPA7 11-year-old boys and girls were 46,4% and 43,1% (respectively) positive on this scale versus 27,8% and 43,1% in MVPA3 group (p <0.05); MVPA7 13-year-old boys and girls were tested 42,7% and 47,9% (respectively) positive on this scale versus 27,2% and 25,5% in MVPA3 group (p <0.05); and MVPA7 15-year-old boys and girls were tested 42,1% and 46,7% (respectively) positive on this scale versus 25,1% and 25,4% in MVPA3 group (p<0.05).

On the family support rating scale, the MVPA7 group was also tested higher than MVPA3 group. Thus the MVPA7 11-year-old boys and girls were 78,5% and 71% (respectively) positive on this scale versus 57,9% and 63,3% in MVPA3 group (p<0.05); MVPA7 13-year-old boys and girls were tested 75,4% and 69,9% (respectively) positive on this scale versus 45,7% and 51,4% in MVPA3 group (p<0.05); and the

MVPA7 15-year-old boys and girls were tested 65,1% and 59,8% (respectively) positive on this scale versus 40,4% and 45,3% in MVPA3 group (p <0.05).

Furthermore, on the family communication rating scale, MVPA7 group was also tested higher than MVPA3 group. Thus on the mother communication scale, the MVPA7 11-year-old boys and girls were 57,3% and 55,7% respectively) positive versus 43,4% and 41% in MVPA3 group (p<0.05); MVPA7 13-year-old boys and girls were tested 50% and 44,4% (respectively) positive on this scale versus 29,3% and 34,8% in MVPA3 group (p<0.05); and the MVPA7 15-year-old boys and girls were tested 48,3% and 50,5% (respectively) positive on the scale versus 29,8% and 35% in MVPA3 group (p<0.05). And on the father communication scale, the MVPA7 11-year-old boys and girls were 39,7% and 27,3% (respectively) positive versus

27,6% and 18,8% in MVPA3 group ($p<0.05$ and insignificant p=0,2, respectively); MVPA7 13-year-old boys and girls were tested 35,5% and 26,8% (respectively) positive on this scale versus 23,8% and 12,2% in the MVPA3 group (insignificant p=0.06 and significant $p<0.05$, respectively); and the MVPA7 15-year-old boys and girls were tested 36,7% and 24,2% (respectively) positive on this scale versus 24,2% and 19,6% in the MVPA3 group ($p<0.05$ and insignificant p=0.7, respectively).

Conclusion. The survey data and analyses showed that the schoolchildren's physical activity is largely dependent on the family climate, support, attention to the children's problems, constructive discussions and role models provided by the adults – jointly referred as the family contribution to the school physical education and sports motivations. In this context, we recommend giving a special priority to innovative technologies focused on the joint physical education and sports services for schoolchildren and their families.

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Preschoolers' physical fitness tests in "bgtoshka" gto project

UDC 796.011

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Abstract

Objective of the study was to rate physical fitness of preschoolers trained under the BGTOshka Project and analyze the test data using the GTO Complex online service toolkit.

Methods and structure of the study. The study was run under the GTO Complex Online Service Implementation Project of the Surgut Government Education Department at Preschool Establishment No. 39 "Snow White" – one of the municipal experimental sites. The study was designed to rate physical fitness of the preschoolers trained under the BGTOshka Project and analyze the test data using the GTO Complex online service toolkit on a sample of 5.6-6 year-olds (n=80).

Results and conclusions. The study data and analyses showed the 5.5-6 year-olds' physical fitness being low on the strength, speed, and speed-strength rating scales. We believe that this backlog may be due to the sensitive beginner period in the speed-strength and speed qualities formation process. We also found that the 5.5-6 year-olds' endurance development process is relatively stalled in this age period, and this fact should be taken into account by the physical education systems for the age group.

Keywords: *GTO Complex, "BGTOshka" project, online service, preschoolers, physical fitness.*

Background. As things now stand, the national theoreticians and practitioners still fail to fully mobilize the GTO Complex potential for the preschool population in the socializing, physical training and healthy lifestyle cultivation domains [1]. The valid physical education concept of the national general education system requires the students' physical education competences and skills being tested at the Russian school sports competitions/ games, Presidential competitions and by the GTO Complex tests. Presently the education system has accumulated valuable experience of the school physical education service elements designed to train the 6-7 year-olds for the future GTO Complex tests [2], physical fitness practices to make them fit for the tests [3, 6]; plus "BGTOshka" (beginner GTO) Project to train preschoolers for the future GTO Complex tests [4, 5]. It should be mentioned, however, that the national educational system is still in need of physical fitness training system for the 3-6 year-olds and the relevant standard regulatory requirements and GTO Complex test standards.

Objective of the study was to rate physical fitness of preschoolers trained under the BGTOshka Project and analyze the test data using the GTO Complex online service toolkit.

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Table 1. *"BGTOshka" Project test data, boys group (n=40)*

Tested qualities	Gold		Silver		Bronze		Failed	
	n	%	n	%	n	%	n	%
Speed	10	25,0	19	47,5	3	7,5	8	20
Strength	13	32,5	11	27,5	7	17,5	8	20
Endurance	13	32,5	22	55,0	4	10,0	1	2,5
Speed- strength	4	10,0	8	20,0	6	15,0	22	55,0
Flexibility	14	35,0	15	37,5	8	20,0	3	7,5

Table 1. *"BGTOshka" Project test data, girls group (n=40)*

Tested qualities	Gold		Silver		Bronze		Failed	
	n	%	n	%	n	%	n	%
Speed	13	32,5	13	32,5	2	5,0	12	30,0
Strength	25	65,5	12	30,0	1	2,5	2	5,0
Endurance	23	57,5	11	27,5	5	12,5	1	2,5
Speed-strength	7	17,5	8	20,0	13	32,5	12	30,0
Flexibility	27	67,5	11	27,5	0	0	2	5,0

Results and discussion. Of special interest for the purposes of the study was the children's physical fitness for the GTO Complex tests rated by the "BGTOshka" Project test system. As a result, in the speed rating 30m sprint test, 25%, 47.5% and 7.5% of the boys group qualified for the gold, silver and bronze badges, respectively, and 20% failed the test: see Table 1.

In the strength rating test, 32.5%, 27.5% and 17.5% of the boys group qualified for the gold, silver and bronze badges, respectively, and 20% failed the test. In the endurance rating test, 32.5%, 55.0% and 10.0% of the boys group qualified for the gold, silver and bronze badges, respectively, and 2.5% failed the test. In the speed-strength rating test, 10.0%, 20% and 15% of the boys group qualified for the gold, silver and bronze badges, respectively, and 55% failed the test. And in the flexibility rating tests, 35%, 37.5% and 20% of the boys group qualified for the gold, silver and bronze badges, respectively, and 7.5% failed the test. Most difficult for the boys group were the strength rating pull-ups, speed rating 30m sprint and speed-strength rating standing long jump tests – with 20%, 20% and 55,0% of the group, respectively, found unable to cope with the tests.

Given in Table 2 hereunder are the test data for the girls group. In the speed rating test, 32.5%, 32.5% and 5% of the girls qualified for the gold, silver and bronze badges, respectively, and 30% failed the test. In the strength rating test, 65.5%, 30% and 2.5% of the girls group qualified for the gold, silver and bronze badges, respectively, and 5% failed the test. In the endurance rating test, 57.5%, 27.5% and 12.5% of the girls qualified for the gold, silver and bronze badges, respectively, and 2.5% failed the test.

In the speed-strength rating test, 17.8%, 20% and 32.5% of the girls group qualified for the gold, silver and bronze badges, respectively, and 30% failed the test. And in the flexibility rating tests, 67.5%, 27.5% and 0% of the girls group qualified for the gold, silver and bronze badges, respectively, and 5% failed the test. Most difficult for the girls group were the speed rating 30m sprint and speed-strength rating standing long jump tests – with 30% and 30% of the group, respectively, failed in the tests.

Conclusion. The study data and analyses showed the 5.5-6 year-olds' physical fitness being low on the strength, speed, and speed-strength rating scales. We believe that this backlog may be due to the sensitive beginner period in the speed-strength and speed qualities formation process. We also found that the 5.5-6 year-olds' endurance development process is relatively stalled in this age period, and this fact should be taken into account by the physical education systems for the age group.

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Functionality monitoring in youth sledge hockey

UDC 796.088

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Abstract

Objective of the study was to analyze benefits of the key physical fitness and functionality tests applicable in the youth sledge hockey sport.

Methods and structure of the study. Modern sledge hockey gives a special priority to many physical qualities including speed (response rates, motor speed, startup movement speed, specific action speed etc.), dexterity (movement coordination, muscular sensations, spatial orientation, relaxation skills), endurance (special and speed keeping), plus explosive strength and active flexibility. It should be emphasized that the health tests and training progress test systems should produce extensive progress stage-specific physical fitness and functionality test data arrays for analyses.

Results and conclusions. All stress tests in sledge hockey may be run using a Firstbeat (or similar) system with a special priority to the cardiovascular system performance tests to produce real-time heart rate variability data under stress read by a chest-fixed sensor. Such a test system produces individual test profiles for every player.

The sledge hockey player's functionality and physical fitness should be high enough to cope with the growing training and competitive work pressures and stressors. Practical experience and research in youth sledge hockey give reasons to recommended that the coaches and families should have permissions from the relevant regulatory and health agencies for the sledge hockey trainings and competitions. The heath tests and training progress tests and analyses in every stage of the training process should be comprehensive enough to ensure that the individual physical fitness and functionality make it possible for the player to safely cope with the physical stressors of the sledge hockey sport.

Keywords: *sledge hockey, functionality tests, physical fitness.*

Background. Sledge hockey is a team sports game on ice, a version of the traditional ice hockey adapted for people with disabilities and a Paralympic sport discipline with its versatile motor skills and techniques, high speed and constant physical pressure, particularly in the power game. Modern sledge hockey training systems are designed to ensure physical and technical progress of the athletes with permanent functionality and physical fitness tests [1] and analyses to rate progress and individualize the training progress on the whole. The sledge hockey training systems should be health-needs-specific and highly sensitive to the individual physical fitness and actual functionality rates, abilities and motor qualities [2]. The national sledge hockey system in Russia includes a Children's Sledge Hockey League which mission is to promote and popularize modern sledge hockey and increase its contribution to the social rehabilitation service for the disabled children and youth.

Objective of the study was to analyze benefits of the key physical fitness and functionality tests applicable in the youth sledge hockey sport.

Methods and structure of the study. Modern sledge hockey gives a special priority to many physical qualities including speed (response rates,

motor speed, startup movement speed, specific action speed etc.), dexterity (movement coordination, muscular sensations, spatial orientation, relaxation skills), endurance (special and speed keeping), plus explosive strength and active flexibility [3]. It should be emphasized that the health tests and training progress test systems should produce extensive progress stage-specific physical fitness and functionality test data arrays for analyses.

Results and discussion. All stress tests in sledge hockey may be run using a Firstbeat (or similar) system with a special priority to the cardiovascular system performance tests to produce real-time heart rate variability data under stress read by a chest-fixed sensor. Such a test system produces individual test profiles for every player. As provided by V.A. Shioshvili, the test set includes the following methods [4]:

1. *Ergometer tests* to profile the players' motor skills (repulsions) using a Vasa ergometer or similar type. The test system includes a roller hockey sledge, with the subject operating the ergometer handles for 30 s with the arms moved forward to full extension and then repulsed back with full power. The Vasa ergometer tests include three 30-second stages with 3 min rest breaks with the right, left and both hands tested to yield the following data: (1) Repulsion rate (pushes/ min); (2) Average both-hands push power (W); 3) average right/ left hand push power (W); (4) Heart rate prior to the test and on its peak (beats/ min), and recovery time (min); and (5) blood pressure prior to and after the test (mm Hg), and recovery time (min).

Tests 2-5 described hereinafter are run on an ice sledge using the Fitlight (or similar) test system. The system includes 5 light sensors fixed in a straight line 15 cm high from the ice and 5 m afar from each other – to split up the test track into 4 five-meter segments. The track is equipped with cones against each sensor to form a test corridor for the following tests.

2. *20m straight no-pack sprint test* that yields the following test rates: (1) Each 5m segment run time, s; (2) First 10m run speed, m/s; (3) 20m run time, s; (4) Push-off rate on the first 10m and 20m (pushes/ min); and (5) Heart rate prior to and on peak of the test (beats/ min), and recovery time (min).

3. *20m zigzag no-pack sprint test* different from the above only in the zigzag run trajectory along the straight sensor line, to yield the following test data: (1) Each 5m segment run time, s; (2) Time differences on the sensors – right/ left hand (s); (3) 20m run time, s; (4) Push-off rate (pushes/ min); and (5) Heart rate prior to the test and on the test peak (beats/ min), and recovery time (min).

4. *20m zigzag with-pack sprint test* (run with pack) to yield the following test data: (1) Each 5m segment run time for the right/ left hands, s; (2) Time differences on the sensors – right/ left hand, s; (3) Push-off rate (pushes/ min); and (4) Heart rate prior to the test and on the test peak (beats/ min), and recovery time (min).

5. *80-100m speed-strength endurance rating test*, with the player running an n-shaped track on the ice rink along the long board, behind the gate and back along the other board. The subject runs the test twice with the right and left turns. The Fitlight system uses 4 sensors and 3 segments in this case, with two 10m segments on the start and finish of the distance, to obtain the following data: (1) Segment run time for the right/ left turns, s; (2) Time differences of right-/ left-turn runs (s); (3) Distance run time, s; (4) Starting 10m speed, m/s; (5) Push-off rate for the whole distance and 10m start segment (pushes/ min); and (6) Heart rate prior to the test and on the test peak (beats/ min), and recovery time (min).

6. 5m standing shooting accuracy/ strength test on a sledge, with two attempts for every hand, to obtain the following test data: (1) Shooting accuracy; and (2) Top shooting speed (km/h).

Physical trainings in modern sledge hockey include special exercises with an emphasis on the individual technical and tactical mastery, with the sledge hockey player expected to be highly skillful in the sledge control, pack shooting, economic passing, power pressure game for the whole match, accelerations, turns, rotations, redirections, fast stops and many other elements. The technical and physical progresses in the sledge hockey trainings are interrelated and equally important, with good physical fitness forming a basis for the technical and tactical progress. Modern sledge hockey training systems are focused on the general and sport-specific motor qualities and skills need to be improved and maintained in both the anaerobic and aerobic energy supply modes.

Conclusion. The sledge hockey player's functionality and physical fitness should be high enough to cope with the growing training and competitive work pressures and stressors. Practical experience and research in youth sledge hockey give reasons to recommended that the coaches and families should have permissions from the relevant regulatory and health agencies for the sledge hockey trainings and competitions. The heath tests and training progress tests and analyses in every stage of the training process should be comprehensive enough to ensure that the individual physical fitness and functionality make it possible for the player to safely cope with the physical stressors of the sledge hockey sport.

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Annual athletic training completion stage prior to 2021 paralympic games

UDC 796.088

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Abstract

Objective of the study was to analyze benefits of the individual-diagnosis-specific pre- Paralympic Games annual training cycle completion stage.

Methods and structure of the study. The individual-diagnosis-specific pre-Paralympic Games final-stage training model was designed on the following provisions: individual adaptability tests; individual training service with versatile physical training elements; and the perfectly timed workload-management trainings. Precompetitive trainings for top-ranking international events are always customized to the local climatic and geographic factors of influence on the athletes' physical fitness and physiological functions, with acclimatization viewed as not only the physiological adaptation to a new climate and geographical location (new time zone) but also mental adaptation to the new environment.

Results and conclusions. The individual progress tests and profiles of the Paralympic sport elite made it possible to find individual predispositions, progress needs, priorities and resources in the vocational sports and effectively design and manage the training systems as required by the actual physical fitness / technical and tactical fitness progress needs and competitive situations. The trainings should ensure the Paralympians with different anthropomentric characteristics, health conditions, technical and tactical skills and performance styles having equal chances for a competitive success. Based on the study data and analyses, the authors offered the following theoretically grounded and practically tested recommendations for the annual training cycle completion stage.

Keywords: *2012 Paralympic Games, athletic training system, theoretical and practical service, climatic and geographic characteristics, physical fitness, technical and tactical fitness.*

Background. Training system individualization is ranked among the key athletic training system design principles for elite sports at any stage of an annual training cycle. Individualization may be described as the customized set of optimal training provisions, methods and tools sensitive to the personality traits and progress needs, with a special priority to the progress/ success motivations building aspects [8]. Paralympic sports are very special in this context as their training systems are necessarily individualized at every stage of the long-term training process as required by the athletes' health conditions, past injuries, rehabilitations systems and usual shortages of the skilled human reserves for the national teams. The theoretical and practical support service in disabled sports should be sensitive to the individual health conditions/ diagnoses, responses to the training workloads and tolerance of every vulnerable bodily system to the sport-specific stressors. The health/ physical fitness / technical and tactical fitness test systems applied in disabled sports may yield totally different test rates for the seemingly equally fit and skilled athletes [1, 2].

Objective of the study was to analyze benefits of the individual-diagnosis-specific pre- Paralympic Games annual training cycle completion stage.

Methods and structure of the study. The individual-diagnosis-specific pre-Paralympic Games final-stage training model was designed on the following provisions: individual adaptability tests; individual training service with versatile physical training elements; and the perfectly timed workload-management trainings. Precompetitive trainings for top-rank-

Table 1. *Sample individual test profile with the competitive goals*

Sport	Sport functionality class	Events	Personal best, s	Competitive goals, s
Paralympic track sports	T35	100m sprint	13,80	13,76
		200m sprint	27,98	27,96

ing international events are always customized to the local climatic and geographic factors of influence on the athletes' physical fitness and physiological functions, with acclimatization viewed as not only the physiological adaptation to a new climate and geographical location (new time zone) but also mental adaptation to the new environment. This was the reason for us to analyze the climatic and geographic specifics of the Paralympic Games site to effectively customize the individual training systems.

The 2020 Paralympic Games rescheduled for 2021 will be held in Tokyo (Japan) in the period of August 25 to September 6. Under the Köppen and Geiger classification that prioritizes the air temperatures and precipitation statistics, the Japan climate is rated high-humid (Cfa-warm, temperate, humid). In the Russian territory a provisionally close climate is found in Crimea on the Black Sea coast. The similar climates may be found in China, Brazil and Argentina, with the air temperatures for the last 20 years averaging 26.4°C in August and 22.8°C in September with the air humidity averaging 71%. A forecast for the 2021 Paralympic Games period gives summer thunderstorms with heavy precipitation up to a few dozen mm; typhoons (with 77 typhoons reported for the last 10 years for this period with the wind speeds above 15 m/s); and earthquakes, since the local statistics give on average 1.1 earthquakes with magnitudes above 4 points per annum.

The local weather statistics for the Paralympic Games area for the last four years shows that the event will be run in hot and humid weather, with virtually no differences in these aspects with the 2012/ 2016 Summer Paralympic Games in London and Rio de Janeiro. It means that the acclimatization recommendations should be much the same as for the last two Paralympic Games. Our precompetitive training and test model was piloted in the training systems of the Russian Paralympic track and field, swimming, goalball and judo teams as provided by the integrated physical fitness / technical and tactical fitness test and analytical system developed for the 2019 Paralympic Games. For the purposes of the study, we formed a coordination team to analyze the training systems, actual training workloads and individual physical, technical and tactical fitness test data. The model tests in a few national Paralympic sport teams made it possible to analyze the Paralympians' fitness for the upcoming event and produce individual-diagnosis-specific physical fitness / technical and tactical fitness building profiles [3, 4, 6, 7].

The trainings were also designed to improve the theoretical knowledge and practical skills of the Paralympic national team coaches, plus the coaching teams were trained to test and analyze the individual physical fitness and technical and tactical fitness test data and learn how to collect and analyze the training progress and test data. The new knowledge and skills made it possible for the coaching teams to efficiently manage the individual training systems on a progress stage specific basis. The new theoretical and practical service elements of the model helped improve the precompetitive fitness of the teams [5].

Results and discussion. The integrated precompetitive test system and the individual physical fitness / technical and tactical fitness profiles made it possible to improve the training process efficiency due to the efficient management based on the individual progress profiles. The elite athletes' individual training systems were customized for the individual theoretical and practical progress needs and specifics with account of the potential factors of influence on the expected competitive performance. Given in Table 1 and Figures hereunder are the sample individual test profiles with the competitive goals.

Given on Figures 1 and 2 are the sample individual technical and tactical fitness profiles for the Paralympic track events.

The new training and test data were used to form a competitive dependability/ fitness profile (see Figure 3). Such individual and group precompetitive fitness profiles were formed for the sampled Paralympians whose training systems were managed in the annual training cycle completion stage as required by the individual progress profiles.

The study data and analysis made it possible to formulate the following requirements to the pre- Paralympic Games training service: optimal recovery rates upon qualifier competitions of different levels; continuous progress in the competitive physical fitness / technical and tactical fitness; good mental control and effective precompetitive mental conditioning system; competitive environment modeling to set fair limits

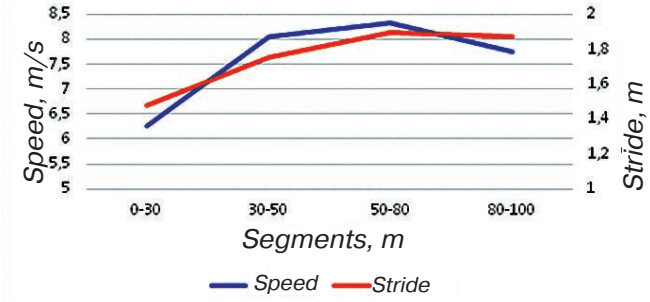

Figure 1. *100m sprint: speed and stride variation profiles*

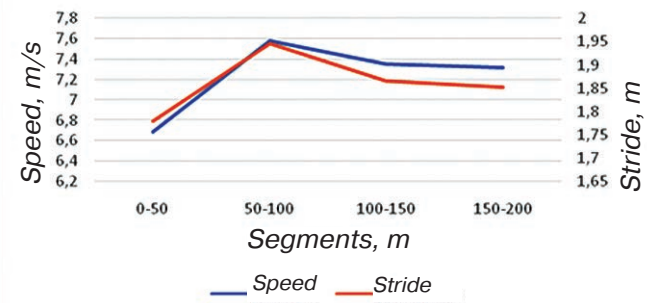

Figure 2. *200m sprint: speed and stride variation profiles*

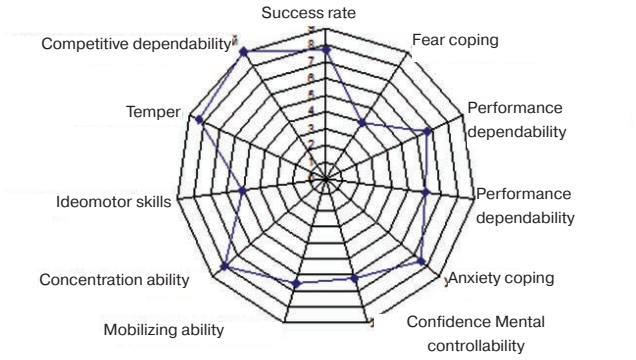

Figure 3. *Individual competitive mental controls test profile*

and provisions for the precompetitive training system; optimal final-stage precompetitive training service to reach the physical fitness / technical and tactical fitness peak as a prerequisite for a competitive success.

Conclusion. The individual progress tests and profiles of the Paralympic sport elite made it possible to find individual predispositions, progress needs, priorities and resources in the vocational sports and effectively design and manage the training systems as required by the actual physical fitness / technical and tactical fitness progress needs and competitive situations. The trainings should ensure the Paralympians with different anthropomentric characteristics, health conditions, technical and tactical skills and performance styles having equal chances for a competitive success. Based on the study data and analyses, we offered the following theoretically grounded and practically tested recommendations for the annual training cycle completion stage:

1) Develop, update and efficiently use modern fitness test systems sensitive to the individual physical fitness / technical and tactical fitness progress needs and health conditions/ diagnoses;

2) Account the training and test process in the special logbooks on the way to the 2021 Paralympic Games;

3) Establish a coordination group to manage the training and test process and keep track of the individual physical fitness / technical and tactical fitness variations versus the training workloads and progress benchmarks;

4) Support the special research teams providing the physical fitness / technical and tactical fitness progress test and management service to the national Paralympic teams in the training camps;

5) Offer good retraining/ advanced training service to the coaching groups of the Paralympic national teams to keep them informed on and skillful in the modern physical fitness / technical and tactical fitness test and management methods and tools; and

6) Effectively use the training progress, competitive performance and physical fitness / technical and tactical fitness test data to make the individual progress profiles with a special priority to the individual sensitivities to the training service aspects.

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Non-specific back pain, physical activity and ways of coping with pain among school-aged children and youth

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Abstract

Back pain (BP) is a serious problem of contemporary society. Research has shown that a low level of physical activity is a BP risk factor. The study sought to characterise non-specific BP and ways of coping with it and to analyse physical activity (PA) among children and youth aged 10-19 with and without BP.

The final analysis included 900 students aged 10-19 years (556 girls and 344 boys). The author's own questionnaire was applied as a research tool. Prior to the study, the questionnaire reliability was assessed. Kappa coefficient in all the analysed variables was equal to or higher than 0.92. Nearly 70% of the respondents declared that they had experienced BP in the last 12 months. Physically active students reported back pain much less frequently than those who were not active. It was revealed that with age, the percentage of students who were taking OTC painkillers increased.

Keywords: *back pain (BP), non-specific BP, children, youth, physical activity (PA).*

Background. Musculoskeletal pains constitute a serious problem of contemporary society. Research revealed that back pain (BP) occurring in adolescence is a risk factor of BP in adulthood [5]. In the majority of cases, BP in children and youth is non-specific. While diagnosing non-specific BP in children and youth, such causes as Scheuermann's disease, infections (discitis and osteomyelitis), tumours (leukaemia, sarcomas), spondylolysis, spondylolisthesis and rheumatic diseases should be excluded [3,6].

The study sought to characterise non-specific BP and ways of coping with it and to analyse PA among children and youth aged 10-19 years with and without BP.

Research methods and organization. The research included 914 children and youth (566 girls and 348 boys) from Biala Podlaska. The study sample was selected in a two-stage cluster sampling. At the first stage, schools from three levels of education were randomly selected, while at the second stage, particular groups of students were selected [2]. The final analysis included 900 students aged 10-13 years (primary school), 14-16 years (lower-secondary school) and 17-19 years (upper-secondary school), which constituted 98.5% of the whole study sample. All the students provided a consent to participate in the study.

The author's own questionnaire was applied as a research tool. It was divided into two parts: (1) personal data and (2) main part. The first part included such data as gender, date of birth, body mass and height. The main part regarded PA, the most common forms of spending free time, i.e. (a) active (swimming, dancing, team games, gymnastics, fitness, martial arts, rollerblading, cycling), (b) passive (reading books and press, watching TV, using a computer, games console, Internet, smartphone, listening to music) and experiencing (or not) BP in the last 12 months. Persons who responded negatively did not complete the remaining part of the questionnaire, which included questions regarding the frequency and location of BP, situations in which BP occurred or increased and ways of coping with BP.

After consulting a school doctor, students with such spinal diseases which may cause BP as Scheuermann's disease, spondylolysis, spondylolisthesis, rheumatic diseases, tumours, sarcomas, etc., were excluded from the study. In the case of girls, those who experience BP only during menstruation were also excluded.

The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Senate Research Ethics Committee of Jozef Pilsudski University of Physical Education in Warsaw, Poland.

Parameters were described using basic measurements of descriptive statistics for qualitative variables, i.e. percentage. Chi-square test was applied in order to evaluate associations between the presence of BP and gender, age and physical activity. Statistical significance was set at $p<0.05$. The collected material was organised and analysed with the use of Statistica 13 software by Statsoft (PL).

Results and discussion. The Kappa coefficient for all the variables analysed during reliability assessment was equal to or higher than 0.91. No significant differences between the results obtained in the two tests were revealed ($p<0.05$).

Among 900 respondents, 628 (69.8%) declared that they had experienced BP in the last 12 months. Girls reported BP more often than boys (73.6%vs.63.7%) ($p<0.1$). The percentage of persons with BP increased with age ($p<0.01$) (Tab. 1).

Table 1. *The prevalence of BP with regard to gender, age and PA of the respondents (n=900)*

Variables n (%)		Absence of BP n (%)	Presence of BP n (%)	p value
Total		272 (30.2)	628 (69.8)	
Gender	Girls n=556 (61.7)	147 (26.4)	409 (73.6)	<0.01
	Boys n=344 (38.2)	125 (36.3)	219 (63.7)	
Age	10-13 years n=313 (34.8)	111 (35.5)	202 (64.5)	<0.01
	14-16 years n=135 (15.0)	46 (34.1)	89 (65.9)	
	17-19 years n=452 (50.2)	115 (25.4)	337 (74.6)	
PA	Only PE lesson n=465 (51.7)	38 (8.2)	427 (91.8)	<0.001
	Additional activity n=435 (48.3)	234 (53.8)	201 (46.2)	
Forms of spending free time	Passive (reading books and press, watching TV, using a computer, games console, Internet, smartphone, listening to music) n=440 (48.9)	31 (7.0)	409 (93.0)	<0.001
	Active (swimming, cycling, rollerblading, fitness, team games, gymnastics, martial arts) n=460 (51.1)	241(52.4)	219 (47.6)	<0,001

Table 2. *Frequency and location of BP among students according to gender and age (n=628)*

	Total n=628	Gender		Age		
		Girls n=409	Boys n=219	10-13 years n=202	14-16 years n=89	17-19 years n=337
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
BP location (segment)*						
Cervical	210 (33.4)	143 (35.0)	67 (30.6)	88 (41.9)	30 (33.7)	92 (27.3)
Thoracic	190 (30.3)	118 (28.9)	72 (32.9)	74 (36.6)	31 (34.8)	85 (25.2)
Lumbar	390 (62.1)	264 (64.5)	126 (57.5)	89 (44.1)	51 (57.3)	250 (74.2)
BP frequency						
Very rare BP (1-2/year)	294 (46.8)	174 (42.5)	120 (54.8)	98 (48.5)	50 (56.2)	146 (43.2)
BP a few times a year (3-6/year)	251 (40.0)	180 (44.0)	71 (32.4)	76 (37.6)	29 (32.6)	146 (43.2)
Frequent or constant BP (more than 1-2 months)	83 (13.2)	55 (13.5)	28 (12.8)	28 (13.9)	10 (11.2)	45 (13.6)

* The numbers do not add to 100% since the respondents were allowed to choose more than one answer

In the next part, the frequency of BP depending on PA was analysed. For nearly 52% of the students, PE lesson was the only form of PA. It was revealed that students who take up PA only during PE lessons report BP more often than those who take up additional PA $p<0.001$ (Tab.1). The analysis of forms of spending free time by students with and without BP revealed that those who spend time in a passive way experience BP more often than those who choose active forms $p<0.001$ (Tab.1)

Table 3. *Ways of coping with BP, difficulties caused by BP and situations in which BP occurs or increases with regard to gender and age (n=628)*

	Total n=628	Gender		Age		
		Girls n=409	Boys n=219	10-13 years n=202	14-16 years n=89	17-19 years n=337
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Seeking doctor's help						
Yes	105 (16.7)	76 (18.6)	29 (13.2)	39 (19.3)	13 (14.6)	53 (15.7)
No	523 (83.7)	333 (81.4)	190 (86.8)	163 (80.7)	76 (85.4)	284 (84.3)
Ways of coping with LBP*						
Medicines prescribed by a doctor	26 (4.1)	18 (4.4)	8 (3.7)	10 (5.0)	4 (4.5)	12 (3.6)
Generally available painkillers	85 (13.5)	64 (15.7)	21 (9.6)	18 (8.9)	11 (12.4)	56 (16.6)
Electrotherapy procedures	139 (22.1)	107 (26.2)	32 (14.6)	45 (22.3)	25 (28.1)	69 (20.5)
Physiotherapeutic treatment other than electrotherapy (gymnastics, exercises)	272 (43.3)	181 (44.3)	91 (41.6)	89 (44.1)	70 (33.7)	153 (45.4)
Rest	456 (72.6)	309 (75.6)	147 (67.1)	139 (68.8)	63 (70.8)	254 (75.4)
Other	32 (5.1)	18 (4.4)	14 (6.4)	13 (6.4)	6 (6.7)	13 (3.9)
Circumstances in which BP occurred*						
Lifting heavy objects	327 (52.1)	241 (58.9)	86 (39.3)	118 (58.4)	43 (48.3)	166 (49.3)
Carrying a school backpack	412 (65.6)	307 (75.1)	105 (48.0)	149 (73.8)	61 (68.5)	202 (59.9)
Physical exercises	129 (20.5)	83 (20.3)	46 (21.0)	42 (20.8)	16 (18.0)	71 (21.1.)
PE lesson	114 (18.2)	80 (19.6)	34 (15.5)	48 (23.8)	22 (24.7)	44 (13.1)
Sitting for a long time	309 (49.2)	228 (55.8)	81 (37.0)	103 (51.0)	37 (41.6)	169 (50.2)
Mental stress	53 (8.4)	42 (10.3)	11 (5.0)	17 (8.4)	9 (10.1)	27 (8.0)
Changeable weather	44 (7.0)	27(6.6)	17(7.8)	9 (4.5)	9 (10.1)	26 (7.7)
Other	48 (7.6)	32 (7.8)	16 (7.3)	16 (7.9)	8 (8.9)	24 (7.1)
BP hampers*						
Sleep	88 (14.0)	53 (13.0)	35 (16.0)	27 (13.4)	21 (23.6)	40 (11.9)
Sitting	237 (37.7)	174 (42.5)	63 (28.8)	57 (28.2)	30 (33.7)	150 (44.5)
Standing	156 (24.8)	122 (29.8)	34 (15.5)	38 (18.8)	23 (25.8)	95 (28.2)
Studying	117 (18.6)	78 (19.1)	39 (17.8)	29 (14.4)	17 (19.1)	71 (21.1)
Concentrating and focusing on an activity	193 (30.7)	140 (34.2)	53 (24.2)	62 (30.7)	20 (22.5)	111 (32.9)
Fun	82 (13.1)	44 (10.8)	38 (17.4)	36 (17.8)	16 (18.0)	30 (8.9)
Sports	111 (17.7)	64 (15.7)	47 (21.5)	42 (20.8)	20 (22.5)	49 (14.5)
Other	20 (3.2)	11 (2.7)	9 (4.1)	3 (1.5)	6 (6.7)	11 (3.3)
BP does not hinder performing any activities	147 (23.4)	85 (20.8)	62 (28.3)	53 (26.2)	17 (19.1)	77 (22.9)

* The numbers do not add to 100% since the respondents were allowed to choose more than one answer

In the next part, the location (multiple choice question) and frequency of BP were analysed. BP was mostly located in the lumbar spine (62.1%). Such a situation was noted in the case of both genders and in all age groups (Tab. 2).

While analysing the declared frequency of BP, it may be noted that the largest group included the respondents who experienced pain rarely, i.e. 1-2 times a year. It was declared by 46.8% of the respondents. While analysing the frequency of BP with regard to gender, it was concluded that girls declared BP occurring 3-6 times a year more often than boys (44.0% vs. 32.4%) (Tab. 2).

The research revealed that a small group of students (16.7%) sought doctor's help due to BP. This percentage decreased with age (19.3% vs. 14.6% vs. 15.7%) (Tab. 3).

The most common way of coping with BP was rest (72.6%). It could be noted in all age groups. A considerable percentage of students (13.5%) mitigated BP by taking OTC painkiller. It was revealed that this percentage increased with age (8.9% vs. 12.4% vs. 16.6%) (Tab.3).

In the next part, situations in which BP occurred or increased were analysed. Carrying a school backpack, lifting heavy objects and sitting for a long time were such situations (65.6% vs. 52.1% vs. 49.2%). Over 18% of the students (19.6% girls and 15.5% boys) declared that they experienced BP during or immediately after a PE lesson (Tab. 3). The research revealed that sitting (37.7%) as well as concentrating and focusing on something (30.7%) were activities the performance of which is mostly hampered due to BP (Tab. 3).

Similar studies that analysed BP in children and youth were conducted in other countries. They revealed that BP regarded 39%-74.4% of the students [1,7,10]. Differences regarding percentage values may result from the fact that some studies took into account BP occurring within the last month or two since the date of the research, while other studies analysed a longer period, e.g. one year.

The present study analysed the period of the last year, which may have led to the fact that the percentage of individuals reporting BP was higher.

The data available in the literature regarding the influence of PA on BP are not unanimous; however, numerous studies underlined positive effects of moderate PA on BP. Vigorous PA has been associated with an increased risk of self-reported back pain, while moderate PA is protective [4,8]. Studies by other authors revealed that taking up PA by persons with BP protects them from returning and chronic pain [9]. The present results prove that physically active students report BP less frequently than individuals who do not take up PA.

The presented results may serve as a stimulus for further investigations aimed at defining BP risk factors in children and youth.

Conclusions

1. The research revealed very high (69.8%) prevalence of BP and the percentage increased with age $p<0.01$.
1. Students who choose passive forms of spending free time and take up PA only during PE lessons report BP more often than those taking up PA in their free time $p<0.001$.
1. BP was mostly located in the lumbar spine (62.1%). The percentage of students seeking doctor's help due to BP decreased, while that of students taking OTC painkillers increased with age.
1.

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Gender-specific characteristics of daily physical activity in persons with visual and hearing im-pairments

UDC 796.01: 376.32: 376.33

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Abstract

Objective of the study was to analyze physical activity and sedantary behavious in population groups with visual / hearing impairments.

Methods and structure of the study. We sampled for the survey hearing impaired people (n=80, 45% female sample) aged 26.0±2.92 years on average; visually impaired people (n=21, 52.4% female sample) aged 43.2±14.0 years on average; and a reference group of healthy people (n=142, 54.8% female sample) aged 34.1±12.6 years on average. Weekly physical activity of the hearing impaired people, visually and hearing impaired groups was tested by a Russian version of the International Physical Activity Questionnaire (IPAQ), with the survey data processed as recommended by the base IPAQ version.

Results and conclusions. The visually impaired men and women were tested with the highest sedentary time on weekends, business days and total sedentary times versus the hearing impaired and healthy groups. The hearing impaired men ($F(1.82) = 4.3320$, $p = 0.0405$) and women ($F(1.74) = 9.4100$, $p = 0.0030$) are less prone to sedentary behavior than their healthy peers.

The survey found 82% and 80% of the visually impaired female and male subsamples (respectively) physically inactive and reporting 8.4 hours of sedentary time per day on average. Their hearing impaired peers were found moderately (58% and 25%) and virogously active (36% and 40%, respectively), with their sedentary time reported to average 5.7 hours a day. In the healthy subgroup, women were tested more prone to low physical activity (33% and 14%), with men dominating in the vigorous-physical-activity subgroup (25% and 54%, respectively), with the sedentary time averaging 6.9 hours a day.

Keywords: *physical activity, IPAQ, sedentary behavior, visually impaired people, hearing impaired people, healthy people.*

Background. The World Health Organization (WHO) rankes physical activity among the key factors of unfluence on health and well-being [12]. Physical activity, however, is reported to rapidly fall the world over with the health deterioration trends [2, 9]. Thus Haegele J.A. et al. (2017) found visual impairments in adults being directrly correlated with the physical activity falls with expansion of sedentary behavior [9]. As for the hearing impairments, they are reported to double every age decade and, as a result, almost two of three 70-plus year-olds are diagnosed with serous hearing disorders [11]. Studies have shown that hearing impairments in elderly population are independently correlated with the low physical activity [7], while correlations of the visual / hearing impairments with the everyday physical activity still need to be explored [9].

Objective of the study was to analyze physical activity and sedantary behavious in population groups with visual / hearing impairments.

Methods and structure of the study. We sampled for the survey hearing impaired people (HIP, n=80, 45% female sample) aged 26.0±2.92 years on average; visually impaired people (VIP, n=21, 52.4% female sample) aged 43.2±14.0 years on average; and a reference

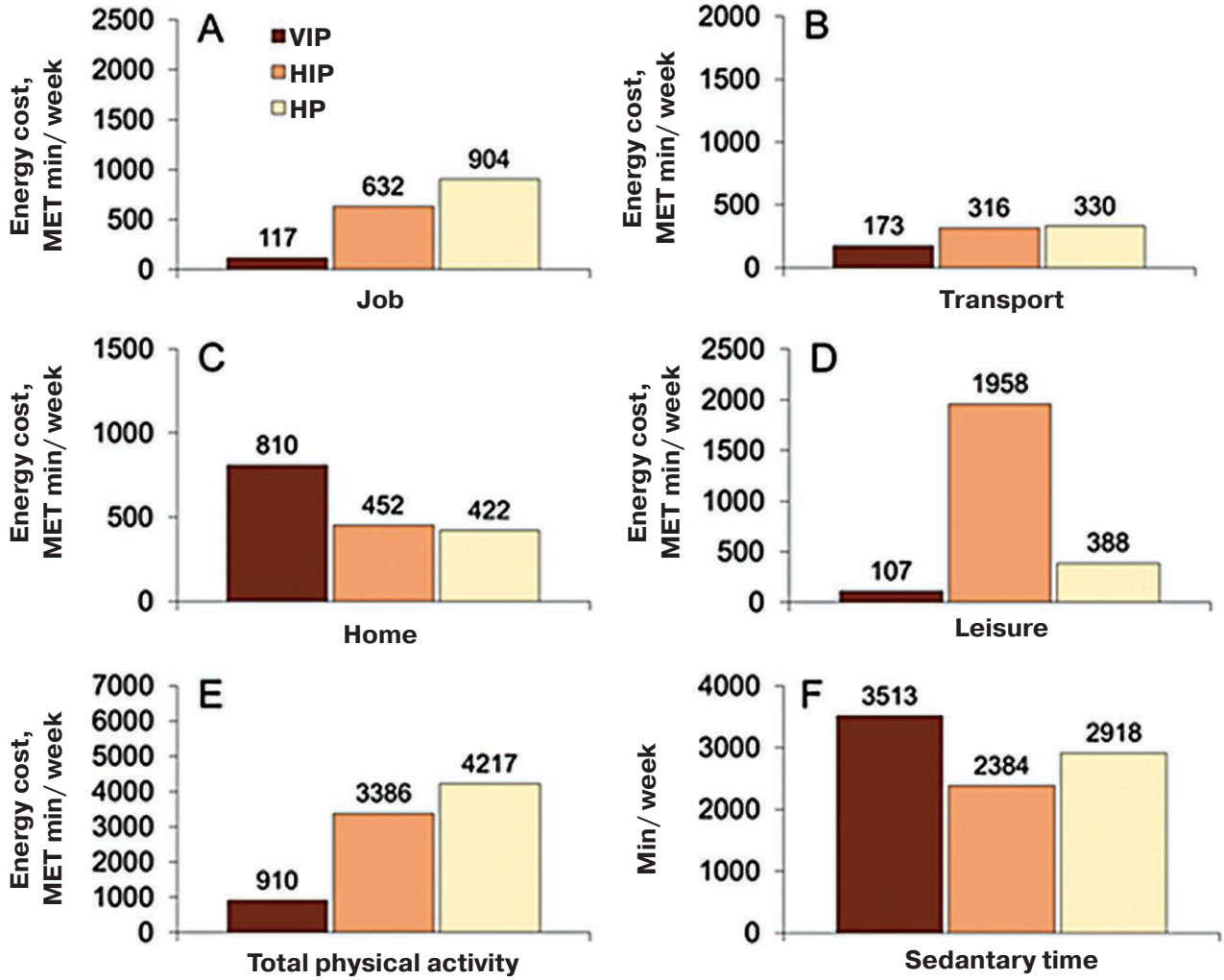

Figure 1. *Group physical activity classified by the energy costs (in MET minutes per week, with 1 MET = 1,0 kcal/kg/h or 3,5 ml O_2 /kg/ min) and sedentary times reported by the visually, hearing impaired and healthy groups (n=21, n=80 and n=142, respectively)*

group of healthy people (HP, n=142, 54.8% female sample) aged 34.1±12.6 years on average. Weekly physical activity of the hearing impaired people, visually and hearing impaired groups was tested by a Russian version of the International Physical Activity Questionnaire (IPAQ), with the survey data processed as recommended by the base IPAQ version [10].

Results and discussion. The survey found the highest physical activity claimed by housework in the visually impaired group and leisure-time in the hearing impaired group. The total sedantary time in the visually impaired group was rated significantly higher than in the hearing impaired group. Both unhealthy groups were tested with significantly lower physical activ-

Table 1. *Hearing impaired versus healthy group lesure-time walking physical activity, MET min/ week ($\bar{X}$ 0,95% CI)*

Physical activity	Hearing impaired males, n=44	Healthy males, n=40	Hearing impaired females, n=36	Healthy females, n=40
Leisure: walking	500 (334; 665)*	161 (65; 257)	806 (541; 1070)**	92 (29; 155)
Leisure: moderate	547 (332; 763)*	141 (0,0; 296)	640 (352; 928)**	42 (0,0; 94)
Leisure: vigorous	938 (526; 1350)*	96 (0,0; 206)	478 (180; 775)	245 (94; 396)
Leisure: total	1986 (1405; 2566)*	398 (164; 632)	1924 (1509; 2338)**	379 (188; 570)

*Note: *male intergroup difference,* p *<0,0001, ** female intergroup difference,* p *<0,0001; $\bar{X}$ mean arithmetic; 0,95% CI confidence interval* (±1,96×SD).

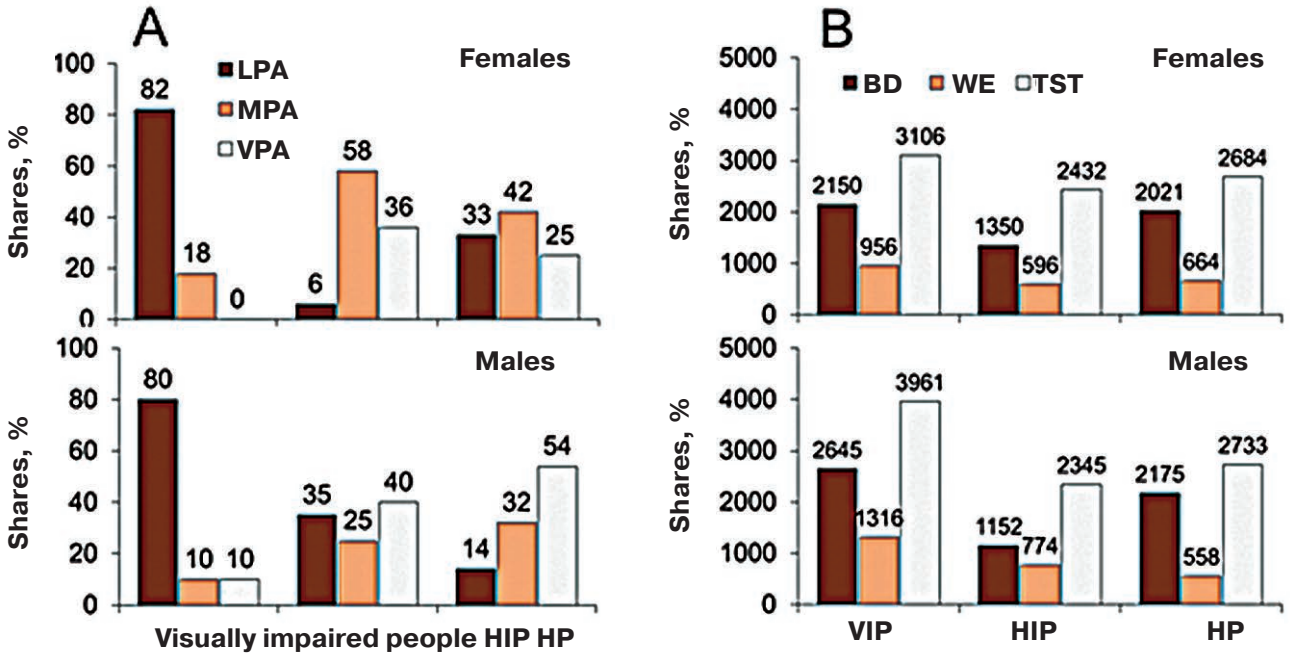

Figure 2. *Gender-specific classified health group physical activity rates (LPA: low physical activity; MPA: moderate physical activity; VPA: vigorous physical activity) and sedentary time (classified by BD business days, WE weekends and TST total sedentary time)*

ity than the healthy group: see Figure 1. It should be emphasized that the leisure-time physical activity was rated lowest in the hearing impaired group versus the visually and hearing impaired groups (Figure 1-D). It should also be noted that the hearing impaired men and women reported much more leisure time walking and higher energy costs claimed by the moderate and high leisure-time physical activity than the healthy group: see Table 1.

Given on Figure 2A hereunder are the gender-specific classified health group physical activity rates – that show that 82% and 80% of the visually impaired women and men (respectively) are physically low-active versus the hearing impaired and healthy groups tested 6% to 35% physically low-active.

The visually impaired men and women were tested with the highest sedentary time on weekends, business days and total sedentary times versus the hearing impaired and healthy groups (Figure 2-B). Note that the variance analysis showed that the hearing impaired men ($F(1.82) = 4.3320$, $p = 0.0405$) and women ($F(1.74) = 9.4100$, $p = 0.0030$) are less prone to sedentary behaviors than their healthy peers.

Having analyzed the relevant study reports, we found only a few reviews of the physical activity and sedentary behavior in people with sensory impairments including the visual and hearing ones. Most of the studies analyze the causes of visual impairments [6], while the physical inactivity and sedentary behavior related studies of these health groups are still very limited [3, 5]. We would mention in this context the World Report on Disability released ten years ago to provide recommendations on how disabled people with different diagnoses should be helped to cope with their life difficulties. The Report emphasized the need for support from a wide range of stakeholders including governmental agencies and NPO that could address specific local problems, conditional on more focused empirical research of the disabled people lifestyles in different aspects – including support from the practical biomedicine, psychology and pedagogy. There was a hope at some point that, with adoption of the Convention on the Rights of Persons with Disabilities and publication of the World Report on Disability, this century will make a turn towards full inclusion of people with disabilities in the social life [1], but in reality we have seen no major breakthrough as yet.

In our largely unique work, we consider the poorly studied problem of the health-related physical activity in the disabled people's lifestyles. Physical activity variations in hearing / visual impaired population groups are still underexplored in the context of the global physical activity falling trend [12]. There are reasons to believe that the physical activity drops in these health groups may be generally the same as for the population on the whole. However, knowing the lifestyle limitations associated with hearing / visual impairments plus the rapid expansion of sedentary behaviors, particularly during the coronavirus pandemy, the physical inactivity related problems cannot but aggravate. The urbanized Siberian North (Yugra) population is no exception, all the more that the locals have to

stay indoors much more time than in other areas due to the harsh climate with long and frosty winters [2].

Healthy and unhealthy people are at least equally exposed to the risks of physical inactivity and sedentary behavior in some age periods – with the associating health risks that give rise to cardiovascular and oncological diseases, diabetes and metabolic disorders [12]. These health risks may be countered by scientifically grounded initiatives to cultivate in the vulnerable population groups moderate-intensive physical activity sensitive to individual preferences and environmental factors. Such initiatives taking into account modern behavioral control theories may facilitate social integration of people with health disorders.

The social integration initiatives are often hampered by the employment problems not unusual for the people with disabilities including low qualifications; lack of adaptable jobs; low wages; fears of potential demotions on the disability scales; losses of benefits for non-working disabled people; lack of accessible transport service; skeptical attitudes of the employers to their working abilities etc. [4]. It is natural that for these and other reasons many disabled people have to opt for different ways to stay busy, with a leisure-time physical activity considered one of such options as verified by the hearing impaired group in our Surgut subsample (Figure 1-D). Physically active behaviors of people with disabilities are known to expand their communication opportunities and communal connections [9] with the relevant health benefits [5].

One the whole, the research community agrees that visually impaired individuals tend to be less physically active than their sighted peers. Special studies need to be undertaken to better understand the visually impaired people's attitudes to and potential motivations for leisure-time physical activity – all the more that at this juncture no correlation between the sedentary times and physical activity levels in this health group could been found [8].

Conclusion. The survey found 82% and 80% of the visually impaired female and male subsamples (respectively) physically inactive and reporting 8.4 hours of sedentary time per day on average. Their hearing impaired peers were found moderately (58% and 25%) and virogously active (36% and 40%, respectively), with their sedentary time reported to average 5.7 hours a day. In the healthy subgroup, women were tested more prone to low physical activity (33% and 14%), with men dominating in the vigorous-physical-activity subgroup (25% and 54%, respectively), with the sedentary time averaging 6.9 hours a day.

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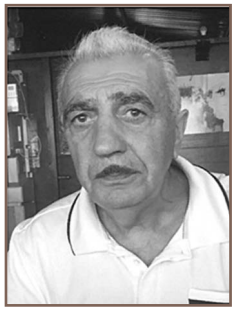
Functional fitness of elite male boxers

UDC 796.015



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Abstract

Objective of the study was to develop a training program aimed to increase the levels of functional and physical fitness of top-class boxers.

Methods and structure of the study. The athletes' functional fitness level was rated by testing the functional reserve of training aimed to determine the level of functional fitness of top-class athletes engaged in combat sports. The testing was carried out at the beginning of each centralized training microcycle and enabled to assess the functional status of the boxers and correct their training process in a timely manner if necessary. A total of 20 athletes preparing for the Olympic Qualifying Tournament in England were examined. They were subject to more than 80 tests designed to assess the athletes' level of adaptation to training loads.

Results and conclusions. The minimum rates of the functional reserve of training at the beginning of the training process (FRT≤20.0±8.2 c.u.) were obtained in the athletes of 4 weight categories. The training programs were adjusted for these athletes, namely, the training load intensity was reduced in the 1st training cycle. The number of overall conditioning tools was increased to 48.8% using running exercises that had a rehabilitative training effect. The training intensity was controlled by changing the strength of the blows when working with the training apparatus and sparring partners. The total number of special and competitive training tools amounted to 37.2% of the total amount of training work.

Such a distribution of the training tools enabled to increase the boxers' functional fitness level to 69.8%, on average.

Keywords: *boxing, training, functionality training reserve, body conditioning, special physical training, specialized training, precompetitive training tools.*

Training system design ('planning') and management ('correction') in any sport discipline is always based on the theoretical and practical athletic fitness control toolkits [1, 4]. The functional fitness tests and analyses in the modern elite boxing sport include the functionality training reserve tests that provide a basis for the timely functional fitness variability control (A.O. Akopyan, 2010). The functional fitness tests include the heart rate and blood pressure tests prior to and after standard workloads, with the test data processed by an application software to produce the functional tension, functional level and functionality training reserve test rates. The functionality test rates variation analyses versus the progress benchmarks make it possible to effectively control and manage the individual functionality as required by the training/ competitive progress needs.

The functionality training reserve variability tests and analyses under the study covered a 40-day centralized training service (2-stage) period for the boxing elite: see Table 1. It should be noted that training system was dominated by 3 trainings per day (31 days out of 40) with 109 trainings in total – that means that the physiological cost of the training workload in the centralized training period was high enough.

Table 1. *Staged centralized training system*

Total training days	40
1 training per day	2
2 trainings per day	7
3 trainings per day	31
Total trainings	109

The body conditioning and special physical training tools dominated training program was designed to build the functional and physical fitness [3, 2], with the partial body conditioning / special physical training volumes estimated at 62.8% of the total training time. Note that the precompetitive training tools accounted for only 2.1% of the total training time: see Table 2.

Table 2. *Classified training toolkit of the centralized training period*

Net total training time	t, min	%
	5216	100
Body conditioning time/ share	2550	48,8
Special physical training time/ share	726	14,0
Specialized training time/ share	1832	35,1
Precompetitive training time/ share	108	2,1

A special role in the body conditioning and special physical training toolkit was played by training/ rehabilitation running/ jogging practices. It was due to the efficient rehabilitation jogging practices that the precompetitive training tools amounted to only 2.1% of total training time. Given on Figure 1 is the analysis of the training toolkit used by the elite team in trainings for the first-stage Olympic qualifiers in England.

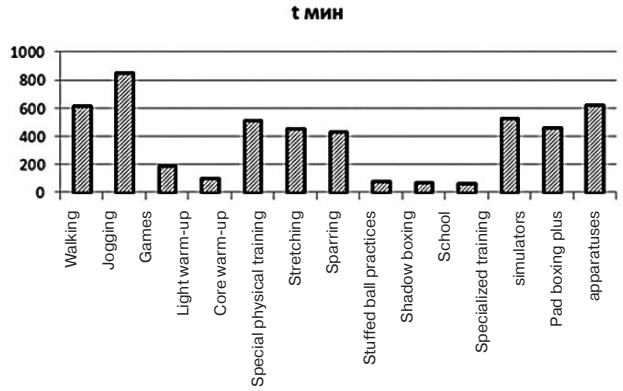

Figure 1. *Pre-qualifier training toolkit analysis:*

Individual adaptations to the training workloads were rated mostly by the functionality training reserve variation rates. The boxers were tested prior to every training micro-cycle and after active rehab days to efficiently manage the individual centralized training programs. Given on Figure 2 are the average functionality training reserve rates of the elite boxing team prior to and after the basic training stage.

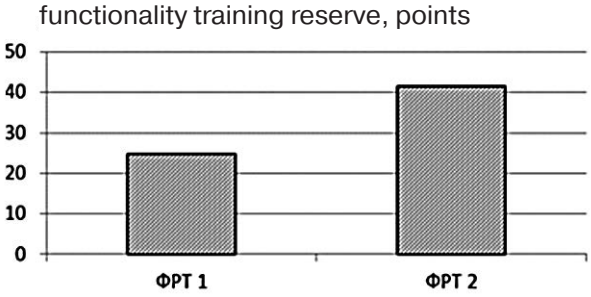

Figure 2. *Average team functionality training reserve rates prior to and after the basic training stage (pre-first-stage and post-second-stage tests)*

The functionality training reserve progress analysis gives a physical fitness growth of 69.8% for the team on the whole. It should be emphasized that the high progress may be indicative of the drawbacks of the traditional home (decentralized) training systems – as apparently verified by the individual functionality training reserve progress (pre- versus post-centralized training) test rates: see Figure 3.

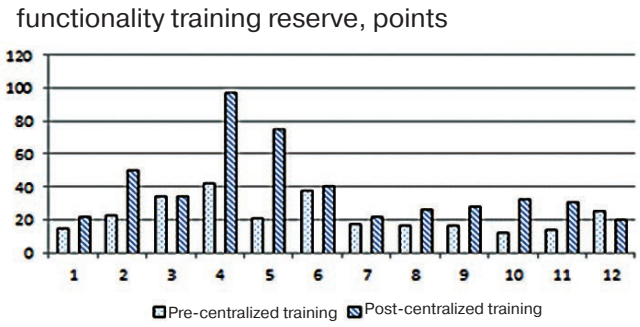

Figure 3. *Individual functionality training reserve progress (pre- versus post-centralized training) charts of the elite boxers*

High progress in the functional training reserve building domain may be interpreted as indicative, on the one hand, of the high efficiency of the centralized training service and, on the other hand, of the drawbacks of the home decentralized training systems that pay little if any attention to the functional trainings. This was the prime reason for the centralized training system designers to prioritize the body conditioning / special physical training at reasonable sacrifice for the technical-tactical and precompetitive training tools. The specialized training plus precompetitive training time was found to account for 37.2% of the total training time. Such training system design may be detrimental to the progress – in contrast to the centralized training service with

the large number of highly skilled sparring partners to facilitate fast progresses in the technical and tactical skills.

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Physiological value of stabilometric studies in complex coordination sports

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Abstract

Objective of the study was to theoretically ground and test benefits of a stabilometric model for complex coordination sports.

Methods and structure of the study. Stabilometric platform makes it possible to rate the postural control movements in projection onto the horizontal plane; with the major persistent deviations being often indicative of the musculoskeletal system functionality disorders or the movement coordination system disorders. The stabilometric test data and analyses make it possible to effectively track such disorders and make the relevant corrections to the individual training systems.

Sampled for the stabilometric model tests were the 16-24-year-old complex coordination sports athletes (n=89, 42.7% female and 57.3% male sample) competing in sailing (n=15), rock climbing (n=14), snowboarding (n=19 including 8 hearing-impaired individuals); biathlon (n=16); and speed-strength intensive track and field sports (n=25, including 9 visually impaired individuals) having 3-5-year basic sports experiences.

Results and conclusions. The results of the stubilometric study in complex coordination sports (on the example of sailing, climbing, snowboarding, double-event, speed-strength disciplines of track and field athletics) proved the appropriateness of this method. In the stabilometric test with the open eyes, regardless of the kind of sport, health restraints, and gender, the examined athletes were found to have either no or mild stabilometric disorders in the basic training period. In snowboarding and double-event, as well as in climbing and sailing, the static component of the coordination structure of the athletes' motor activity was found to be the most stable. In the test with eyes closed, the individual ability of each athlete to maintain balance was assessed.

Keywords: *stabilometric method, balance function, vestibular balance disorders, complex coordination sports.*

Background. Body balance function may be defined as the dynamic postural control quality secured by the vestibular apparatus controlled it its turn by the medulla oblongata, thalamus (diencephalon), cerebral cortex, cerebellum, visual analyzer, musculoskeletal and proprioceptive systems [8, 9]. Currently the research community is in need of a sound common concept to explain the origins of somatic and autonomic reactions in the postural control (vestibular balance) function, since the existing scientific concepts of reflexes-driven functionality controls are rather contradictory and dubious in many aspects [2]. As things now stand, the terms “equilibrium”, “postural balance”, “vestibular stability” and “postural control” are largely synonymic in the scientific literature with reference to the bodily vertical position securing mechanisms [6, 7]. Postural stability may be defined as the position where all forces of influence on the body are balanced in a quiescent state (static balance) or in movement (dynamic balance) to oppose every destabilizing effect [9].

Normally an upright bodily position is secured by only tonic and tonic-phasic muscles [7, 8]. Modern stabilometric tests the postural control function by a

range of quantitative, spatial and temporal test criteria and analyses. Thus D.V. Skvortsov reports benefits of the stabilometric tests and analyses for medicine [5, 6]; and E.M. Berdichevskaya demonstrates benefits of the modern stabilometric for balance function tests in wrestling sport [1]. Stabilometry applications have proved beneficial for studies of physical rehabilitation process, balance function and balance function variability analyses [1-5]. Stabilometric data and analyses are also highly important for the age- and skills-specific studies of the individual athletic postural controls; diagnoses of vestibular balance disorders; vestibular balance disorder severity rating tests; and vestibular balance progress tests and analyses. The individual postural control qualities and skills – both static and dynamic (particularly the movement correction and combining skills) – are critical for success in many modern complex coordination sports disciplines.

Objective of the study was to theoretically ground and test benefits of a stabilometric model for complex coordination sports.

Methods and structure of the study. Stabilometric platform makes it possible to rate the postural control movements in projection onto the horizontal plane; with the major persistent deviations being often indicative of the musculoskeletal system functionality disorders or the movement coordination system disorders. The stabilometric test data and analyses make it possible to effectively track such disorders and make the relevant corrections to the individual training systems [3]. This goal was attained in our study by a computerized stabiloanalyzer system that reads and analyzes fine postural control movements of the body pressure center on a stabilometric platform in the efforts to keep vertical posture and balance.

The stabilometric model included the following two tests. Test 1 rated the eyes-open 1min vertical postural control skills; and Test 2 rated the eyes-closed 1min dynamic postural control skills – with the disabled visual analyzer plus varied stressors on the other analyzer systems. The tests yielded the following test rates: R, mm - average pressure center travel radius; V, mm/s - average pressure center movement speed; SV, mm^2/s – statokinesiogram area variation rate; EllS, mm^2 - confidence ellipse; Angle, degrees - average oscillation vector; and KFR,% - equilibrium function quality correlated with the pressure center speed. Findings of the tests were classified as follows: no vestibular balance disorders; preclinical minor vestibular balance disorders; moderate vestibular balance disorders; and severe vestibular balance disorders [4]. These findings took into account the current typological age- and gender-specific variations in the vestibular balance and coordination function.

We sampled for the stabilometric model tests the 16-24-year-old complex coordination sports athletes (n=89, 42.7% female and 57.3% male sample) competing in sailing (n=15), rock climbing (n=14), snowboarding (n=19 including 8 hearing-impaired individuals); biathlon (n=16); and speed-strength intensive track and field sports (n=25, including 9 visually impaired individuals) having 3-5-year basic sports experiences.

Results and discussion. The eyes-open and eyes-closed tests yielded the classical data arrays with the dominant movement vectors, and the test data analyses made it possible to produce the individual vestibular balance function quality rates for every athlete [3]. The analyses found no sport-, health- and gender-specific moderate or severe vestibular balance disorders in the sample – that means that the sample was tested with dominant good vestibular balance function with well-coordinated afferent and effector elements in the vestibular balance. Only 6 individuals with visual impairments and 4 individuals with hearing impairment were tested with minor preclinical vestibular balance disorders.

Despite the 4-plus-year experiences in sports, some of the athletes were tested with health disorders of disharmonizing effects on the postural control system, central nervous system and the auditory analyzer. Compensatory mechanisms in this group fail to effectively coordinate the vestibular balance function and, hence, expose the athletes to vestibular balance disorders. The snowboarders, biathletes, rock climbers and sailors were tested with the lowest vestibular balance disorders rates indicative of the perfect postural controls and movement coordination qualities. It should be mentioned that these sports are particularly demanding to the dynamic postural control and movement biomechanics and, hence, naturally develop better synergy of the postural system elements and mechanisms.

In track and field sports, the vestibular balance skills were found basically experience- rather than gender-dependant. The virtually healthy individuals are typically tested with the stabilometric oscillations within four degrees, whilst our stabilometric tests and analyses found the oscillations in the sample being 7-10% higher as a result of the more economical cardio-respiratory system performance in a quiescent state, slower heart rate and respiratory cycles, plus stronger cardiac outputs – that collectively allow a wider oscillation of the pressure center on the stabilometric platform. The eyes-closed test rates showed the individual vestibular balance and coordination abilities being skills-dependent – i.e. the higher are the skills and experience, the better is the vestibular balance quality in the closed eyes test. We found the

visual analyzer assisted balance function being more effective in 36.6% of the sample regardless of the sports and gender grouping. Generally we found that the semi-automatic sport-specific movement patterns and skills improve the afferent and efferent movement control elements.

Conclusion. The stabilometric test data and analyses may be used for the sport research applications with the above-proposed vestibular balance disorders classification system and athletes' ratings on the sport-specific complex coordination scales. The stabilometric test rates and findings with valuations of the physiological meanings of the individual vestibular balance disorder data may be helpful for the coaches both for the athletes vestibular balance function control and sport selection purposes. The eyes-open stabilometric tests found no moderate or severe vestibular balance disorders in the sample; with only 6 individuals with visual impairments and 4 individuals with hearing impairment were tested with minor preclinical vestibular balance disorders. Based on the stabilometric test data and analyses, we ranked the sampled sports on the vestibular balance scale as follows: ranked on top was snowboarding sport, with the particularly high dynamic vestibular balance and coordination test rates; followed by biathlon, rock climbing sport and sailing sports. In the speed-strength intensive track and field sports, the vestibular balance and coordination skills were found experience-dependent and gender-unspecific.

The eyes-closed test rates showed the individual vestibular balance and coordination abilities being skills-dependent – i.e. the higher are the skills and experience, the better is the vestibular balance quality in the test.

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Mrna expression of inflammatory and anti-inflammatory cytokines during tissue regeneration of skeletal muscles

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Abstract

Objective of the study was to determine the sequence of events and complex intercellular interactions involved in the complex biological process of skeletal muscle regeneration in mice.

Methods and structure of the study. Sampled for the experiment were the mice inbred line C57BL/6. C57BL/6 mice were divided into two groups: Control Group with the skeletal muscle damage (Group S) and Experimental Group with the muscle damage and macrophage depletion (Group T). The trauma was inflicted by dropping a ball with a diameter of 15.9 mm and a weight of 16.3 g into a 100 cm pipe to hit the hind leg (calf muscle) of the animal. For depletion of macrophages, the mice were intra-abdominally injected with 2 mg clodronate-containing liposomes 3 days before the injury, followed by 0.5 mg on the 0th, 3rd, 6th, 9th, and 12th days after the injury. Hematoxylin and eosin stainings were used for morphological analysis. The fibrous tissue was studied using Masson's trichrome staining.

Results and conclusions. The macrophage depletion disrupts the microenvironment, which causes changes in the regulatory influence of inflammatory and anti-inflammatory cells. This, in turn, disrupts the balance between Th1 and Th2 immune responses resulting in an impaired immune response, slower regeneration, and incomplete recovery of muscle tissue.

Keywords: *skeletal muscle regeneration, growth factors, cytokines, macrophages.*

Background. Skeletal muscle damage may lead to malfunctioning of the bodily systems responsible for movements, respiration, and postural control. Skeletal muscle injuries can be caused by dystrophy, mechanical effects, aging, and other factors. The issue of skeletal muscle damage is also relevant in sports physiology, as the potential for injury is typical for any type of active muscle work. Therefore, the molecular processes of recovery of the skeletal muscles are of interest to sports science.

The role of macrophages can change greatly during skeletal muscle regeneration, thus contributing to greater damage at one stage and facilitating their recovery at another [5]. The role of different growth drivers, cytokines, and chemokines involved in skeletal muscle regeneration should also be emphasized. These cells are mainly secreted by the active immune cells, damaged skeletal muscles, and activated macrophages that penetrate the necrosis area [3]. In general, changes in the number of cells, their phenotype, or the stage of regeneration at which they are involved may lead to different outcomes of the regeneration process [2].

Objective of the study was to determine the sequence of events and complex intercellular interactions involved in the complex biological process of skeletal muscle regeneration in mice.

Methods and structure of the study. Sampled for the experiment were the mice inbred line C57BL/6. C57BL/6 mice were divided into two groups: Control Group with the skeletal muscle damage (Group S) and Experimental Group with the muscle damage

and macrophage depletion (Group T). After which the groups were divided into 6 subgroups, 8 mice each, depending on the time elapsed after the injury (12 hours, 1 day, 3 days, 5 days, 7 days and 14 days). The trauma was inflicted by dropping a ball with a diameter of 15.9 mm and a weight of 16.3 g into a 100 cm pipe to hit the hind leg (calf muscle) of the animal.

For depletion of macrophages, the mice were intraabdominally injected with 2 mg clodronate-containing liposomes 3 days before the injury, followed by 0.5 mg on the 0th, 3rd, 6th, 9th, and 12th days after the injury. Hematoxylin and eosin stainings were used for morphological analysis. The fibrous tissue was studied using Masson's trichrome staining.

The real-time method was used to estimate the level of mRNA expression using the StepOnePlus™PCR-Cycler (LifeTechnologies) device.

Results and discussion. The skeletal muscle injury was accompanied by damage to all components of the skeletal muscle tissue. On the 1st day after the injury, we observed a significant infiltration of the inflammatory cells in the damaged area. By the 3rd day after the injury, along with the inflammatory cells, primary myoblasts with centered nuclei appeared, indicating a shift from the pro-inflammatory phase of the immune response to the anti-inflammatory one, thus testifying to wound healing. By the 14th day after the injury, the CG subjects were found to have minimal signs of fiber inflammation or degeneration. In the EG, the number of collagen by the 14-day post-traumatic period was significantly higher than in the CG.

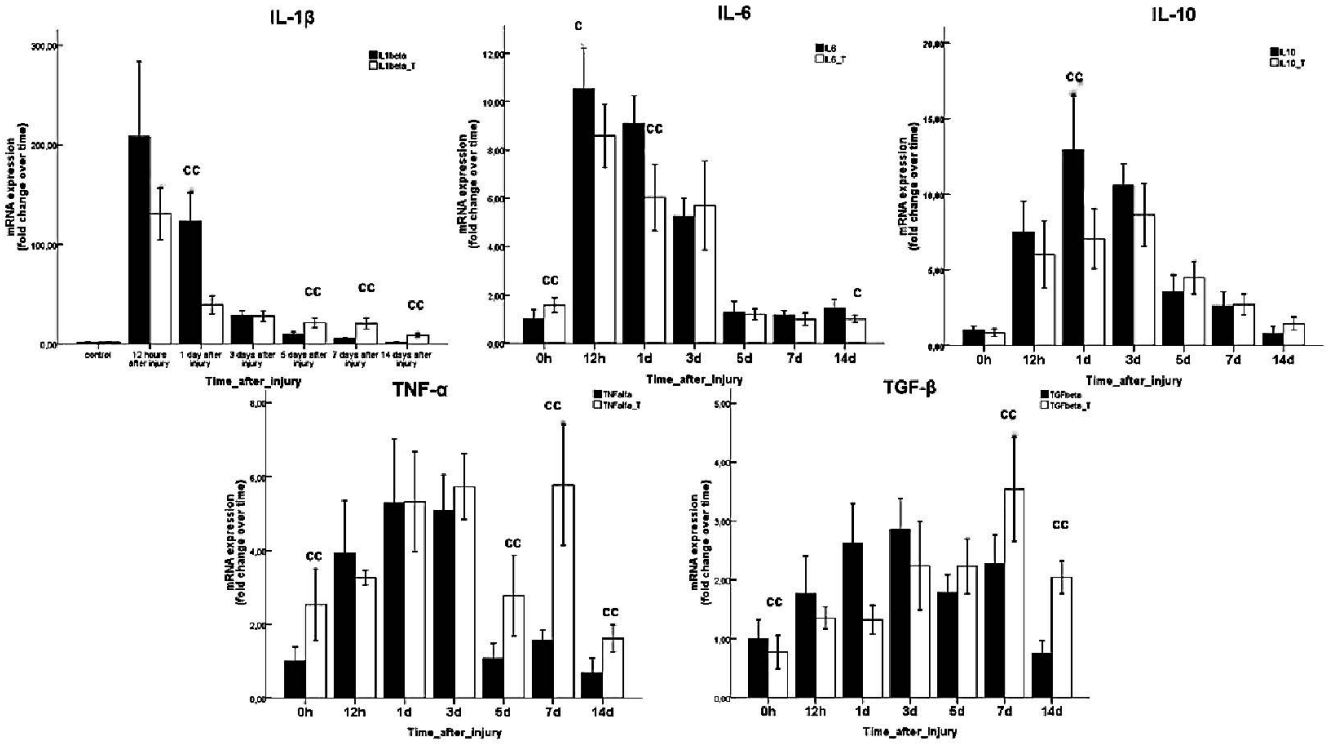
The release of inflammatory cytokines and chemokines was characterized by its specific dynamics, which manifested itself in the execution of reparative functions of macrophages and their distant effects [2].

The intensive production of cytokines, especially interleukin 1β (IL-1β) and 6 (IL-6), indicated the activation of macrophages with the M1 phenotype in response to injury at the initial stage of the immune response, as inactive macrophages do not produce IL-1β [5].

Another pro-inflammatory cytokine is a tumor necrosis factor alpha (TNF-α) produced in the early stages of the immune response after acute traumas of the skeletal muscles. In addition, this cytokine participates in the late stages of skeletal muscle tissue regeneration [6].

In our study, the TNF-α mRNA expression in the CG peaked on the 1st day after the injury, and then began to decrease, though not as rapidly as IL-1β; there was also a sharp increase in the mRNA expression levels in the first 12 hours after the injury (see the figure).

In the first hours after the injury, we observed a strong increase in the level of IL-6 mRNA expression, which is also important in the rapid formation of the body's response to tissue damage after acute trau-



Cytokine mRNA expression in CG (black columns) and EG (white columns). Letters denote the level of significance of expression differences between the groups: c - p<0.05, cc - p<0.01

mas of the skeletal muscles. On the other hand, IL-6 may contribute to the reduction of pro-inflammatory cytokine IL-1 and TNF-α due to its autocrine activity [2].

Interleukin 10 (IL-10) is a factor that modulates the function of macrophages and is characterized by a powerful anti-inflammatory activity [4]. The transforming growth factor beta (TGF-β) has multiple effects on a large number of cell types and is involved in the processes of regulation of growth, differentiation, and apoptosis of cells and modulation of the immune system [3]. In our study, the expression of these two cytokines in the CG increased gradually, peaking on the 3rd day after the injury (see the figure).

Therefore, we observed a standard immune response in the CG with a sharp increase in the concentration of pro-inflammatory cells followed by its gradual decrease, while the anti-inflammatory cells continued to grow in quantity. These results indicated a shift in the macrophage phenotypes from M1 to M2, reflecting the completion of pro-inflammatory processes and the beginning of the process of wound healing.

As a result of the macrophage depletion in the EG, the expression of all the cell populations was disrupted, so was the process of recovery of the muscle tissue.

Masson's trichrome staining enabled to determine the replacement of muscle tissue with fibrous one in the EG.

With the macrophage depletion, the level of IL-1β pro-inflammatory cytokine expression also increased in the 1st day after the injury, but its amount was significantly lower than the expression level, and at the late stages of skeletal muscle tissue regeneration, the expression level was higher than that in the CG. We observed a significant increase in the level of TNF-α pro-inflammatory cytokine in the late stages of recovery in the EG. Elevated levels of IL-1β and TNF-α in the late stages of skeletal muscle regeneration may indicate incomplete removal of necrotic debris and hence a malfunction of these pro-inflammatory cytokines.

Since the induction of IL-6 expression has a profound effect on muscle differentiation and plays a functional role in muscle growth, the decrease in the level of IL-6 mRNA expression disrupts the transition from the proliferative stage to the early stage of myogenic differentiation.

Conclusion. The macrophage depletion disrupts the microenvironment, causes changes in the cytokine functions, which may lead to cicatrization as a result of impaired muscle healing.

Although the study was mainly conducted on animals, these models provide an understanding of the cellular and molecular signaling pathways involved in the muscle degeneration and regeneration processes, and therefore potentially lead to clinical interventions and cellular therapy. Consequently, further research should seek to additionally and more fully define the molecular pathways and interactions that are necessary for effective skeletal muscle regeneration, which may contribute to the development of new methods of treatment in humans.

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Functional state of cardiovascular system in highly-skilled swimmers at latitudinal displacement

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Abstract

Objective of the study was to assess changes in the adaptive and functional capabilities of highly-skilled athletes at latitudinal displacement.

Methods and structure of the study. We evaluated the functional state of the cardiovascular system in the male swimmers of the same age group qualified not lower than Masters of Sport right after the flight through several time zones and three weeks after their stay outside their habitual time zone. Their response to the exercise experienced was evaluated based on the selected indicators and indices that reflect the state of both adaptive capabilities and functional capacity of the cardiovascular system.

Results and conclusions. The analysis of the dynamics of changes in the hemodynamic indices revealed that, on the one hand, the displacement of the central regulatory mechanisms in the examined group was adequate enough to optimize the functional reserves, while the current vegetative status contributed to the economization of energy resource, thus shifting the hemodynamic load towards the vascular bed. This means that the regulatory adjustments in this group were optimal.

It should be noted, however, that the athletes' functional reserve was somewhat constrained by the low values of the maximum aerobic capacity, which were not associated with the central regulatory mechanisms. This was not due to the time offset, as during the flight, there were no significant changes in the characteristics of the biological rhythm, and therefore in the adaptive capabilities. The most probable reason was exercise, which can lead to a state known as overtraining. It is impossible to avoid exercise, so this fact should be taken into account when organizing the training process and dosing the training loads.

Keywords: *functional capacity, cardiovascular system, adaptive capabilities, exercise, flight.*

Background. Numerous observations of athletes flying transmeridional routes revealed diverse changes in their adaptive capabilities and functional capacity occurring when flying through several time zones, which is an additional and very substantial load [4]. They are characterized by a number of both temporal and gender-specific features, and require, in our view, a separate, detailed analysis, since these changes are not so much related to the functional capacities of the body, especially in highly-skilled athletes, as to the regulatory adjustments that help the body adapt primarily to non-specific training loads associated with the synchronization of biorhythm [2]. It is clear that the ability to make such adjustments determines the adaptive capabilities of the athlete's body, moreover, the rate of such adjustments determines the athlete's and coach's sports results they are most interested in. While the physiological cost of success depends on the course of these changes since it determines the type of compensatory response and the predominant distribution of loads between the structural elements of the body and, most importantly, not only in the short but also in the long range.

Objective of the study was to assess changes in the adaptive and functional capabilities of highly-skilled athletes at latitudinal displacement.

Methods and structure of the study. We evaluated the functional state of the cardiovascular system in the male swimmers of the same age group qualified not lower than Masters of Sport right after the flight through several time zones and three weeks after their stay outside their habitual time zone. The logic and procedure of measurement are described in the study [3].

Their response to the exercise experienced was evaluated based on the selected indicators and indices that reflect the state of both adaptive capabilities and functional capacity of the cardiovascular system.

Moreover, their values can be calculated providing that there are enough data on the biological rhythm and no exercise tolerance tests are required.

The available data included: HR - heart rate, SBP - systolic and DBP - diastolic blood pressure, PP - pulse pressure, ADP - average dynamic blood pressure, SO - systolic output, CO - cardiac output. Based on the daily average values of these indicators, we calculated: Kerdo vegetative index (KVI=(1-DBP/HR)x100), index of functional changes in the circulatory system or adaptive potential (FCI=0.011HR+0.014SBP+0.008DBP+0.014A+0.009BM–0.009H–0.27), where A is age, years old; BM – body mass, kg; H - height, cm; type of self-regulation of circulation (TSC=DBP/HRx100), circulatory deficiency coefficient (CDC=DBP/HR), circulatory endurance coefficient (CE=HR/PPx10), circulatory efficiency coefficient [CEC=(SBP-DBP)xHR], Robinson index or double product (RI=HRxSBP/100) [1].

The numeric data obtained were processed using the variation statistics method with the calculation of the mean value and its error.

The results are presented in Table 1 hereunder. Due to the abundance of the digital material, the table presents the milestone results only, as the remaining data did not differ significantly from those reported.

It is to be recalled that the results obtained when previously analyzing the daily biorhythms in the same group of athletes indicated that there were both urgent and extended targeted systemic changes in their biorhythms in response to the time zone offset, which is a substantial load even for trained athletes since it is almost impossible to avoid an “acute” stage of desynchronosis of bodily rhythms [3]. Although these quantitative adjustments were neither critical nor particularly pathological, they should be taken into account both in the organization of the athletes’ regime during the flight and in the organization of the long-term training process. The second challenge, however, already requires an understanding of the existence, depth, and course of regulatory changes.

The functional analysis of the state of the cardiovascular system and its reaction to non-specific training loads confirmed these findings. Thus, the value of the index of functional changes, which is closely related to the main parameters of hemodynamics, did not even come close to the critical value of 2.59 for the whole period of observation, which means that there

Table 1. *Changes in the functional indicators of the cardiovascular system of the highly-skilled athletes outside their geographic region and habitual time zone.*

Indicators	Before the flight	1st day of stay	2nd day of stay	3r day of stay
KVI	-16 ± 2.1	-19 ± 3.2	-22 ± 2.6	-17 ± 1.8
FCI	2.25 ± 0.04	2.28 ± 0.04	2.31 ± 0.05	2.31 ± 0.04
TSC	115.9 ± 2.64	118.8 ± 2.81	121.7 ± 2.71	117.1 ± 2.61
CDC	1.79 ± 0.02	1.81 ± 0.03	1.83 ± 0.02	1.80 ± 0.01
CE	15.7 ± 1.11	15.7 ± 1.21	15.3 ± 1.17	15.9 ± 1.21
CEC	3036 ± 121	2967 ± 133	2898 ± 126	3030 ± 117
RI	85.6 ± 2.87	86.3 ± 2.93	86.9 ± 2.9	88.2 ±2.43
Indicators	**7th day of stay**	**Before the flight**	**1st day at home**	**3rd day at home**
KVI	-18 ± 1.7	-22 ± 2.9	-22 ± 2.8	-19 ± 2.7
FCI	2.22 ± 0.03	2.27 ± 0.06	2.31 ± 0.05	2.24 ± 0.04
TSC	117.9 ± 2.42	122.7 ± 2.46	122.1 ± 2.91	119.4 ± 2.77
CDC	1.85 ± 0.02	1.92 ± 0.03	1.87 ± 0.03	1.87 ± 0.02
CE	14.8 ± 1.13	14.3 ± 1.17	15.4 ± 1.19	14.6 ± 1.17
CEC	3015 ± 114	3036 ± 126	2992 ± 134	3015 ± 124
RI	83.1 ±1.93	83.8 ± 2.63	86.4 ± 2.77	83.8 ± 2.81

was no reduction in the adaptive capabilities in the study group at all.

Nevertheless, the functional response to current needs is not so much determined by the adaptive capabilities of the body, which is for the most part a strategic reserve. The direction of vegetative reactions is mediated by changes in the activity of the central regulatory mechanisms causing changes in the vegetative tone, which ultimately determines the selection of adequate compensatory reactions.

Thus, the level of activity of the mechanisms pumping blood through the vascular system and maintaining the heart rate is determined by the predominant activity of the sympathetic or parasympathetic divisions of the autonomic nervous system, while the type of self-regulation of the heart rate determines the bodily response to physical loads. In our case, the significant preflight predominance of parasympathetic influence, as indicated by the Kerdo index value, indicates the economical distribution of hemodynamic loads and large functional reserve.

The level of tension of the mechanisms of regulation of the cardiovascular system estimated based on the value of self-regulation of circulation, always being above 110, characterizes the vascular type, which also indicates its economization and increased functional reserves of the body, at least hemodynamics.

Unfortunately, this is probably the limit of economization, as the circulatory efficiency coefficient characterizing the circulation-related energy expenditure, which in our case indicates the onset of fatigue, remains constantly high. Fatigue may be proved by a slightly decreasing value of the endurance coefficient used to assess the level of preparedness of the cardiovascular system to physical loads. Nor is there a decrease in the circulatory deficiency coefficient, which is not critical in itself but indicative of the functional reserve depletion.

The reason for this is probably not the vegetative tone, which in our group was quite adequate for highly-skilled athletes, but a reduced aerobic capacity and, as a consequence, a reduced level of functional capacity of the body as indicated by an average value of Robinson or double product index.

Results and conclusions. The analysis of the dynamic changes in the hemodynamic indices revealed that, on the one hand, the displacement of the central regulatory mechanisms in the examined group was adequate enough to optimize the functional reserves, while the current vegetative status contributed to the economization of energy resource, thus shifting the hemodynamic load towards the vascular bed. This means that the regulatory adjustments in this group were optimal.

It should be noted, however, that the athletes' functional reserve was somewhat constrained by the low values of the maximum aerobic capacity, which were not associated with the central regulatory mechanisms. This was not due to the time offset, as during the flight, there were no significant changes in the characteristics of the biological rhythm, and therefore in the adaptive capabilities. The most probable reason was exercise, which can lead to a state known as overtraining. It is impossible to avoid exercise, so this fact should be taken into account when organizing the training process and dosing the training loads.

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Image of women's olympic disciplines in single-sex sports

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Abstract

Objective of the study was to identify the peculiarities of perception and develop the statistical (fac-tor) models of the image of women's Olympic disciplines in single-sex sports.

Methods and structure of the study. At the first stage of the study, we interviewed 124 students of the Russian Presidential Academy of National Economy and Public Administration and 99 students of the Russian State Social University, considered as potential parents of future female athletes. The respondents were asked to present their associations and opinions on women's football and women's weightlifting. Proceeding from the data obtained, we developed 40 bipolar semantic differential scales for football and 31 - for weightlifting. At the second stage of the study, the same students were asked to assess their attitude to the above sports according to the developed semantic differential scales. The data obtained were subjected to a factorial analysis based on the com-mon Varimax rotation criterion. As a result of the factorization, we developed the statistical models of the image of two women's Olympic disciplines - football and weightlifting.

Results of the study and conclusions. The analysis of the mentioned sports on the bipolar semantic differential scales showed that in the students' perception women's football appears, on the one hand (positive side), as an "emotional", "energetic", "dynamic", "spectacular", "accessible", "evolving", "humane", "healthy", "suitable for women" sport; on the other (negative) - as an "unpopular", "unusu-al", "difficult", "traumatic", "tough", "mannish" and "low-intellectual" sport. Women's weightlifting is seen by the students, on the one hand, as a sport that "tempers character", "strengthens health", "modern", "great", "healthful", "Olympic", "noted for the successes of the domestic athletes"; on the other - as a "physically complex", "traumatic", "low-intellectual", "unsuitable for women", "ugly", "spoiling women's figure", "associated with doping scandals", "unpopular" sport.

The factor model of the image of women's football includes five groups of features characterizing "emotional intensity", "activity", "popularity", "spectacularity" and "prestige" of the sport. The image profile of women's weightlifting is represented by seven components: "emotional intensity", "fashion", "simplicity", "popularity", "cultivation", "gender equality", "accessibility".

The data obtained can serve as reference data for the development of the programs: a) image correction and b) winning positioning and popularization of women's football and women's weightlifting among students as potential parents of young female athletes.

Keywords: *women's football, women's weightlifting, single-sex sports, image.*

Background. One of the key trends in the development of the modern Olympic movement is the commitment to gender equality. The increasing role of women was noted by the President of the International Olympic Committee (IOC) T. Bach, who emphasized that the proportion of women participating in the Tokyo Olympics would reach 50% [3]. In 2020, women would be competing in certain types of shooting and sailing competitions for the first time ever. The Olympic program now includes new weight categories in

women's boxing, and the number of weight categories in men's and women's weightlifting disciplines has been equalized.

Nowadays, the IOC is heading for gender equality, which calls for the popularization of single-sex sports in our country. However, recent researches have shown that a sport cannot be successfully popularized without comprehensive information on how its targeted audience takes it [1]. The target group of the current study was made of students as future parents, who would shortly be shaping sports interests in their children.

Objective of the study was to identify the peculiarities of perception and develop the statistical (factor) models of the image of women's Olympic disciplines in single-sex sports.

Methods and structure of the study. At the first stage of the study, we interviewed 124 students of the Russian Presidential Academy of National Economy and Public Administration and 99 students of the Russian State Social University, considered as potential parents of future female athletes. The respondents were asked to present their associations and opinions on women's football and women's weightlifting. Proceeding from the data obtained, we developed 40 bipolar semantic differential scales for football and 31 - for weightlifting. At the second stage of the study, the same students were asked to assess their attitude to the above sports according to the developed semantic differential scales. The data obtained were subjected to a factorial analysis based on the common Varimax rotation criterion. As a result of the factorization, we developed the statistical models of the image of two women's Olympic disciplines - football and weightlifting.

Results and discussion. Tables 1 and 2 represent the results of evaluation of the Olympic disciplines on the bipolar semantic differential scales.

Table 1 shows that in the students' perception women's football appears, on the one hand (positive side), as an "emotional", "energetic", "dynamic", "spectacular", "accessible", "evolving", "humane", "healthful", "suitable for women" sport; on the other (negative) - as an "unpopular", "unusual", "difficult", "traumatic", "tough", "mannish" and "low-intellectual" sport. It should be noted that out of 40 characteristics of football, 16 (40%) were favorably received.

Table 2 shows that women's weightlifting is seen by the students, on the one hand, as a sport that "tempers character", "strengthens health", being "modern", "great", "healthful", "Olympic", "noted for the

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Table 1. *Psychosemantic image-building profile of women's football (n=124)*

Characteristic	Average	Characteristic	Average
Emotional	1.85	*Football*	*–0.19*
Time-honored	1.34	*Smart*	*–0.29*
Intriguing	1.25	*With good prospects*	*–0.30*
Athletic	1.04	*Clean*	*–0.31*
Energetic	0.92	*Highly intellectual*	*–0.56*
Spectacular	0.76	*I would engage my daughter in this sport*	*–0.62*
Humane	0.73	*Reputable*	*–0.65*
Dynamic	0.69	*Professional*	*–0.68*
Accessible	0.55	*Creative*	*–0.70*
Fancy	0.43	*Smooth*	*–0.75*
Uncorrupted	0.36	*Non-traumatic*	*–0.81*
Health-promoting	0.24	*Well paid*	*–0.86*
Evolving	0.17	*Recognized*	*–0.93*
Interesting	0.10	*In-demand*	*–1.19*
Suitable for women	0.07	*Prestigious*	*–1.30*
Fun-filled	0.04	*Light*	*–1.52*
I take it positively	*–0.07*	*Famous*	*–1.60*
Powerful	*–0.17*	*Stress free*	*–1.63*
Complex	*–0.18*	*Habitual*	*–1.73*
Feminine	*–0.19*	*Popular*	*–1.94*

Note. Average estimates of the characteristics on the scale from -3 to +3

successes of the domestic athletes"; on the other - as a "physically complex", "traumatic", "low-intellectual", "unsuitable for women", "ugly", "spoiling women's figure", "associated with doping scandals", "unpopular" sport. Despite the fact that the total number of positively assessed characteristics of women's weightlifting (16) exceeded that of negative estimates (15), such characteristics as "I would engage my daughter in weightlifting" was assessed most negatively (-1.97), which indicated the forthcoming difficulties in the process of popularization of this sport discipline.

The data obtained during the survey were subjected to a factorial analysis based on the common Varimax rotation criterion, which enabled to build a statistical model of image of women's football and women's weightlifting (Table 3).

As Table 3 shows, the statistical model of the image of women's weightlifting includes 7 components (groups of characteristics): 1) "emotional intensity", explaining 18.465% of the total sample variance and characterized by such features as "fancy", "spectacular", "suitable for women", "interesting", "I take it positively", "shaping a good body", "great", and "normal"; 2) "fashion" with a specific weight of 9.592% and including 2 elements - "modern" and "noted for the successes of the Russian female athletes"; 3) "simplicity", explaining 7.949% of the total sample variance and including such features as "physically easy" and "doping-free"; 4) "popularity" with a specific weight of 7.184% and represented by 2 variables - "popular" and "well covered by the media"; 5) "evolution" ("tempers character and develops volitional qualities"), which has a factor load of 6.483%; 6) "gender equality" ("treats women on par with men") with a specific weight of 6.174%; 7) "accessibility" ("financially accessible") with a factor load of 4.920%.

The factor model of the image of women's football is represented by 5 components: 1) "emotional intensity" with the explained sample variance, including such characteristics as "creative", "highly intelligent", "I would engage my daughter in football", "suitable for women", "I take it positively", "with good prospects", "reputable", "feminine", and "evolving"; 2) "activity" with a specific weight of 11.734% and characterized by such variables as "energetic", "traumatic", "dynamic", "smooth", "powerful", and "professional"; 3) "popularity" with a contribution to the total sample variance of 10.626% and including such characteristics as "renowned", "popular", and "habitual"; 4) "spectacularity", explaining 8.208% of the total sample variance and formed by 3 characteristics: "spectacular", "intriguing", and "interesting"; 5) "prestige" giving 5.942% of the total sample variance and combining 2 features - "recognized" and "well paid".

Table 2. *Psychosemantic image-building profile of female weightlifters (n=99)*

Characteristics	Average	Characteristics	Average
Tempers character	2.29	*Harmonious development of muscles*	*–0.04*
High competitive results demonstrated by the Russian female weightlifters	1.33	*I take it positively*	*–0.04*
Olympic	1.04	*Interesting*	*–0.08*
Well-developed infrastructure	0.90	*Popular with the young*	*–0.25*
Health forming	0.58	*Well covered by the media*	*–0.30*
Public esteem	0.44	*Popular*	*–0.36*
Modern	0.37	*Doping-free*	*–0.49*
Great	0.34	*Fancy*	*–0.66*
Healthful	0.34	*Shapes a good body*	*–0.67*
Has a positive image	0.30	*Suitable for women*	*–0.90*
Spectacular	0.23	*Highly intellectual*	*–1.15*
Financially accessible	0.23	*Does not require special skills*	*–1.31*
Treats women on par with men	0.22	*Non-traumatic*	*–1.39*
Norm	0.13	*Physically easy*	*–1.72*
Helps women fulfill themselves	0.04	*I would engage my daughter in this sport*	*–1.79*
Prestigious	0.04		

Note. Average estimates of the characteristics on the scale from -3 to +3

Table 3. *Factor model of image of women's football women's weightlifting*

№	Weightlifting	Football
1	**Emotional intensity – 18.465 %** (fancy – 0.810; spectacular – 0.755; suitable for women – 0.730; interesting – 0.716; I take it positively – 0.698; shapes a good body – 0.638; great – 0.623; norm – 0.613)	**Emotional intensity – 24.764 %** (creative – 0.864; highly intellectual – 0.840; smart – 0.795; I would engage my daughter in this sport – 0.763; suitable for women – 0.749; I take it positively – 0.737; with good prospects – 0.730; football – 0.686; reputable – 0.685; feminine – 0.683; evolving – 0.667)
2	**Fashion – 9.592 %** (modern – 0.708; noted for the successes of the Russian female athletes – 0.644)	**Activity – 11.734 %** (energetic – 0.804; traumatic – 0.784; dynamic – 0.756; smooth – 0.735; powerful – 0.648; professional – 0.636)
3	**Simplicity – 7.949 %** (physically easy – 0.768; doping-free – 0.655)	**Popularity – 10.626 %** (famous – 0.743; popular – 0.690; habitual – 0.644)
4	**Popularity – 7.184 %** (popular – 0.804; well covered by the media – 0.684)	**Spectacularity – 8.208 %** (spectacular – 0.754; intriguing – 0.658; interesting – 0.655)
5	**Evolving – 6.483 %** (tempers character and develops volitional qualities – 0.771)	**Prestige – 5.942 %** (recognized – 0.622; well paid – 0.614)
6	**Gender equality – 6.174 %** (treats women on par with men – 0.694)	
7	**Accessibility – 4.920 %** (financially accessible – 0.764)	
	Total sample variance – 60,766 %	**Total sample variance – 61,274 %**

Note. Components with specific weights above 0.6

It should be noted that, given the similarity of the indicators of the total sample variance, the image of women's weightlifting is more differentiated in the perception of students, as it is represented by a greater number of factors. In terms of the statistical models, there are both similar components ("emotional intensity" and "popularity", although they have different specific weights) and factors reflecting the specific perception of each of the sport disciplines ("activity", "spectacularity", and "prestige" in football and "fashion", "simplicity", "evolution", "gender equality", and "accessibility" in weightlifting). In addition, the specific weights of individual characteristics of sport are different.

Conclusions. The work on improving the image of both women's disciplines should be carried out in two directions: on the one hand, there is a need to reinforce and target positive messages to the targeted audiences; on the other hand, strategies to overcome negative attitudes should be developed. According to the findings, the image strategies of "marketing of iconic figures", "transformation of negative to positive" (variants: "reasonable negation of negative sides" or "presentation of negative sides as features and advantages of the sport"), "current of positive images", "binding" the image of the sport to successfully implemented images of other sport disciplines can have the greatest effect.

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Value-motivational aspects of anti-doping education

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Abstract

Objective of the study was to marshal information on which value-motivational messages should be broadcast when considering the main content-related divisions of the anti-doping education program, as well as the main objections on the part of listeners and the ways educators react to them.

Methods and structure of the study. The study was based on the author's experience in the development and implementation of anti-doping education programs. In particular, we participated in the development of the programs for various target audiences at the request of the Ministry of Sports of the Russian Federation and conducted anti-doping education in a number Children and Youth Sports Schools, as well as among students and trainees of vocational retraining courses of the Institute of Adaptive Physical Education under Lesgaft National State University.

Results and conclusions. Anti-doping education implies not only the broadcast of factual information but also the formation of an attitude to the given problem at the value-motivational level. Due to the constant "doping scandals", athletes and students of sports universities develop a critical attitude towards anti-doping education and anti-doping policy in general. This is manifested in objections and attempts to devalue anti-doping education. Based on the personal pedagogical experience, the article presents the systematization of the value-motivational messages, which should be broadcast when mastering the main content-related divisions of the anti-doping education program, as well as when dealing with the most common objections on the part of the participants.

Keywords: *doping, anti-doping education, sports values and motivations, physical education and sports, Prohibited List.*

Background. Presently many anti-doping education programs under implementation involve not only athletes and physical education and sports university students, but also much broader population groups including students of non-sport universities and colleges, schoolchildren and even preschoolers [3]. Despite the different target population groups, actual coverage, methods and tools of such anti-doping education programs are standard enough, as they overview the doping-related problems, consequences, conflicts with the key values and priorities of the global sporting culture, anti-doping movement mission and methods, doping in the context of many social problems, etc. It is emphasized that the anti-doping education mission is not only to disseminate facts and knowledge, but also contribute to formation of the genuine sports values and cultures intolerant to doping. Such anti-doping education programs make a special emphasis on the cultural aspects with the fair play ideology and its moral dimensions including the value of honest victory [2]. Lectors and teachers normally face no difficulties as far as the contents of the anti-doping education programs are concerned due to no shortage of comprehensive education materials in multiple manuals, textbooks [1] and reference sources including the official RUSADA website www.rusada.ru. It is much more difficult for them to decide how their messages and priorities should be structured in every education

subject in terms of values and motivations – i.e. why the anti-doping knowledge and competences are so important, what priorities the students need to accept, and what personal conclusions they are expected to come to? The usual commonplace anti-doping education on the unhealthy and unsporting aspects of doping and fair sports are often ineffective in the anti-doping education programs, and this is the reason why they need to be addressed in more personality-sensitive and social formats.

Objective of the study was to systematize practial experience of the anti-doping education service programs with a special priority to their core values and motivations need to be advanced, with the usual implicit and explicit disagreements in the audience and the teacher's responses to them.

Methods and structure of the study. The study was based on our own practical anti-doping education programming and servicing experience including anti-doping education programs for different target audiences on commissions from the Ministry of Sports of the Russian Federation [3]; anti-doping education programs for a few Children and Youth Sport Schools (CYSS), professional retraining courses at the Institute of Adaptive Physical Culture of P.F. Lesgaft NSU etc.

Results and discussion. Given in Table 1 hereunder are the key messages on priority values and motivations we recommend to emphasize in every component of the anti-doping education .service, with the components referred to as the semantic modules rather than formal topics for classes, with such modules critical in one or another form in most of such programs.

Given in Table 3 hereunder is a digest of our own practical anti-doping education experience with the list of the usual arguments and skeptical questions from the audience with the teacher's counter-argument logics and options.

Conclusion. Doping issues in sports are still rather contradictory, with the solutions in many cases determined by moral and ethical dilemmas with their choice points when an unambiguous solution cannot be found and every possible solution is costly in some aspects.

The anti-doping education teacher's attempts to pretend knowing the "ultimate truth" with undeniable messages may be successful only in case of non-judgmental factual knowledge – e.g. on the rules of the doping probing procedure. Modern anti-doping education, however, may not be limited by pure information only, as the personality sensitivities, values, motivations and priorities should be addressed on

Table 1. *Key messages on the priority values and motivations in the anti-doping education modules*

Anti-doping education module	Module-specific values and motivations
Doping history	Doping is interpreted as the specific violation of sports rules – not necessarily synonymic to artificial performance enhancement. The rules are revised with time, and the performance stimulation methods have always been usual, but most of them are far from «doping» in its modern definition. Modern terms, definitions and rating criteria are not always applicable to the past reality (and vice versa).
Doping issues in modern sports	Modern sports mission is to fairly match the individual/ team athletic skills and accomplishments within the framework of the valid rules. Doping creates the situation when there is no way to fairly match the skills and accomplishments, and instead it is the biotechnologies that compete rather than athletes at violation of the rules.
Prohibited agents and methods	Such prohibitions may not always be explained objectively, but this is not required: anti-doping rules (like the sports-specific rules) are rather conventional – that means that their contents are secondary to the uniformity of requirements and intolerance to double standards.
Consequences of doping	Consequences are not limited to personal/ team failures due to disqualifications, health problems, etc.; and detriments to the image of sports discipline and mistrust in the national sports on the whole, with the relevant political repercussions. In the personality domain, doping-facilitated victories can never make the athlete happier.
Doping controls in sports	Modern doping control procedures give a special priority to the athletes' comfort and safety, with minor inconveniences fully compensated by the more fair competitive conditions.
Doping and additive behaviors	Many prohibited substances give rise to addictions i.e. drug dependences, with the doping and addiction issues largely similar in the values and motivational domain. Doping-associated sports fail to prevent addictive behaviors as they rather encourage the latter – not only in the athletic communities but also in the close (supporter and shareholder) ones.
Doping and sports social functions	Doping-associated sports are perceived as legalized deception – that comes in conflict with the basic idea that a win should be secured by one's own skills, qualities and efforts. Such corrupt sports with their negative messages and values fail to perform their natural cultural and educational functions and turn into a socially harmful phenomenon.

Table 2. *Typical arguments and skeptical questions from the audience in anti-doping education courses with the teacher's response logics and options*

Arguments	Counter argument logics
Doping campaign against the Russian sports is fuelled by vested political interests	Doping is primarily an internal sports problem. The political conflicts can unlikely be associated with the doping claims against the Russian athletes due to apparently no causal relationship. Other countries have also been involved in doping scandals, but we just know less about them.
Virtually every elite athlete has to make resort to doping, otherwise he/she has nothing to do in modern sports	Actual objective statistical reports give no more than 2.5% of doping-positive cases in the doping tests; even if some violations remain undetected, the true figure is clearly very far from 100%. Note that many sports-specific qualities and skills are little if ever affected by doping in fact.
Doping is defined as 'violation of one or few anti-doping rules' by the World Anti-Doping Code, but this definition is illogical in referring to itself	The definition is later on spelled out in the text. If you read the paragraph to the end, you will see no more contradictions. Actually the definition is rather specific and suitable for practical use. Alternative definitions (for example, with references to the 'unnatural' substances and methods of effect on the performance) may be even more questionable.
The Prohibited List is formed based on vague and subjective (like «contradiction to the sporting spirit») criteria	The Prohibited List, first of all, may be questioned only by competent experts including pharmacologists and biochemists; and second, much more important in the context of sporting values is the consistency and common applicability of the requirements rather than their specific contents.
Athletes' rights are violated when they are held accountable for the things beyond their control - for example, when they take such agents unknowingly	It's an inevitable cost we have to pay in the efforts to protect the rights of clean athletes otherwise the anti-doping policies may be dramatically ineffective. The unknown use may serve as an excuse in the vast majority of doping cases – with even more serious damage to the rights of clean athletes.
Some privileged athletes use doping legally for TUE	It is not always possible to prevent abuses, although note that one of the TUE provisions is that the agent «is extremely unlikely to improve the athletic performance» (International Standard for Therapeutic Use Exemption, & 4.1)
Athletes are in fact isolated from modern medical services when they face health problems	Most of the diseases in need of the prohibited substances and methods are anyway incompatible with elite sports. In exceptional cases, athletes may get permits for therapeutic use.
It is unfair that athletes are kept away from modern medical performance enhancers unlike people of other professions	Sports are different from 'other professions' in their mission that is to achieve and demonstrate successes via the personal abilities, qualities and efforts – whilst the other professionals create an external alienable product with certain consumer qualities
Anti-doping education makes no sense since it cannot stop the doping addicted athletes whilst the others don't need it	Many anti-doping rule violations are due to ignorance, particularly among newcomers to sports, with their «accidental» intakes of untested drugs, etc. Sports professionals cannot but discuss these issues in different audiences.
Since the doping control efforts are unsuccessful anyway, doping shall be permitted to solve these issues at once	Even if the doping control efforts are not always successful due to new technologies and unclear borderlines between the prohibited and permitted substances etc. – the anti-doping efforts still act as deterrents. If doping is permitted, the actual consequences will be devastating for many reasons – including sharp growths in the health risks, lost public trust in sports with damage to their image etc.

a priority basis as well. Such anti-doping education service shall give room to dialogues in addition to the anti-doping messages and arguments, with the anti-doping education teacher demonstrating openness and willingness to consider arguments of those who believe that doping is natural for the modern sports, and to counter their arguments with logically structured facts and reasoning.

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Algorithmic approach in physical education system

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Abstract

Objective of the study was to provide a theoretical basis for and test benefits of an algorithmic health protection service prioritizing physical education teacher training service model.

Methods and structure of the study. The study was carried out in 2018/19 academic year at the premises of the Physical Education Department of Belgorod State National Research University. The following methods were applied during the study: theoretical (analysis of scientific sources on the research problem, analysis of training sessions, analysis students' academic progress and own pedagogical activities); empirical (supervision of the activities and interaction of teachers and students during vocational training, questionnaires, pedagogical experiment, tests, mathematical-statistical methods for processing of research results).

Resuls of the study and conclusions. The ascertaining experiment revealed the prevalence of the critical level of readiness in 58.2% of students; acceptable level - 34.3%; optimal level - 7.5%. Proceeding from the analysis of the pedagogical theory and practice and results of the ascertaining experiment, we determined the content of the health-saving activity of physical education teachers using the algorithmic approach and developed a set of algorithmic instructions aimed to train future specialists for this type of activity.

The leading condition for the successful preparation of future physical education teachers for the health-saving activity using the algorithmic approach is the creation of a heuristic educational environment that would include interactive and professionally oriented practical exercises, creative tasks, problem situations, enabling to update the algorithmic knowledge acquired while mastering individual stages of the heath-saving activity by students.

Keywords: *health protection service, physical education, physical education teacher, physical education service algorithm, algorithmic education model.*

Background. In view of the national youth health deterioration statistics for the last decades, the physical education research community gives a special priority to the physical education teacher training for health protection service. Since the health problems and complex and multidimensional, new health service solutions should spell out clear operations, skills and technologies for success of the modern health protection service. This mission was addressed by the algorithmic education model (offered by M.L. Khasanova, L.N. Aksenova, V.V. Rudnev et al.) with its ideas and principles focused on the educational service goals and methods structured on an algorithmic basis [3]. It should be mentioned, however, that the algorithmic education model applications for the physical education teacher training for health protection service still remain virtually unexplored. Such training system should be designed based on a health protection service prioritizing physical education teacher training algorithm with the relevant education goals and benchmarks for the health protection service competence building in the physical education teacher training curricula.

Objective of the study was to provide a theoretical basis for and test benefits of an algorithmic health

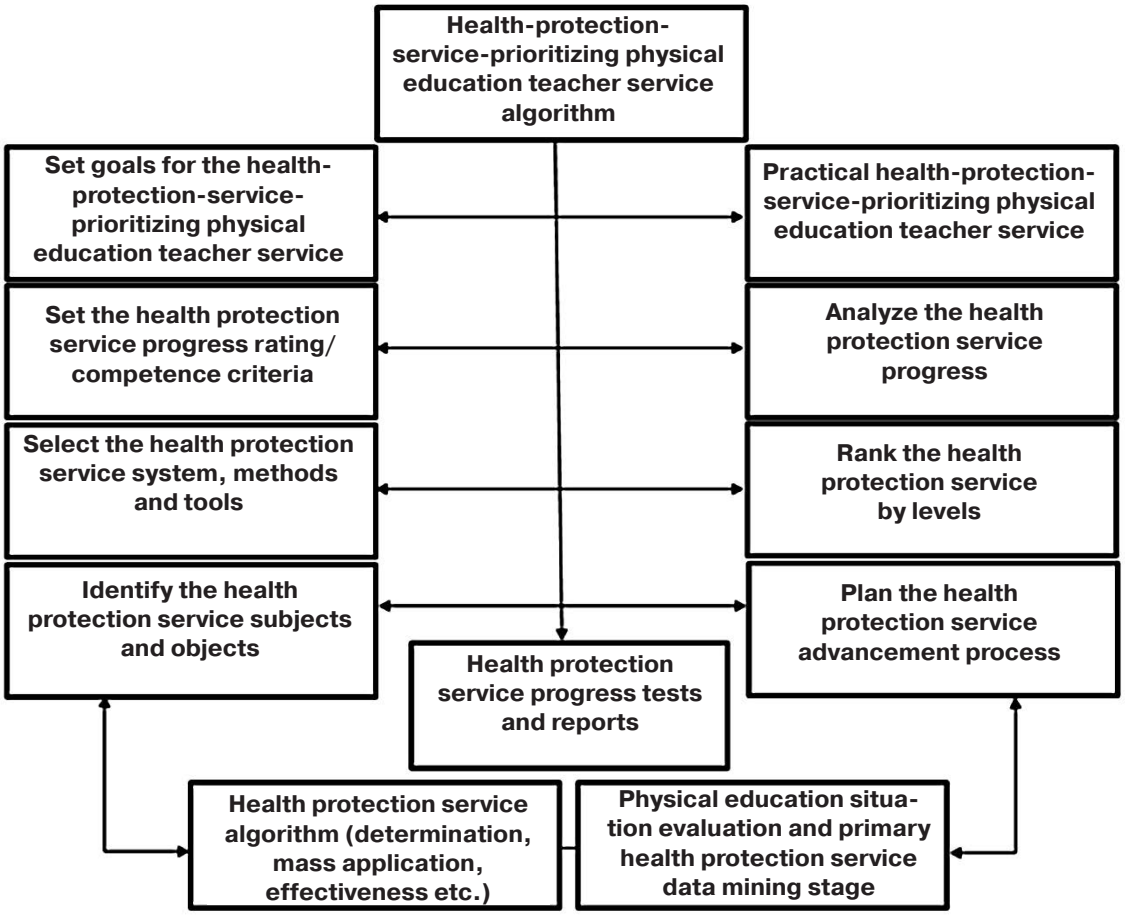

Figure 1. *Health-protection-service-centered physical education teacher service algorithm*

protection service prioritizing physical education teacher training service model.

Results and discussion. The health-protection-service-prioritizing physical education teacher training service algorithm may be defined as the sequence of health-protection procedures, steps, operations and education cycles in the physical education teacher service geared to secure and improve the schoolchildren's health in the school physical education process. Knowing the traditional physical education teacher service design, the health protection service algorithm may be formed of the following logical operations/ actions: (1) Formulate the health protection service mission and subject(s); (2) Set goals for the health protection service; (3) Spell out the health protection service progress rating criteria; (4) Select the best health protection service methods, technologies and tools; (5) Implement the latter in practice; (6) Analyze the practical health protection service progress; (7) Rank the health protection service progress levels; (8) Fix and report the health protection service progress; (9) Update and expand the health protection service. We believe that this health-protection-service-centered physical education teacher training service algorithm is optimal at this juncture since it gives a consistent framework for the health protection service-prioritizing physical education teacher training service: see Figure 1 hereunder.

We tested our health-protection-service-centered physical education teacher training service model by an experiment at the Pedagogical Institute of Belgorod State National Research University (BSNU) in the 2018-19 academic year; with 58.2%, 34.3% and 7.5% of the student sample pre-tested with the low, acceptable and good health protection service competences, respectively. In the algorithmic health protection service model piloting experiment, the 2-3-year students of the Physical Education Department surveyed the 5-6th grade schoolchildren groups with an emphasis on their individual physical education / health needs and motivations. The survey goals were attained, for example, by the following tasks: (1) Rate the children's predispositions for the health protection service; (2) Rate the children's physical fitness; etc.

Note that the above tasks required the students to acting in accordance with a well-thought-out action algorithm intended to put the health protection service on an algorithmic basis and help the future physical education teacher master basics of the health-protec-

tion-service-centered customizable theoretical and practical education service, with timely corrections and prudent planning. The algorithmic health protection service aspects may be listed as follows: certain determinism, i.e. every instruction in the algorithm must accurately determine every physical education teacher action with the relevant provisions; limit randomness of the choice options; mass application i.e. the primary data sources may include any phenomenon, process and event of specific class; and effectiveness, i.e. a search should produce the expected outcome conditional on the algorithm being followed in every aspect [1].

The health protection service algorithm as a sequence of actions may be described as follows: frontal study of the object with the specific educational goals setting; primary purposeful and systemic data collection on the object-specific service, relationships and connections; data classification to facilitate solutions for the health protection service issues and problems; externalities definition, accounting and rating; analysis of the factors of influence on the externalities; determination of their stability and expectancy; data interpretation to produce a hypothesis of the possible connections of the externalities with internalities; resultant data verification to test its scope/ coverage and accuracy; preliminary data correction to facilitate them being applied for the health protection service design; long- and short-term health protection service planning stage [1, 4].

A key mission of the health protection service algorithm is to set a mainstream vector for the physical education teacher service [2, 3], and with this purpose to: collect an extensive health protection service database; classify the data by the priority classes; find the best data processing tools and process them; check up the results versus the health protection service goals and the service tactics and strategies. The algorithm will include an algorithmic Class Health Protection Service Roadmap with indication of the following: numbers/ shares of students successful and unsuccessful in the physical education classes; possible reasons for the physical education backlogs (absenteeism, poor fitness, reluctance, low motivations, too difficult homework, insufficient attention from the teacher, execution difficulties etc.). And the algorithmic Teaching Health Protection Service Mastery Building Roadmap, for example, should spell out the progress stages with reports of the open lessons, innovative service methods, non-standard lessons, contests, competitions, self-learning practices, practical assistance to students, dissemination of the best health protection service experiences etc. The health protection service algorithm may include the following stages: individual health protection service content, method and toolkit; and practical findings for further progress

Conclusion. The algorithmic health-protection-service-prioritizing physical education teacher service includes: optimal combination of education methods, models, technologies and tools; education service roadmaps/ algorithms, methods and tools focused on the student health improvement aspects; psychologically comfortable health protection service environment; optimal education process design and management algorithms; individualized learning patterns/ paces; prudent design of the education curricula; sensitivity to the age-related and other individual specifics, motivations and needs of the students etc. First findings of the health-protection-service-prioritizing physical education teacher service model piloting experiment showed the model being quite beneficial as verified by the students' progress both in the modern health-protection service methods and tools and the health protection service / physical education service design algorithms.

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