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The application of motor sets in the practice of sport

UDC 796.012



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Abstract

Objective of the study is the creation of a descriptive neurological model of the processes of the transformation of verbal instructions into a state of readiness of the nervous system to solve a motor task in a particular way.

Methods and structure of the study. The method of theoretical and conceptual modelling was used in the research, directed at constructing a descriptive model of the neuromotor mechanisms that ensure the formation and realisation of motor sets. The model is constructed on the basis of an analysis of data on the functional role of the speech, cognitive, emotional-motivational, associative and sensorimotor structures of the nervous system, as well as of their interaction in the process of motor programming and control.

Results and conclusions. The type of motor set influences the parameters of the motor action. With a set for 'force/power' the technique is restructured to favour the manifestation of power at the expense of economy and accuracy. With a set for 'technique' the brain concentrates attention on creating a biomechanically expedient structure of the movement, but may thereby limit the ultimate power of the working efforts. If the set diverges from the athlete's current state or contradicts an already formed motor skill, then the system of motor programming will most probably shift towards protective motor strategies.

Keywords: motor sets, verbal instructions, management of the training process, motor strategies.

Introduction. The preparation of an athlete represents a many-sided pedagogical process having a specific content and form of organisation, which turn it into a complex systemic influence on the athlete's body, managed on the part of the coach [3].

In the course of addressing the tasks of motor learning or of increasing working capacity, the coach gives the pupil various motor sets – brief instructions that form in the athlete a series of operational rules helping him or her to 'assemble' the required form of the movement or to shift the control of the movement towards the task of a functional result ('faster', 'more powerfully', 'more aggressively' and so on) [4].

Various motor sets activate different priorities in the motor organisation of the movement in the athlete's nervous system [1, 2, 5].

Thus, for example, the set 'more powerfully/faster' shifts motor programming towards the maximisa-

tion of the working efforts: the level of cortical excitation rises, the recruitment of motor units increases and readiness for high muscular tension grows [2, 4]. From the standpoint of the output power of the movement this is useful, but it often impairs the fine spatial and temporal organisation of the movement – 'technique' is sacrificed to motor function [4, 5].

Conversely, with a set for 'technique' the power may decrease for the reason that the concentration of attention switches to the control of posture, amplitude, trajectory, angles and rhythm. The motor systems of the brain optimise the movement according to the criterion of 'accuracy', and control switches to maintaining the external form at the expense of power [1, 3, 5].

A correctly formulated motor set probably contains great potential for the motor learning or functional improvement of the athlete; for this, however, it is neces-



sary to have an idea of the neuromotor mechanisms of the transformation of the coach's verbal instructions into specific motor decisions on the part of the athlete. The present study is devoted to the creation of a descriptive model of the operation of these mechanisms; it was carried out within the framework of the state assignment of the Federal Scientific Centre VNIIFK No. 777-00021-26 (topic No. 001-25/9).

Objective of the study is the creation of a descriptive neurological model of the processes of the transformation of verbal instructions into a state of readiness of the nervous system to solve a motor task in a particular way.

Methods and structure of the study. The method of theoretical and conceptual modelling was used in the research, directed at constructing a descriptive model of the neuromotor mechanisms that ensure the formation and realisation of motor sets. The model is constructed on the basis of an analysis of data on the functional role of the speech, cognitive, emotional-motivational, associative and sensorimotor structures of the nervous system, as well as of their interaction in the process of motor programming and control.

Results of the study and discussion. From the standpoint of cognitive neurobiology, a motor set is a situationally determined, previously formed state of the nervous system in which:

1. the mode of control of the movement is chosen (which pattern and which motor strategy will be the priority);
2. the redistribution of the contributions of the sensory inputs between the vestibular, visual, tactile and proprioceptive sources of information for the formation of the motor response is carried out;
3. the parameters of attention and of the 'cost of error' are set;
4. the threshold of the choice of the motor programmes controlling the efforts of the skeletal muscles changes.

Accordingly, a motor set is not simply the coach's phrase 'do it this way', but a tuning of the athlete's whole system of motor programming and control before the attempt to perform the movement: which sensory information is to be regarded as the leading one, which pattern is to be launched, and which 'cost of error' is to be considered significant.

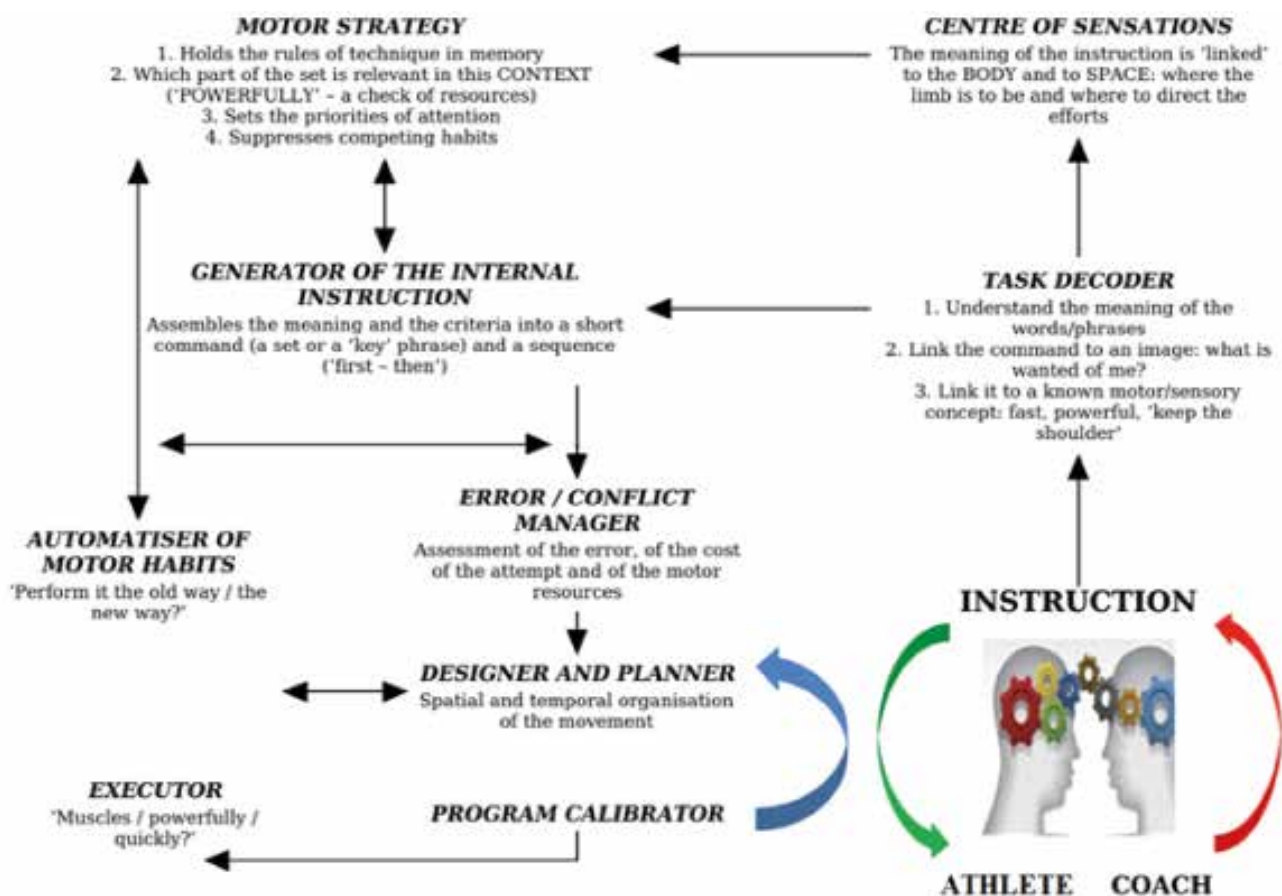


Figure. Neuromotor model of the transformation of verbal instructions into a motor strategy and a pattern of movement



The Figure presents a descriptive model of how a set arises, where it is stored and how it influences the control of the movement.

For the ease of understanding of the operation of the model by educators (coaches), we have replaced the anatomical names of the various zones of the brain by their functional analogues, using terminology that is intuitively comprehensible for specialists of a pedagogical profile. In addition, owing to the limitation on the length of the article, some functionally significant zones of the brain have not been included in the model; we shall present them in the text. For physiologists, neurologists and physicians, the corresponding zones of the brain will be indicated in the description of the model from the standpoint of the accepted terminology.

After the coach has voiced the task or instruction to the athlete, information from the auditory cortex reaches Wernicke's speech centre (the 'task decoder' in our model), which extracts the meaning of the instruction and links it with a sensory and motor concept (experience) known to the athlete. After this the information enters Broca's centre (the generator of the internal instruction) and the parietal zone of the cortex (the 'centre of sensations'). Broca's zone converts the meaning of the instruction into an internal command / motor set, while the parietal zone of the cortex correlates the meaning of the set with the body and with space. After this the motor set enters the dorsolateral prefrontal cortex (the 'centre of motor strategies') and the anterior cingulate cortex (the manager of errors / conflict). The centre of motor strategies forms the project of the motor operations (the strategy), suppresses competing motor skills and holds in short-term memory the rules of how to construct the movement in accordance with the motor set. In turn, the other nerve centre (the 'manager of errors and conflict'), having received the motor set, compares it with the current state of the body and with the available motor resources. This information reaches the 'manager of errors' from the insular cortex (not included in the model), which integrates sensory information of various types and provides the athlete with the function of bodily self-awareness. It is precisely thanks to the 'manager of errors' that the brain can detect a conflict between the motor set and the internal sensation of the current state of the organism and can change the set contrary to the wish of the coach and of the athlete himself. In doing so, the 'manager of errors' may launch the process of activation of

a protective motor strategy – the activation of spinal reflexes creating rigidity in the joints and a limitation of the amplitude, force and speed of the movement. In addition, the 'manager of errors' transmits information to the amygdala (not presented in the model) – the 'centre of emotions' – and the latter in turn directs information to the orbitofrontal and ventrolateral prefrontal zones of the cortex (not presented in the model) – the centres of decision-making about the value of the motor strategy chosen on the basis of the motor set. These centres initiate the processes of inhibiting or preserving the old motor strategies / programmes of behaviour. The decision taken by these centres is propagated to the basal ganglia (the 'automatiser of motor habits'), which switch the motor strategies and programmes to alternatives corresponding to the motor set.

In parallel with these processes, the 'centre of motor strategies' and the 'manager of errors' direct to the premotor and supplementary zones of the cortex (the 'designer' and the 'planner') a signal on the formation of a new motor programme in accordance with the new motor set and the chosen motor strategy. A copy of the motor programme is sent to the cerebellum (the 'program calibrator') and is corrected before the beginning of the movement, after which the programme passes to the primary motor zone of the cortex (the 'executor'), where the composition of the muscles, the sequence of their inclusion in the work, and the force and duration of the muscular contraction are determined. New commands to the muscles are formed and the movement is performed in accordance with the motor set. It may be said that the athlete performs the movement as he understands it through the motor set.

Some practical aspects of the operation of the model presented:

1. The more strongly the motor set diverges from the current state of the body, the more probable it is that the system of motor programming will shift towards protective motor strategies (rigidity in the joints, a limitation of amplitude, power and speed). For example, after strength work the painful sensations that have arisen in the athlete's muscles (the current state of the body) come into conflict with the coach's set 'do it faster', which launches the whole network of the brain responsible for choosing more primitive motor programmes with substantial limitations of the power of the working efforts and with a restructuring of the technique.



2. If the motor set is of a 'technical' character but contradicts an already formed motor skill, then the brain may perceive it as conflicting, and in this case it may either ignore the instruction or engage a protective motor strategy – perform the movement differently, but far worse.

3. With a motor set for 'force/power' the brain understands the meaning of the movement through the result and not through the geometry (form) of the movement – the technique becomes 'coarser' and is restructured to favour the manifestation of power at the expense of economy and accuracy.

4. With a motor set for 'technique' the brain understands the meaning of the movement as the correct form and concentrates attention on creating a biomechanically expedient structure of the movement, but may thereby limit the ultimate power of the working efforts.

Conclusions. An understanding of the nature of motor sets is fundamentally important for their effective application in sport, since it makes it possible to regard the verbal instruction not as a system of external orders but as a factor that restructures attention, sensorimotor integration, motor programming and the character of the subsequent motor realisation.

Knowledge of which sets better direct attention towards technique and which towards the power of the working efforts, of which sets cause conflict and which accelerate the formation of a motor programme, gives practitioners the opportunity to select them in a targeted and dosed manner and in accordance with the level of the current capabilities of the athlete's body. All this makes the coach's influence more precise and creates favourable conditions for reducing the risk of overload and of the disruption of coordination, and also increases the chances of the successful improve-

ment of technique and of an increase in motor performance.

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Features of piloting on tracks of different profiles in bobsleigh

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Abstract

Objective of the study is, on the basis of an analysis of the luge and bobsleigh tracks of a number of countries, to develop an algorithm of the pilot's actions for negotiating the various elements of the tracks.

Methods and structure of the study. The following research methods were applied to address the tasks set: a review of the literature, the collection of information, and questionnaires. Questions connected with piloting in bobsleigh on tracks with different profiles were examined. The most sought-after tracks of Europe, the USA and Canada were analysed. The best-known corners were identified. The questionnaires were carried out with the aim of determining the algorithm and the rules of the pilot's actions on the track.

Results and conclusions. An algorithm and rules for negotiating the track have been developed which will enable athletes to raise their level of mastery and to achieve high sporting results at competitions of various levels.

Keywords: luge and bobsleigh tracks, corner, pilot, track profile.

Introduction. Bobsleigh is an Olympic sport both for men and for women. The history of the emergence of this sport goes back to the end of the 18th century. It is one of the few sports in which high demands are placed on the athlete not only in respect of physical preparedness but also in respect of the readiness of the vestibular apparatus. Contemporary bobsleigh tracks, while often having approximately the same length, may include different profiles and geometric characteristics (Table 1).

Objective of the study is, on the basis of an analysis of the luge and bobsleigh tracks of a number of countries, to develop an algorithm of the pilot's actions for negotiating the various elements of the tracks.

Methods and structure of the study. In order to address the tasks set, we studied and analysed the profiles of the Olympic luge and bobsleigh track in Sochi and the profiles of the tracks of Europe and North America, and identified the most common elements of these tracks.

Bobsleigh tracks in various countries have different profiles in terms of length (from 1200 m to 1814 m), vertical drop (from 96 m to 148 m) and number of corners (from 12 to 19).

Let us consider the Olympic luge and bobsleigh track in Sochi. The length of the track is 1814 m; it includes 17 corners, and the vertical drop from the highest point to the lowest is 124 metres. In the main all the corners alternate in direction: corners 1-2 are right-handed, corners 3-4 left-handed, corner 5 right-handed, corner 6 left-handed, corner 7 right-handed, corners 9-10 left-handed, corners 11 and 14 left-handed, corners 15-17 right-handed, and then the finishing braking section. Between corners 5 and 6, 10 and 11, and 14 and 15 there are counter-slopes which do not allow maximum speed to be developed. And between corners 7 and 9 and corners 11 and 14 there are bends, the so-called 'curved straights'. For this reason the numbers 8, 12 and 13 are absent from the sequence of numbering of the corners.



Table 1. Characteristics of the bobsleigh tracks of various countries of the world

No.	Country	Track length (m)	Vertical drop (m)	Number of corners
1	Austria	1218	124	14
2	Canada	1450	148	16
3	China	1618	121	16
4	France	1507	124	14
5	Germany	1237	110	12
6	Italy	1445	107	14
7	Korea	1376	96	13
8	Latvia	1200	99	13
9	Norway	1305	117	13
10	Russia	1814	124	17
11	Switzerland	1722	130	19
12	USA	1455	128	17

Characteristics of the corners:

1, 2, 3, 4 – low-falling;

5 – transitional: the entry into the corner is low-falling, the exit is on a counter-slope;

6 – transitional: the entry into the corner is on a counter-slope, the exit is low-falling;

7, 9 – low-falling;

10 – transitional: the entry is low-falling, the exit is on a counter-slope;

11 – transitional: the entry into the corner is on a counter-slope, the exit is low-falling;

14 – transitional: the entry into the corner is low-falling, the exit is on a counter-slope;

15 – transitional: the entry into the corner is on a

counter-slope, the exit is low-falling;

16 – low-falling;

17 – transitional: the entry is in the horizontal plane, the remaining part of the corner (from the middle) is located on a counter-slope. Then comes the finish.

Knowing the characteristics and features of the corners, the coach and the athlete (pilot) build the strategy of negotiating (running) the track.

The study of the profiles of the tracks of Europe and North America made it possible to identify the most common elements of these tracks. A detailed analysis of each of the tracks presented in the table made it possible to identify the most frequently occurring corners, such as the 'loop', the 'labyrinth', the 'omega',

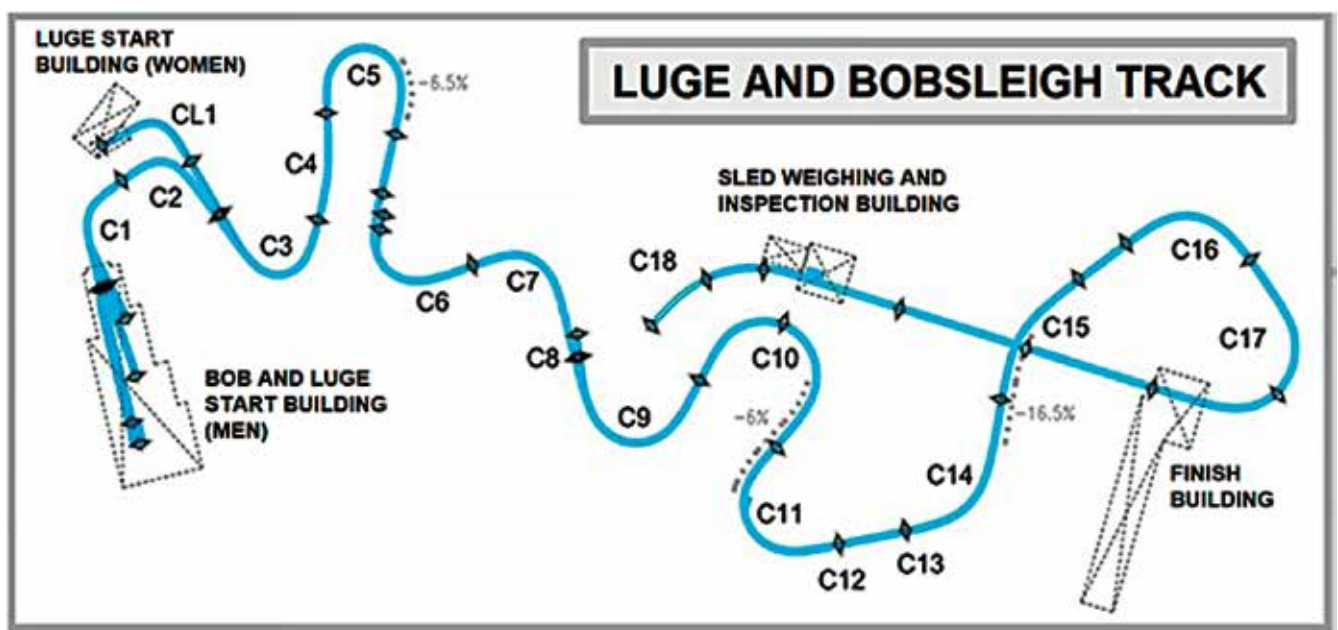


Figure. Characteristic elements of the track profiles



the 'comma', the 'ring' and others (see the Figure).

Having carried out a comparative analysis of the tracks of Europe and North America and of the Olympic luge and bobsleigh track in Sochi, we came to the conclusion that the track in Sochi is an embodiment of the most frequently occurring elements of the tracks of the world, is competently modelled and is optimally suited to the organisation of the training and competitive processes of high-class athletes.

Results of the study and discussion. Having carried out an analysis of the specialist literature and a survey and questionnaire of coaches and pilots, we have formulated a motor algorithm of the pilot's actions using the example of the Olympic track in Sochi.

If the pilot is starting for the first time on an unfamiliar track, it is recommended that he immediately take his place in the pilot's seat in the bob, concentrate, go through the whole track mentally and only then perform the descent. At the beginning of the start the coach helps him to push the bob off from its place. At the upper point of the men's start a starting groove of up to 50 metres in length is cut, for the starting acceleration and the boarding of the crew [1]. The starting speed and the subsequent piloting depend on the acceleration and the boarding of the crew. The pilot must not be constrained by the other members of the crew during the descent. When the bob has left the groove, the pilot pulls the steering ropes towards himself with a light effort, thereby exercising control so that the bob does not veer to the side before the first corner [2].

The entry into the first corner is performed to the left of the middle by means of the right rope with a smooth movement; from the middle of the corner it is necessary to turn the bob and to place it parallel to the direction of movement along the track. On exiting the corner, from the middle the right rope is returned, so that the centrifugal forces contribute to a high-quality transition into the second corner.

At the second corner the entry is made to the left of the middle with a smooth movement of the right steering rope without a shift of trajectory towards the exit from the corner. The transition from the second to the third corner is performed with a slight diagonal on entry, so that the entry into the third corner and the exit are not abrupt and the bob is not broken in the damper section. The entry into the fourth corner is made to the right with control by the left rope, and the exit from the middle without a shift of trajectory towards the exit.

The entry into the fifth corner and the fifth corner itself are performed to the left of the middle, with

steering by the right rope so as not to create the maximum trajectory of the bob parallel to the direction of the corner, and to control the negotiation of the corner and the exit (which is located on a counter-slope) by the right rope. The long straight between the fifth and sixth corners must be driven without skidding and without striking the walls. If the bob does strike a wall, it is levelled out by steering with short movements of the steering ropes in the direction of the skid.

For the entry into the sixth corner, the bob should be held to the right of the middle by the left rope, controlling its passage through the corner. If the maximum and not high point of the trajectory is maintained in the middle, we bring the bob out parallel to the direction of the exit from the corner. The transition from the sixth to the seventh corner (a short straight section) is the beginning of the build-up of speed.

The entry into the seventh corner must be made to the left of the middle, controlling the height of the trajectory with the right rope, and from the middle of the corner the bob must be turned and directed towards the exit without drawing it out (without lengthening the exit itself).

Further on, between the seventh and ninth corners there is a curved straight; it must be negotiated in such a way that on entry into the ninth corner the bob is parallel to, and to the right of, the middle of the channel.

In the first half of the ninth corner the trajectory must not be high; otherwise the bob will drop in the middle and on the exit will find itself on a higher trajectory, which threatens an overturn. The whole corner must be controlled by the left rope.

Between the ninth and tenth corners there is a short straight section, and therefore the exit from the ninth and the entry into the tenth corner must be performed with a slight diagonal, so as to enter the corner along the left wall, with the right rope slightly taut, not allowing the bob by inertia to be high in the first part. The whole corner must be in a parallel position and be controlled by the right rope, without drawing out the exit.

The tenth corner is technically complex to pilot, since it lies in different planes. The entry into the eleventh corner is to be made along the right wall, to the right of the middle, with the left rope slightly taut, shifting the maximum (not high) trajectory closer to the middle and, from it, controlling with the left rope, performing a smooth exit with a subsequent repositioning on the curved straight, repositioning for an early entry into the fourteenth corner (in parallel) along the right wall. The left rope is slightly taut and fully controls the



freedom of the glide on this section of piloting, where the maximum speed and the maximum load on the pilot are reached.

Between the fifteenth and sixteenth corners there is a long straight, on which it is necessary to reposition smoothly along the left wall for an early entry into the sixteenth corner, sending the bob towards the middle without creating a high trajectory, and from the middle to perform a smooth and long exit with a subsequent repositioning on the short straight section for an early entry into the seventeenth corner. On entry the right rope is taut and is fully controlled. Then comes the long straight finishing section, on which braking takes place.

In the course of the study, rules were determined which it is important for pilots to know for the fast and error-free negotiation of the track:

- a fast acceleration at the beginning of the distance means a high speed along the track [3];
- the less steering one applies, the higher the speed;
- during the descent the choice of a free trajectory must be controlled by the pilot by means of smooth pulls on the steering ropes;
- in order to maintain the speed of the bob on the corners, the steering ropes must be held in a fixed position, and on the straight sections their tension must be increased in order to avoid skidding and contact of the bob with the wall;
- a high level of physical preparedness has a positive effect on general cognitive functions, including concentration of attention and speed of reaction, which contributes to the growth of sporting results [4].

Conclusions. In order to raise the level of mastery, the pilot needs knowledge of the parameters and features of different tracks, with different profiles and geometric characteristics. On many of the world's tracks the combination of corners is designed at the initial stage and depends on the terrain on which the

sports facility is located. On some tracks the corners (rhythms) come in combination with a 'ring' or an 'omega'; on others, in the sequence of their arrangement, there are right-handed corners in combination with long straights, a ring and zigzag corners. Knowledge of the combinations of corners, of their arrangement and of the basic rules of negotiating the tracks enables the pilot to acquire experience and to improve his mastery of piloting.

The choice of trajectory by the pilot depends on the characteristics of the track, namely: the profile, the temperature regimes (ice, air), the state of the ice surface, the rate of the build-up of speed, the weather conditions, the technical condition of the bobsleigh sled, the starting acceleration and the experience of the pilot.

The algorithm and rules for negotiating the track that have been developed will enable athletes to raise their level of mastery and to achieve high sporting results at competitions of various levels.

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Determining parameters of serve variability in qualified volleyball players

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Abstract

Objective of the study is to identify the determining parameters of serve variability in qualified volleyball players.

Methods and structure of the study. In the course of the examination the following parameters were assessed: dynamometry data, the accuracy of the differentiation of muscular efforts and the magnitude of their deviation from the calculated value, the coefficients of agility in running and in jumping, the ability to discriminate time intervals, and also the endurance of the nervous system and its capacity to switch to movements performed at different speeds. The effectiveness of the serve was determined with account taken of the method of execution (serve for accuracy, serve for power, 'hybrid' serve). Ten games of leading teams were processed using the professional software Data Volley 4Pro. The objects of the study were 12 male athletes with the qualifications of Candidate for Master of Sport and Master of Sport, participants in the Russian volleyball championship.

Results and conclusions. 1. It was established that in the serve for accuracy the leading parameters are the differentiation of muscular effort (25 % and 50 % of maximum) and the discrimination of time intervals (10 and 30 seconds). 2. It was determined that in the serve for power the determining indicators are the coefficient of agility in jumping, the level of endurance of the nervous system and its capacity to switch to movements at different speeds. 3. It was revealed that in the hybrid serve the determining parameters are jumping agility, maximum hand strength, the accurate discrimination of time intervals (10, 30 and 60 seconds), the differentiation of muscular effort (75 % of maximum), and high values of the endurance of the nervous system and of its capacity to switch between movements at different speeds.

Keywords: *serve variability, parameters, qualified volleyball players.*

Introduction. According to the statistical data of the Russian championship, teams that achieve victories in the majority of cases demonstrate higher indicators of the difficulty and effectiveness of their serves than their opponents [4]. Each player chooses the type of serve individually, proceeding from an assessment of his own physical qualities, functional capabilities and anthropometric parameters [2]. The demands on the personal level of readiness of the athlete when executing the serve are thereby made more stringent [5]. Nevertheless, the scientific literature on volleyball presents no data concerning the preparedness of qualified athletes in the context of executing the serve by different methods.

The contemporary tendency in the development of volleyball is characterised by a change of priorities:

the float and power serves are being replaced by the serve of the hybrid type [3]. The introduction of the hybrid serve places demands on the player in respect of mastering additional technical skills [1].

For an adequate assessment of players' readiness to serve, a detailed study is required of which specific parameters of preparedness influence the execution of the serve by one or another method.

Objective of the study is to identify the determining parameters of serve variability in qualified volleyball players.

Methods and structure of the study. In the course of the examination the following parameters were assessed: dynamometry data, the accuracy of the differentiation of muscular efforts and the magnitude of their deviation from the calculated value,



the coefficients of agility in running and in jumping, the ability to discriminate time intervals, and also the endurance of the nervous system and its capacity to switch to movements performed at different speeds. The effectiveness of the serve was determined with account taken of the method of execution (serve for accuracy, serve for power, hybrid serve). Ten games of leading teams were processed using the professional software Data Volley 4Pro. The objects of the study were 12 male athletes with the qualifications of Candidate for Master of Sport and Master of Sport, participants in the Russian volleyball championship.

Results of the study and discussion. In order to achieve the task set, data were collected and analysed reflecting the indicators of highly qualified volleyball players when executing the jump serve by various methods (see the Figure).

It was revealed that under the conditions of the competitive activity of the Russian volleyball championship the frequency of application of the hybrid serve is lower than that of the power and float serves, but that it is precisely the hybrid serve that demonstrates the greatest effectiveness.

In the course of the testing, the characteristics of

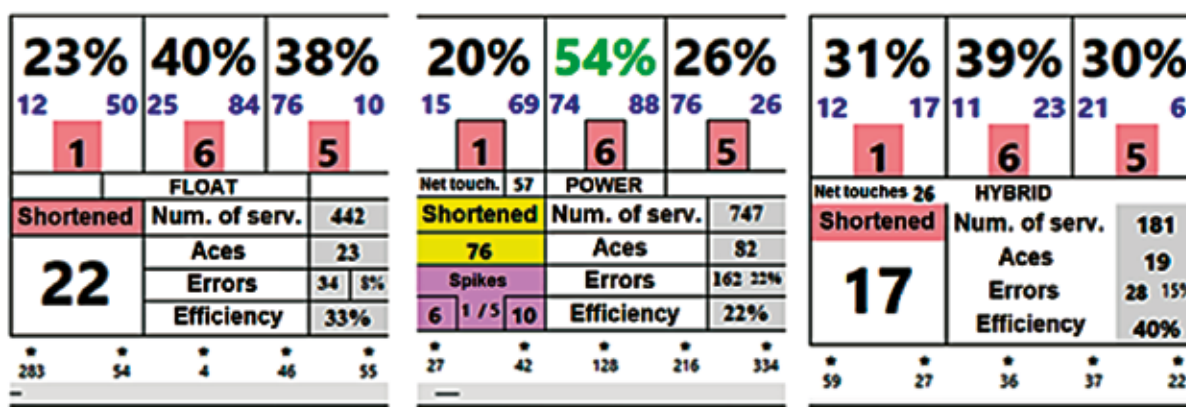


Figure. Parameters of the execution of the serve by various methods

Table 1. Results of the testing of qualified games players executing the serve by different methods (n=12)

Parameter	$\bar{X} \pm S_x$		
	Serve for accuracy	Serve for power	Hybrid serve
Coefficient of agility in running (conv. units)	1.5±0.08	1.48±0.02	1.58±0.04
Coefficient of agility in jumping (conv. units)	0.61±0.04	0.64±0.02	0.67±0.02
Differentiation of the 10 s time interval	9.83±0.39	9.85±0.30	9.92±0.40
Differentiation of the 30 s time interval	30.75±1.46	29.86±0.70	30.05±0.77
Differentiation of the 60 s time interval	63.95±22.48	64.95±0.73	60.62±1.91
Dynamometry, maximum strength (kg)	39.33±0.82	47.56±0.80	55.46±1.68
Differentiation of muscular efforts, 75 % of maximum strength (kg)	27.56±1.27	32.43±1.18	42.2±0.49
Calculated value / deviation (kg)	29.49 / -1.91	35.67 / -2.56	41.59 / +0.61
Differentiation of muscular efforts, 50 % of maximum strength (kg)	21.33±0.33	28.19±1.02	31.03±1.66
Calculated value / deviation (kg)	19.66 / +1.66	23.78 / +4.41	22.73 / +3.3
Differentiation of muscular efforts, 25 % of maximum strength (kg)	12.63±0.88	21.31±1.20	22.53±0.39
Calculated value / deviation (kg)	9.83 / +2.79	11.89 / +9.42	13.86 / +8.66
Tapping test, change in speed of movements (number per minute)	50.32±0.60	60.05±0.62	62.28±0.58
Tapping test, maximum speed of movements (number per minute)	56.33±0.89	63.33±0.50	64.44±0.38



the preparedness of the volleyball players were determined. The results are given in Table 1.

The results of the study show that the variability of the execution of the serve is determined by a combination of specific qualities of the functional preparedness of qualified volleyball players.

For the successful execution of the serve for accuracy, a high level of agility in running, a fine differentiation of muscular efforts (25 % and 50 % of maximum) and a high accuracy of discrimination of time intervals (10 and 30 seconds) are significant. Conversely, the serve for accuracy corresponds to low values of maximum hand strength, of the endurance of the nervous system and of switching between movements of different speeds.

The float serve is applied by highly qualified players as an occasional tactical means, since in high-level teams the reception of such serves does not create serious problems. Highly qualified athletes therefore apply float serves on an individual basis.

The execution of the serve for power is associated with an increase in the coefficient of jumping agility, a growth in maximum hand strength, and an increase in the endurance of the nervous system and in its capacity to switch quickly between movements of different speeds.

The key parameters in this method of serving are the ability to discriminate muscular effort at the level

of 75 % of maximum, as well as the differentiation of time intervals of 10 and 30 seconds. In highly qualified volleyball players the power serve is the principal technical and tactical means of putting the ball into play.

It was revealed that the hybrid serve, which requires a restructuring of the player's movements in the non-support phase, is characterised by still higher values of maximum hand strength and of the coefficient of jumping agility, as well as by a more accurate differentiation of each of the three time intervals measured and of muscular effort at the level of 75 % of maximum. In addition, this method of serving is associated with the highest indicators of the endurance of the nervous system and of its capacity to switch between movements at different speeds.

An analysis of the parameters of players' readiness shows that the most difficult to execute is the hybrid serve. It requires of players higher indicators which, taken together, reflect their technical and tactical mastery and make it possible to increase the proportion of points won directly from the serve under competitive conditions.

The data obtained make it possible to specify the leading parameters and confirm the assumption that, if these parameters are insufficiently formed, players either do not apply the hybrid serve at all or execute it with serious technical and tactical errors.

Table 2. Variability of the parameters when executing the serve by different methods

Indicators	Players of the Candidate for Master of Sport category, Vi (S/M) (n=12)		
	Serve for accuracy	Power serve	Hybrid serve
Coefficient of agility in running (conv. units)	0.06	0.02	0.02
Coefficient of agility in jumping (conv. units)	0.08	0.05	0.04
Differentiation of the 10 s time interval	0.05	0.03	0.03
Differentiation of the 30 s time interval	0.06	0.02	0.02
Differentiation of the 60 s time interval	0.048	0.01	0.01
Dynamometry, maximum strength (kg)	0.027	0.021	0.021
Differentiation of muscular efforts, 75 % of maximum strength (kg)	0.054	0.04	0.04
Differentiation of muscular efforts, 50 % of maximum strength (kg)	0.02	0.04	0.04
Differentiation of muscular efforts, 25 % of maximum strength (kg)	0.87	0.07	0.07
Tapping test, change in speed of movements (number per minute)	0.01	0.01	0.01
Tapping test, maximum speed of movements (number per minute)	0.02	0.01	0.01

Note: Vi – variability of the changes in the parameter.



The variability of the parameters studied in qualified players is presented in Table 2.

It was determined that as the technical difficulty of the serve increases, the variability of all the parameters of the players' preparedness decreases. The most pronounced reduction in the variability of the coefficient of jumping agility was noted in the execution of the hybrid serve, as the most difficult method.

An analysis of the preparedness of qualified volleyball players also shows that it is incorrect to assert that any single indicator has a decisive influence on the quality of the serve irrespective of its method. For an adequate assessment of players' readiness to execute the serve by one or another method, a comprehensive approach is necessary which presupposes taking into account at least such basic parameters as agility in running and jumping (coefficient), maximum hand strength, the endurance of the nervous system and its capacity to switch to movements at different speeds, and the ability to differentiate muscular effort and time intervals.

The study conducted made it possible to identify parameters indicating the need to develop an individual methodology for teaching different methods of executing the serve in volleyball. For the coaching staff, the results of the work are valuable from the point of view of planning the content of training sessions connected with the selection of a variant of the serve for each particular athlete.

Conclusions. It was established that in the serve for accuracy the leading parameters are the differentiation of muscular effort (25 % and 50 % of maximum) and the discrimination of time intervals (10 and 30 seconds).

It was determined that in the serve for power the determining indicators are the coefficient of agility in jumping, the level of endurance of the nervous system

and its capacity to switch to movements at different speeds. It was revealed that in the hybrid serve the determining parameters are jumping agility, maximum hand strength, the accurate discrimination of time intervals (10, 30 and 60 seconds), the differentiation of muscular effort (75 % of maximum), and high values of the endurance of the nervous system and of its capacity to switch between movements at different speeds.

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Individualisation of the competitive activity of young short-distance female runners

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Abstract

Objective of the study is to identify the individual features of the structural components of the competitive activity of young short-distance female runners.

Methods and structure of the study. With the help of video analysis and photoelectronic timing, the individual features of the structure of the competitive activity of short-distance female runners aged 15-17 years were determined. The data obtained were subjected to correlation analysis.

Results and conclusions. It was established that the informativeness of individual elements of competitive activity in relation to the final result varies substantially between different athletes. The general factors and the individual features of the kinematic indicators of the technical mastery of short-distance female runners aged 15-17 years were determined. It was revealed that the character of the performance of the main exercise and of its individual elements under competitive conditions, being a complex indicator, reflects a distinctive 'synthesis' of the individual features of the athlete and of the level of her technical and physical preparedness. The need for the individualisation of the training process of the particular runner on the basis of an analysis of the structure of her competitive activity is demonstrated.

Keywords: *short-distance running, female athletes aged 15-17 years, competitive activity, individual features, kinematic indicators, variability.*

Introduction. The effectiveness of competitive activity may be judged by the sporting result at competitions. However, the latter contains little information about the course of the contest and does not make it possible to identify the strong and weak aspects of the athlete's preparedness in order to outline promising directions for his or her sporting improvement [4, 8]. These purposes are served by indicators that can be obtained in the process of the objective recording of competitive activity when analysing its composition (of which elements it consists) and its structure (how these elements are connected with one another and with the sporting result). Before preparing an athlete to achieve a specific result, it is necessary to know the conditions of the motor manifestations during the performance of the competitive exercise, the demands placed on the individual functions of the body, its energy expenditure and the features of the work of the neuromuscular apparatus under competitive con-

ditions, and then, proceeding from this, to build the training process [1, 3, 7]. This determines the need to bring the content of the training process into correspondence with the requirements of real competitive activity.

Objective of the study is to identify the individual features of the structural components of the competitive activity of young short-distance female runners.

Methods and structure of the study. With the aim of comparing the group and individual models of the competitive activity of short-distance female runners whose range of results in the 100 m run was from 12.11 to 13.02 s (level of sporting qualification: First Category – Candidate for Master of Sport), two series of experiments were conducted. Using a video camera and an electronic timing system, the time of covering the 30, 60 and 80 m segments of the hundred-metre distance was recorded in 26 athletes, and the frequency and length of the strides, their total number



over the distance, and also the 'stride modulus' – the ratio of the length of the athlete's stride to the length of her leg – were measured. Then, over the course of the competition period, for each of 12 athletes from this group the time of covering the segments of the 100 m distance was determined 13-15 times in competitions and analogous indicators were calculated. The data obtained were subjected to correlation analysis. In the first case R-analysis was used, in the second P-analysis [2].

Results of the study and discussion. In examining the correlation relationship obtained from the group data of the runners aged 15-17 years (see the Table, highlighted in bold), it may be established that the sporting result in the 100 m run for athletes of this qualification depends to a greater degree on the time of covering the last 20 m ($r = 0.869$) and on the ability to maintain the frequency of the strides over the second half of the distance ($r = -0.836$ and -0.812). Poorly correlated with the result are the time of the starting acceleration ($r = 0.218$) and the number of strides expended on covering the whole distance ($r = -0.249$). If one proceeds from the structure of the group model, the training process should be oriented predominantly towards developing the abilities that provide the possibility of covering the second half of the distance quickly with a high frequency of running strides. Meanwhile, an analysis of the individual relationships shows that in none of the runners do the correlation coefficients between the time of running the 100 m distance and

its structural components of competitive activity correspond to the group ones. This fact testifies to the influence of the individual data of each participant on the relationships under examination.

Thus, in two runners the intra-individual correlation coefficients between the time of running the last 20 m of the distance and the sporting result are close to the group ones; in three the magnitude of these coefficients is sufficiently high and significant at the 5 % level of significance. In the athletes L.Kh., Ch.K. and M.N. the result in the 100 m run statistically 'depends' on the ability to perform the starting acceleration in a short time and to reach their maximum speed. In four runners (A.R., Ch.O., L.S., K.D.) a close correlation relationship of the sporting result with the fast covering of the last metres of the distance through the maintenance of a sufficiently high running tempo is observed.

For S.D., Ch.E. and R.Kh. a dependence of the result on the individual capacity to maintain an optimal stride length over the second half of the distance is characteristic. At the same time, a low statistical relationship of the 100 m running time with the frequency of the strides at the end of the distance is observed in them (respectively $r = -0.348$; -0.330 and -0.109). Evidently, in training sessions, when selecting the means of the individual preparation of one or another runner, it is necessary to take into account the specific nature of these factors.

The coefficients of variation calculated testify that the greatest inter-individual differences in the kin-

Table. Group and individual correlation relationships of the sporting result and of the structural components of competitive activity in female 100 m runners (First Category – Candidate for Master of Sport)

Indicators	Group relationship	Individual relationship											
		A.R.	Ch.O.	S.Sh.	L.Kh.	L.S.	Ch.K.	S.D.	K.D.	Ch.E.	M.Sh.	M.N.	R.Kh.
t 0-30 m	218	168	236	340	810	482	732	161	381	108	118	836	380
t 30-60 m	683	482	583	462	780	650	806	620	486	210	331	622	408
t 60-80 m	786	330	728	310	436	736	668	366	732	366	402	316	422
t 80-100 m	869	740	730	390	280	692	436	422	840	410	566	622	806
s.m. 100 m	-736	-626	-620	-612	-321	-286	-720	-266	-686	-619	-680	-780	-336
s.m. 0-30 m	-658	-262	-226	-530	-722	-364	-321	-420	-631	-228	-122	-268	-309
s.m. 30-60 m	-786	-528	-380	-426	-683	-426	-480	-382	-766	-366	-171	-333	-266
s.m. 60-80 m	-332	-412	-521	-482	-422	-566	-266	-664	-301	-705	-408	-340	-660
s.m. 80-100 m	-485	-626	-328	-470	-381	-399	-620	-786	-582	-722	-609	-420	-712
f.s. 100 m	-685	-326	-632	-312	-726	-680	-326	-168	-660	-228	-402	-669	-333
f.s. 0-30 m	-363	-208	-208	-580	-480	-126	-162	-626	-366	-486	-106	-320	-162
f.s. 30-60 m	-711	-366	-202	-226	-426	-263	-680	-280	-720	-722	-288	-368	-336
f.s. 60-80 m	-836	-602	-726	-522	-412	-480	-636	-362	-736	-328	-569	-716	-426
f.s. 80-100 m	-812	-710	-802	-631	-336	-906	-322	-348	-802	-330	608	-619	-109
Number of strides	-249	-370	-521	-282	-502	-406	-250	-322	-630	-288	106	-212	-266

Note: t – running time; s.m. – 'stride modulus' = length of the stride / length of the leg; f.s. – frequency of the strides; zeros and decimal points are omitted; $r \leq 0.05$ at 580.



ematic indicators of the athletes' running technique are observed at the beginning of the distance, the differences are somewhat smaller in the middle, and the maximum spread of the indicators is recorded at the finish of the hundred-metre distance.

It should be emphasised that when the individual indicators of the athletes are compared with the group model data, a discrepancy is often revealed: the athlete possesses capabilities exceeding the required indicators, while in individual characteristics she is quite far from them. Naturally the question arises: which path should be taken towards further improvement? According to the widespread point of view, the disproportion should be eliminated and the qualities lagging behind in development should be 'brought up' to the required values.

Meanwhile it is known from practice [1, 3, 5, 6] that such an apparently entirely logical approach is ineffective for athletes possessing a marked individuality. The coach not infrequently strives to raise those capabilities of his charges which are largely conditioned genetically or are constrained by an exceptionally high level of development of other qualities. In this case the training, as a rule, not only fails to produce results but also reduces the strongest aspects of preparedness, smoothing out the individual features that might have become the key to success. At the same time, the apparent shortcomings in the preparedness of many, even well-known, athletes are a natural continuation of their strong points, which ultimately ensure the achievement of outstanding results.

Thus, the studies conducted show that the individualisation of the training process should be based on information about the structure of the manifestation of motor abilities and about the indicators of the technique of the competitive exercise in each athlete. At the same time, the maximum development of individual aptitudes should be combined with a sufficiently harmonious and comprehensive preparation which does not, however, come into contradiction with her individuality.

Conclusions. The correlation coefficients between the sporting result and its structural components, calculated from the results of a single testing of the participants (mean group indicators), differ from the analogous values of the correlation coefficients calculated from the results of the repeated testing of a single participant (intra-individual indicators). At the same time, the distribution of the load, its magnitude and the target orientation of the training process for

achieving the planned structure of competitive activity should be carried out on the basis of the individual features of one or another athlete, since the character of the performance of the main exercise and of its individual elements under competitive conditions, being a complex indicator, reflects a distinctive 'synthesis' of the level of the athlete's technical and physical preparedness and of her specific characteristics.

Information about the athlete's activity at competitions therefore serves as the basis for the choice of the means and methods and of the volume and intensity of the training influences. Without revealing the cause-and-effect relations of the training process and sporting achievements, an analysis of the level of the latter provides only descriptive information.

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Rationale for the use of neuromotor means in the system of adaptive physical education of preschool children with speech disorders

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Keywords: *adaptive physical education (APE); neuromotor means; speech disorders; interhemispheric interaction; central nervous system (CNS).*

Introduction. The growing practical interest in neuromotor technologies, which have proven effective when working with various nosological groups [1], underscores the need for their application in correctional and developmental work with children with speech disorders, who are characterized by deficits in the development of the psychomotor and motor domains [2]. It is known that speech disorders are associated with distinctive features in the formation of the psychomotor sphere (movement coordination, voluntary regulation, interhemispheric interaction); however, current correctional and developmental practice makes insufficient and fragmentary use of APE means.

Objective of the study – to determine the composition of neuromotor means in the system of adaptive physical education of preschool children with speech disorders.

Methods and organization of the study. Analysis of scientific and methodological literature, selection of means, and pilot testing in work with children with speech disorders.

Results and discussion. The theoretical basis of neuromotor means is formed by: the theory of N.A. Bernstein (voluntary movements are regulated by hierarchical levels of the CNS, some of which are also involved in speech programming); the work of A.R. Luria (the brain mechanisms of movement and speech partially overlap, and the maturation of the cortical speech areas is linked to the development of fine motor skills); and A.J. Ayres's theory of sensory integration. However, the commonality of these neurophysiological mechanisms does not imply identity of the areas of pedagogical influence: the development of the psychomotor sphere creates conditions for the child's overall development, whereas correction of sound pronunciation, lexico-grammatical structure, and phonemic hearing remains the task of speech therapy. Neuromotor means (NMM) are a set of exercises and motor tasks that activate the mechanisms of sensorimotor integration, interhemispheric interaction, and level-based regulation of movement. The composition of NMM includes three groups: neurogymnastics - the

coordinated performance of motor actions combined with a cognitive task (breathing exercises, oculomotor exercises, stretching, and interhemispheric-interaction tasks) used in the preparatory and concluding parts of a session; neuro-games - play-based and motor tasks built on motor planning and mnemonic techniques, used in the main part of a session; and neurobics - exercises implementing the principle of ambidexterity, cross-lateral movements, and increased sensory afferentation (unstable support surfaces, restricted visual control). These means differ from speech-therapy practice in their organization (delivered by an APE specialist) and in their measured outcome.

Conclusions. Neuromotor means can legitimately be regarded as an independent component of the content of adaptive physical education for children with speech disorders, differentiated from speech-therapy and neuropsychological-correction practice by the agent delivering it, its form of inclusion in a session, and its measured outcome. A further direction for research is the design of a methodology based on the three-component structure of NMM and its experimental testing, including diagnosis of the baseline level of psychomotor development in this group of children.

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Analysis of the bioenergetic profile and metabolic capacity of athletes of the national Muay Thai team

UDC 796.8:612.1



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Abstract

Objective of the study is to monitor the bioenergetic indicators of 98 athletes of the national Muay Thai team.

Methods and structure of the study. The research was carried out using D&K-TEST rapid diagnostics and methods of assessing functional state, including the indicators of anaerobic, aerobic and total metabolic capacity, as well as heart rate at the level of the anaerobic threshold (HR AT). The data obtained made it possible to determine the pronounced heterogeneity of the functional profile of the athletes examined and to identify the features of their energy metabolism. It was established that the 4th metabolic type predominates in the structure of the team; it is characterised by an anaerobic-aerobic profile and an orientation towards strength endurance. The proportion of athletes with the balanced 3rd type is also significant, whereas representatives of the 1st type occur only in isolated cases.

The range of values of total metabolic capacity proved to be wide, which testifies to differences in the level of special working capacity and functional reserves. The average values of HR AT correspond to a high-intensity regime of loading typical of combat sports; however, the individual fluctuations of the parameter indicate an unequal degree of adaptation of the cardiovascular system to competitive activity.

Results and conclusions. The work carried out confirmed the expediency of using bioenergetic monitoring in the system of preparing combat sports athletes. The practical significance of the work consists in the possibility of individualising the training process with account taken of the metabolic type, the level of total metabolic capacity and the features of the threshold response of the cardiovascular system. The information obtained may be used in planning loads, monitoring recovery and adjusting the orientation of the preparation of the athletes of national teams.

Keywords: *Muay Thai, bioenergetics, metabolic capacity, anaerobic threshold, heart rate, functional preparation.*

Introduction. Muay Thai belongs to those combat sports in which competitive activity is characterised by an alternation of short high-power actions, series of strikes, clinching, movements and short intervals of recovery. Such a structure of the bout places high demands both on the anaerobic and on the aerobic mechanisms of energy supply, as well as on the ability of the body to maintain working capacity under conditions of increasing fatigue [4, 6]. In this connection, particular relevance attaches to the monitoring of bioenergetic indicators, which makes it possible to assess objectively the functional state of the athletes and to forecast their readiness for competitive activity [9].

Contemporary approaches to the preparation of combat sports athletes are based on the idea of the individualisation of the training process with account taken of the dominant type of energy supply, of the magnitude of the metabolic capacity and of the degree of expression of the adaptive reactions of the cardiovascular system. For this purpose, methods of assessing aerobic and anaerobic performance, the threshold characteristics of the heart rhythm and integral indicators of the functional state of the body are used [1, 2, 7]. In sporting practice, rapid methods that make it possible to obtain promptly the data necessary for managing load and recovery are particularly in demand.



The relevance of the present study is conditioned by the need for a scientifically well-founded typology of the athletes of the national Muay Thai team according to their bioenergetic characteristics. Such a typology makes it possible to identify the strong and weak aspects of functional preparedness, to determine the structure of the distribution of the athletes by metabolic profile, and to use these data in the system of sporting selection and preparation.

Objective of the study is, on the basis of the data of the monitoring of bioenergetic indicators, to determine the structure of the distribution of the athletes of the national Muay Thai team by metabolic type and to describe the features of their metabolic capacity and HR AT.

Methods and structure of the study. Ninety-eight athletes of the national Muay Thai team took part in the research. The examination was carried out under the conditions of current functional monitoring in the preparatory period. The D&K-TEST hardware and software complex for rapid diagnostics was used to assess the bioenergetic profile; it makes it possible to calculate anaerobic metabolic capacity, aerobic metabolic capacity, total metabolic capacity and heart rate at the level of the anaerobic threshold.

On the basis of the ratio of the aerobic and anaerobic components of energy supply, the athletes were distributed into five metabolic types. The data were interpreted with account taken of the principles of assessing functional state in sport and of the concepts of the regulation of the heart rhythm and of adaptation to physical loads [2, 7]. The results were analysed on the basis of descriptive statistics and the comparative juxtaposition of individual and group indicators.

Results of the study and discussion. The monitoring revealed a considerable heterogeneity of the bioenergetic profile of the athletes of the national team. The values of total metabolic capacity varied over a wide range: from the minimum indicators characteristic of athletes with more limited reserves of energy supply to high values reflecting a high level of special working capacity. Such a spread testifies to differences in functional specialisation, length of training and individual response to load.

The most pronounced proved to be the 4th metabolic type, which was identified in 46 athletes, amounting to 46.9 % of the sample. This profile is characterised by a combination of anaerobic and aerobic mechanisms of energy supply and corresponds to the strength endurance type. Its dominance in the struc-

ture of the team is consistent with the specific nature of competitive activity in Muay Thai, where the athlete must repeatedly perform explosive actions against a background of insufficient time for recovery.

Second in number was the 3rd type, represented in 29 athletes (29.6 %). This variant may be regarded as a balanced profile providing relative versatility and sufficient resistance to loads of various orientations. The presence of a considerable proportion of athletes of this type may indicate a harmonious development of the aerobic and anaerobic mechanisms; however, in individual cases it requires the strengthening of either the speed-strength or the endurance component.

The 5th type, associated with a pronounced anaerobic-power profile, amounted to 11.2 % of the sample. These athletes possess a high potential for short-term intensive work, but may accumulate fatigue more quickly when the aerobic support of recovery is insufficient. The 2nd type, predominantly aerobic, was identified in 10.2 % of those examined. This group is characterised by a better recovery capacity; however, a deficit of power may be observed under conditions of intense competitive dynamics. The 1st type proved to be the least represented – 2.0 % – which indicates the rarity of a pronounced speed-strength profile in this team.

An analysis of HR AT showed that in the majority of the athletes this indicator lies in the range of 165-175 bpm, which corresponds to a high-intensity regime of work and reflects the specific nature of combat sports. At the same time, the individual differences were considerable: in some athletes HR AT proved to be comparatively low with a high working capacity, which may testify to an economisation of cardiac activity; in others it was higher, which requires additional monitoring of the recovery processes and of the dynamics of adaptation [1, 7].

The results obtained confirm that the structure of energy metabolism in the national Muay Thai team is not homogeneous. The predominance of the 4th type indicates the high significance of special endurance in this sport, whereas the presence of the 2nd and 5th types shows the need for a differentiated approach to the individual preparation of the athletes. The use of the indicators of total metabolic capacity and HR AT may serve as an effective instrument for monitoring adaptive changes and adjusting loads in the process of sports preparation [3].

Conclusions. The monitoring of the bioenergetic indicators of 98 athletes of the national Muay Thai



team revealed a pronounced heterogeneity in metabolic capacity and in type of energy supply. The 4th metabolic type, characterised by an anaerobic-aerobic profile and an orientation towards strength endurance, dominates in the structure of the team. The significant proportion of the 3rd type testifies to the presence of athletes with balanced functional capabilities, whereas the 1st type is represented only in isolated cases.

It was established that the indicators of HR AT correspond on the whole to the high intensities characteristic of competitive activity in combat sports; however, the individual differences in the parameter require a personalised approach to the planning of loads and to recovery. The data obtained confirm the expediency of using bioenergetic monitoring as a basis for the individualisation of the training process in Muay Thai.

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Extreme occupational factors of high-speed train drivers as a basis for applied physical training

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Keywords: *professionally applied physical training, high-speed train driver, extreme working conditions, readiness for professional activity, operator stress.*

Introduction. Russia is building high-speed railway lines, and train speeds will reach 400 km/h [1]. A high-speed train driver spends many hours in a small cab, monitors a large number of movement parameters, and is exposed to vibration, noise, and electromagnetic fields. Physical activity is minimal, while psycho-emotional strain stays high. About 70 % of occupational accidents are linked to the human factor, mainly to fatigue and stress of the worker [2]. Applied physical training of railway specialists was studied by V.A. Sadovsky, T.A. Zenkova, and D.O. Belov [3].

Objective of the study to substantiate that the work of a high-speed train driver belongs to activity in extreme conditions and to define the focus of applied physical training on this basis.

Methods and organization of the study. The Transport Strategy of the Russian Federation, professional standard 17.010 for locomotive operation staff, and the federal educational standard for the specialty 23.05.03 Railway Rolling Stock were analysed. The study was conducted at Emperor Alexander I St. Petersburg State Transport University.

Results and discussion. Conditions are considered extreme when unfavourable factors cause the maximum strain of the adaptation mechanisms of the body [4]. Driving a train at a speed above 250 km/h fits this definition. Five factors were identified. The speed factor reduces the time required to make a decision to just a few seconds. The sensory and information factor sharply increases the amount of incoming information. Monotony keeps the driver in uniform operations for up to 6 hours in a row while full alertness is required. Hypokinesia is caused by the forced posture in the confined cab. The responsibility factor makes the cost of an error comparable with aviation. By their nature these factors form three groups, namely physical, information and cognitive, and psycho-emotional.

Acting together, they produce operator stress of the

high-speed profile, which depletes physical, functional, and psycho-emotional resources at the same time. Readiness for such work includes three components. The conditioning and coordination component covers static endurance of the back and neck muscles, fine motor coordination, and speed of visual motor reaction. The functional and adaptation component reflects vestibular stability, the work of the cardiovascular and respiratory systems under hypokinesia, and autonomic regulation. The psycho-emotional component combines resistance to monotony, attention properties, stress tolerance, and emotional and volitional self-regulation.

This leads to the principle of anticipatory modelling of occupational stress factors. Students first perform exercises under standard conditions, then the conditions become more complex through sensory interference, time pressure, and preliminary fatigue. In parallel they learn methods of mental self-regulation and recovery of working capacity.

Conclusions. The work of a high-speed train driver belongs to activity in extreme conditions, which are created by the combination of the speed factor, the sensory and information factor, monotony, hypokinesia, and high responsibility. Applied physical training of future drivers should develop the three components of readiness at the same time and should be based on anticipatory modelling of occupational stress factors in training sessions.

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Development and application of means for improving the special physical preparation of qualified kickboxers and hand-to-hand combat athletes at the pre-competition stage

UDC 796.835



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Abstract

Objective of the study is to develop and introduce means for improving the special physical preparation of kickboxers and hand-to-hand combat athletes.

Methods and structure of the study. Thirty-five students of Omsk State Medical University aged 17-25 years took part in the research; they are members of the OmSMU kickboxing team at the pre-competition stage of preparation for the Universiade in kickboxing among students of medical and pharmaceutical universities of the Russian Federation held in Ufa. The set of exercises developed was also applied during the preparation of 40 cadets of the Omsk Tank-Automotive Engineering Institute for the N. Chepik memorial tournament in army hand-to-hand combat, which has the status of a stage of the Cup of the Armed Forces of Russia.

Results and conclusions. Exercises oriented towards the development of explosive strength were taken as the means of improving special physical preparation for the kickboxers. The first element represents a combined rotation of the torso while holding a medicine ball together with a split-stance jump. It consists of two phases: in the first phase the medicine ball is at the side and behind the torso; in the second, the position of the legs is changed and the torso is simultaneously rotated with the ball being thrown forwards. Shadow boxing is then performed for 30 seconds. The technique of the second element of preparation involves the use of 1 kg dumbbells: straight punches must be performed at maximum speed for 20 seconds. The set concludes with shadow boxing without weights (30 s).

The study showed a growth in punching power after the application of the set of exercises developed. Punching power is composed of the speed of the strike multiplied by the mass of the striking limb. Of great importance are the distribution of this mass and the coordination of the movements (rotation of the torso, impulse from the legs, position of the elbow and hand).

Keywords: kickboxing, hand-to-hand combat, special physical preparation.

Introduction. Kickboxing requires the constant improvement of the execution of elements in bouts by means of exercises directed at developing explosive strength. In order to win by knockout, a high speed of execution of the strike in combination with accuracy is necessary. The set of exercises we propose is aimed at creating the necessary conditions for performing powerful and sharp strikes. The methodology is also relevant for hand-to-hand combat athletes, in view of the need to apply effective strikes and combinations with throws.

Objective of the study is to develop and introduce means for improving the special physical preparation of kickboxers and hand-to-hand combat athletes.

Methods and structure of the study. A comparative analysis of the literature was carried out. Exercises oriented towards the development of explosive strength were taken as the means of improving special physical preparation for the kickboxers. The first element represents a combined rotation of the torso while holding a medicine ball together with a split-stance jump. It consists of two phases: in the first phase the



medicine ball is at the side and behind the torso; in the second, the position of the legs is changed and the torso is simultaneously rotated with the ball being thrown forwards. It is performed for 1 minute [1]. Shadow boxing is then performed for 30 seconds. The technique of the second element of preparation involves the use of 1 kg dumbbells: straight punches must be performed at maximum speed for 20 seconds. The set concludes with shadow boxing without weights (30 s). Five sets must be performed with a rest of 2 minutes between them. In order to assess the effectiveness of the exercises selected, testing using a strength meter and a survey were carried out.

Results of the study and discussion. Last year the team of the medical university fought 38 bouts at kickboxing competitions, of which 4 were won by knockout. After analysing the competitions and summing up the results, it was established that the number of victories by knockout was insufficient relative to the total number of bouts fought. The coaching and teaching staff took the decision to develop a methodology for increasing punching power in order to raise the proportion of early victories of the team [2].

There are two principal categories of exercise used in kickboxing on a regular basis: strength exercises, by means of which a state is achieved in which the muscle fibres involved in the exercise are at maximum tone, and speed-strength exercises, the action of which is directed at developing the speed and increasing the coordination abilities of the muscle fibres. Three components are of primary importance in improving the technique of kickboxers: functional preparation, speed-strength work and general physical preparation. All the elements are inseparably connected with one another and form a system, adherence to which leads to the achievement of results. Speed-strength preparation (SSP) presupposes the formation of a particular rhythm of performing various combinations with account taken of the physiological and anatomical features of the athlete. The speed-strength skills of kickboxers are improved by means of the method of repeating speed-strength tasks with weights, as well as by a method that reproduces the mixed regime of work of the muscles functionally significant for kickboxing. Any variant of the exercises proposed is performed with high intensity and a low volume of training load [3, 8].

Many authors, in discussing the special physical preparation of the kickboxers of the national team of Russia, single out several principal principles: obser-

vance of the regime of work and rest – performing SSP 1-2 times a week, since after high-intensity work the body must have time to recover fully; performing the exercises at the highest tempo for 15 s, with a rest between exercises of 1-2 minutes, while the rest between sets should be 10-15 minutes. These intervals are conditioned by the need for the recovery of the nervous system (the reserves of neurotransmitters) and by the specific feature of SSP – the performance of work at maximum speed – and consequently there must be a sufficient quantity of creatine phosphate and a low level of metabolic products (lactate and other metabolites) in the muscles [4, 9, 10]. The improvement of the speed indicators of punching and kicking technique is carried out in accordance with several principles of constructing the tasks. At the pre-competition stage the decision was taken to use a new set of exercises with the kickboxing team of Omsk State Medical University, in which 35 qualified athletes train [5, 12]. The experiment was conducted over the course of a month, after which 19 athletes (one person in each weight category) represented our university at the competitions in Ufa and demonstrated the results of the methodology applied. A total of 41 bouts were fought, of which 7 were won by knockout, which is 7 % more than in the previous year. Both the total number of victorious bouts increased (from 24 to 30) and the number of bouts ended early (from 4 to 7). These results showed that means of preparation based on speed-strength work have a high effectiveness.

A test on a rigid wall-mounted strength meter was also used to diagnose the speed-strength parameters before the beginning of the experiment and after it. At OmSMU, with all the participants in a normal functional state, the members of the kickboxing team demonstrated the force of the straight punch of the working hand, the force of the straight punch of the weaker hand and the force of the hook (of the dominant hand). Three attempts were allowed for each strike, after which the results of the best attempt were recorded. The mean values for the 35 participants were then calculated. The study showed a growth in punching power after the application of the set of exercises developed. Punching power is composed of the speed of the strike multiplied by the mass of the striking limb [6, 7, 11]. Of great importance are the distribution of this mass and the coordination of the movements (rotation of the torso, impulse from the legs, position of the elbow and hand).



This set of exercises was also applied at the Omsk Tank-Automotive Engineering Institute. After the experiment a survey was conducted, as a result of which 7 cadets noted no changes in their level of preparation, while 33 cadets noticed a considerable growth in punching power and an improvement in coordination during sparring.

Conclusions. In the course of the study and of the examination of the scientific and methodological literature, the effectiveness of the proposed means of special physical preparation for increasing punching power in the members of the kickboxing team was demonstrated.

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Assessment of the effectiveness of the application of isometric exercises in the special strength preparation of qualified volleyball players

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Abstract

Objective of the study is to assess the effectiveness of the application of isometric exercises in the special strength preparation of qualified volleyball players.

Methods and structure of the study. Sixteen qualified male volleyball players (of a category not lower than Candidate for Master of Sport) aged 18-25 years took part in the research; they make up the main squad of the higher league team of the Autonomous Non-Profit Organisation 'Volleyball Club Kama' (Perm). The effectiveness of the application of isometric exercises was assessed by means of the following indicators: the height of the vertical jumps without and with an arm swing (cm), assessed by the method of tensometry using a ForceDecks dual force platform; the strength of the muscles of the hand and forearm for the left and right hands and the strength of the extensors of the trunk, assessed by the method of dynamometry (a DK hand dynamometer and a DS-200 back dynamometer); the time of performance of the control test 'Plank' (s); the distance in the control test 'throw of a 1 kg ball from behind the head with two hands, seated' (m); and the calculated data of the video analysis of official matches: the effectiveness of serves (%), the 'height of the block' (cm), the 'percentage of blocks won' (%) and the effectiveness of attacking hits (%). In the course of the mathematical processing of the results, the arithmetic mean and the standard deviation ($\bar{x} \pm \sigma$), the indicator of dynamics (relative change, %) and the effect size (ES) were calculated.

Hypotheses about the significance of the statistical differences in the athletes' indicators over the period of the study were tested by calculating the Wilcoxon test for the 5 % level of significance.

Results and conclusions. The application of isometric exercises ensures statistically significant gains in the indicators of the strength abilities of qualified volleyball players, including those manifested in jumps and those requiring strength endurance, and also ensures an increase in the effectiveness of their competitive activity (serves, blocking and attacking hits).

Keywords: volleyball, strength preparation, isometric exercises.

Introduction. Isometric exercises (the name given to exercises in which muscular tension is not accompanied by a change in the length of the muscle fibre) are applied in various sports and in physical education to address a wide range of tasks [1].

For all their merits and advantages, established opinions have taken shape in Russian practice of the physical (including strength) preparation of athletes to the effect that:

- it makes sense to use them as the principal means in the case of developing maximum strength

or hypertrophy, and as an auxiliary means in the case of developing speed-strength abilities [1];

- the maximum effect of the application of isometric exercises is recorded in beginner athletes, whereas in qualified athletes the effect is minimal [2];

- the transfer of the effect of isometric exercises to a strength competitive exercise of a dynamic character is minimal [1].

As for foreign researchers, publications have recently been appearing more and more frequently



which testify that these propositions are not so unambiguous [3, 4, 5].

In the context of our work with qualified volleyball players, the following publications and the conclusions of their authors presented in them are of interest:

- the application of isometric strength exercises as pre-activation before a game leads to a statistically significant increase in jump height in qualified male volleyball players (acute effect) [3];
- the effects of isometric exercises in volleyball players over 19 years of age are more pronounced than in volleyball players below this age, and in male volleyball players they are more pronounced than in female players [4];
- the transfer of the effects of isometric strength exercises to the dynamic competitive exercises of volleyball players (long-term effect) is possible subject to the following conditions: a) the presence of biomechanical similarity in the structures of the two exercises; b) the isometric exercise was performed with the involvement of large and long muscle groups [5].

In view of the above, the relevance of the present study is determined by the need to refine the theoretical propositions indicated and to assess the expediency of applying isometric exercises in the practice of the strength preparation of qualified volleyball players.

Objective of the study is to assess the effectiveness of the application of isometric exercises in the special strength preparation of qualified volleyball players.

Methods and structure of the study. Sixteen qualified male volleyball players (of a category not lower than Candidate for Master of Sport) aged 18-25 years took part in the research; they make up the

main squad of the higher league team of the Autonomous Non-Profit Organisation 'Volleyball Club Kama' (Perm).

The monitoring of the tensometric indicator 'jump height' (cm) in two types of jump (the vertical jump without an arm swing and with an arm swing) was carried out using a ForceDecks dual force platform.

The strength of the muscles of the hand and forearm for the left and right hands was measured using a hand dynamometer (DK hand dynamometer), and the strength of the extensors of the trunk was measured using a back dynamometer (DS-200 back dynamometer).

As control tests assessing strength abilities, those recommended by the federal standard of sports preparation for the sport of volleyball were used: the «throw of a 1 kg ball from behind the head with two hands, seated» and the «Plank».

As indicators of competitive activity, the data of the video analysis of official matches were used: the effectiveness of serves (%), the 'height of the block' (cm), the 'percentage of blocks won' (%) and the effectiveness of attacking hits (%).

Hypotheses about the significance of the statistical differences in the athletes' indicators over the period of the study were tested by calculating the Wilcoxon test for the 5 % level of significance.

The effect size (ES) was calculated to assess the 'degree of influence' of the isometric exercises on the indicators.

Results of the study and discussion. Within the framework of the working hypothesis it was assumed that the transfer of the effects of isometric exercises to the dynamic competitive actions of volleyball players is possible and is on the whole positively reflected in their effectiveness.

Table 1. Dynamics of the indicators characterising the strength abilities of the athletes over the period of the study

Indicator	Beginning of the study	End of the study	Rate of gain, %	p	Cohen's d
Vertical jump without an arm swing, cm	43.63 ± 1.4	46.9 ± 1.3	+7.49	≤ 0.05	0.96
Vertical jump with an arm swing, cm	46.66 ± 2.5	48.54 ± 3.1	+4	> 0.05	0.68
Hand dynamometry (right hand)	66.1 ± 0.9	68.7 ± 1.2	+3.93	≤ 0.05	0.96
Hand dynamometry (left hand)	63.2 ± 1.2	65.9 ± 1.2	+4.27	≤ 0.05	0.94
Back dynamometry	155.2 ± 5.4	165.3 ± 4.5	+6.5	≤ 0.05	0.93
Plank (s)	176 ± 36	254 ± 28	+44.32	≤ 0.05	0.96
Throw of a 1 kg ball from behind the head with two hands, seated (m)	13.2 ± 1.1	14.3 ± 0.6	+8.33	> 0.05	0.81



The dynamics of the indicators characterising the strength abilities of the athletes over the period of the study are presented in Table 1.

The lowest values of the rates of gain were recorded for the right hand of the athletes (+3.93 %) (in the overwhelming majority of players it is the 'dominant' hand); a slightly greater rate of gain was recorded for the left hand of the players (+4.27 %) (it is easier to elicit a functional response).

The most pronounced statistically significant shifts were noted in the indicator of static endurance (the rate of gain in the control test 'Plank' amounted to +44.31 %).

In performing the control test 'throw of a 1 kg ball from behind the head with two hands, seated,' the lower links of the kinematic chain are 'switched off' and the movement is carried out only by the muscles of the trunk and arms, which is not typical of the ordinary competitive activity of a volleyball player. It is precisely by this that we explain the fact that, following the results of the study, the differences observed in the results of this control test proved to be statistically insignificant, although they had the character of a positive tendency ($p > 0.05$).

As for the jumping control tests, the jump without an arm swing most probably proved to be closer in biomechanics to the isometric exercises applied in the course of training, and therefore elicited more significant shifts, and the differences observed proved to be statistically significant; whereas the jump with an arm swing, most frequently used by volleyball players in game situations, differed from the isometric exercises applied, and therefore the effects proved to be less pronounced, although they had a general positive tendency.

The dynamics of the indicators characterising the competitive actions of the athletes over the period of the study are presented in Table 2.

The maximum effect of the application of isometric exercises was recorded in the indicator 'ef-

fectiveness of serves' (the rate of gain amounted to +24.89 %, effect size $d = 0.93$), which in our view may be explained by an increase in the stability of the shoulder girdle ensured by the application of biomechanically similar isometric exercises (it is easier to model an isometric exercise close in biomechanics to the serve).

The situation of the attacking hit can also be modelled in isometric exercises; however, its effectiveness is composed not only of the speed-strength component but also of the technical one and of the factor of the opponents' counteraction. Therefore the fact that in the course of the study statistically significant shifts were obtained in this indicator (albeit less pronounced in comparison with the shifts in the effectiveness of serves (the rate of gain amounted to +14.77 %, effect size $d = 0.81$)) was assigned by us to the positive results of the study.

The lowest rates of gain were recorded in the indicator 'height of the block' – +5.26 %, effect size $d = 0.89$ – although the effectiveness of their execution increased statistically significantly (the rate of gain amounted to +19.79 %, effect size $d = 0.72$). The data obtained testify that the application of isometric exercises is also expedient for improving defensive actions.

Conclusions. The study conducted makes it possible to draw a number of conclusions and assumptions:

1. The performance of isometric exercises has an overall positive but selective influence on the strength abilities of qualified volleyball players: in the case where the measured indicator and/or the control test are biomechanically similar to the isometric exercises used in the course of training, the differences observed will most probably prove to be statistically significant ($p \leq 0.05$); otherwise they will exert a positive influence, but only at the level of tendencies ($p > 0.05$).

Table 2. Dynamics of the indicators characterising the competitive actions of the athletes over the period of the study

Indicator	Beginning of the study	End of the study	Rate of gain, %	p	Cohen's d
Effectiveness of serves (%)	23.7 ± 2.4	29.6 ± 3.3	+24.89	≤ 0.05	0.93
Height of the block (cm)	298.5 ± 8.7	314.2 ± 9.1	+5.26	≤ 0.05	0.89
Percentage of blocks won (%)	18.7 ± 4.3	22.4 ± 4.5	+19.79	≤ 0.05	0.72
Effectiveness of attacking hits (%)	32.5 ± 3.8	37.3 ± 4.1	+14.77	≤ 0.05	0.81



2. The application of biomechanically similar isometric exercises has a positive effect on the performance of both the attacking and the defensive competitive actions of qualified volleyball players.

3. The systematic inclusion of isometric exercises in the training process of qualified volleyball players ensures a positive transfer of their effects to the indicators of competitive exercises.

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The influence of motor sets on the motor performance of ski jumpers

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Abstract

Objective of the study is to examine the features of the influence of various motor sets on the indicators of motor performance in ski jumpers.

Methods and structure of the study. The influence of the motor sets was assessed in the course of the pedagogical testing of three ski jumpers (aged 23±3 years) performing an upward jump from the ' jumper's crouch ' using a linear encoder of the Muscledab system. The values of force (N/kg), power (W/kg), height (cm) and time of the jump (s), as well as the maximum speed of the jump (m/s), were recorded as control indicators. In the course of the mathematical processing of the results, the arithmetic mean and the standard deviation ($\bar{x} \pm \sigma$), the indicators of dynamics (absolute change (Δ) and relative change (%)) and the indicator of the minimal detectable change with a 95 % confidence interval (MDC95) were calculated.

Results and conclusions. The effect of the motor sets is determined by the level of sporting and technical mastery and preparedness of the ski jumper. The maximum reactivity to various motor sets is possessed by athletes of an average level of preparedness, who demonstrate positive responses in motor performance (force/speed of the jump). The skill-based stabilisation of motor programmes, conditioned by the growth of sporting and technical mastery, reduces the effect of various motor sets in respect of the indicators of motor performance.

Keywords: *ski jumping, motor sets, verbal instructions, management of the training process.*

Introduction. Ski jumping places high demands on the speed-strength abilities of the muscles of the lower limbs, since at the moment of the push-off from the take-off table the athlete is required to manifest the maximum possible magnitude of effort in the minimum period of time [2]. Speed-strength abilities are under strong genetic control, and their directed improvement requires a constant search for new methodological devices which probably should lie not only in the plane of pedagogy, since the ultimate mobilisation of the neuromuscular apparatus is impossible without the ultimate mobilisation of the athlete's psyche [1]. One of the possible ways of exerting a stimulating influence on the manifestation of the functional capabilities of the neuromuscular apparatus may be motor sets, which constitute the basis of the verbal methods of influencing the athlete [3].

Motor sets are the product of the cognitive processing by the athlete's brain of the coach's instruction into a motor-and-verbal encoded rule which sets the priority goal of the movement, directs attention, activates the necessary sensorimotor connections and prepares the motor zones of the brain for the manifestation of the motor function in strict accordance with the way the athlete has understood the meaning of the instruction [4, 5]. All the above determines the promise of applying motor sets in the practice of preparing ski jumpers. An analysis of the literary sources showed the insufficient scientific and methodological coverage of the question of applying motor sets in ski jumpers, which makes the present study relevant.

Objective of the study is to examine the features of the influence of various motor sets on the indicators of motor performance in ski jumpers.



Methods and structure of the study. Three ski jumpers aged 23 ± 3 years took part in the research; they have different levels of sporting and technical mastery, assessed by the final rating of the winter season (the 'leader' – 288 points, then athletes with 287 and 232 points respectively). The assessment of the speed-strength indicators was performed in a specific test – an upward jump from the 'jumper's crouch.' The indicators of the movement were recorded using a linear encoder of the Musclelab system fixed to the athlete's belt, which made it possible to record the vertical displacement of the general centre of body mass (hereinafter GCBM).

After a warm-up, from a static starting position the athletes performed 5 attempts at the specialised jump imitating the push-off phase on the take-off table, without applying any motor sets. Each athlete then performed a further 5 attempts at jumps with the application of a motor set 'for force' and 'for speed.' The recovery time between attempts was determined

by each athlete at will, proceeding from his subjective sensations of readiness. After each attempt the mean values of force (N/kg), power (W/kg), height (cm) and time of the jump (s), as well as the maximum speed of the jump (m/s), were recorded in a special protocol.

The results are presented in the format $x \pm \sigma$ (arithmetic mean and standard deviation) for the baseline condition (the exercise without a set).

To assess the effect of the management intervention (the sets 'for force' and 'speed'), the indicators of individual dynamics were calculated: absolute change (Δ) and relative change (%).

To differentiate true changes in the indicators from the random variability of the changes, the indicator of the minimal detectable change with a 95 % confidence interval (MDC95) was used. A change in an indicator was considered practically significant if the absolute magnitude of Δ exceeded the MDC95 threshold for the given test.

Table. Indicators of motor performance in ski jumpers with the application of different motor sets

Participant	Performance of the exercise without a set $x \pm \sigma$	Performance of the exercise with the set for «force», F			Performance of the exercise with the set for «speed», V			Sig-nificance threshold MDC95
		x	Changes relative to the baseline result		x	Changes relative to the baseline result		
			Δ	%		Δ	%	
Power (W/kg)								
1	17.39 ± 1.63	16.4	-0.99	-5.69	16.87	-0.52	-2.99	4.52
2	19.13 ± 3.07	22.57	3.44	17.98	26.71	7.58	39.62	8.51
3	22.33 ± 0.27	24.01	1.68*	7.52	24.39	2.06*	9.23	0.75
Force (N/kg)								
1	11.7 ± 0.28	11.53	-0.17	-1.45	11.62	-0.08	-0.68	0.78
2	12.25 ± 0.54	14.81	2.56*	20.9	15.44	3.19*	26.04	1.5
3	12.66 ± 0.05	12.96	0.3*	2.37	12.95	0.29*	2.29	0.14
Speed (m/s)								
1	3.7 ± 0.1	3.57	-0.13	-3.51	3.6	-0.1	-2.7	0.28
2	3.36 ± 0.16	3.51	0.15	4.46	3.89	0.53*	15.77	0.44
3	4.15 ± 0.12	4.37	0.22	5.3	4.41	0.26	6.27	0.33
Magnitude of displacement of the GCBM (cm)								
1	96.43 ± 3.26	100.57	4.14	4.29	100.13	3.7	3.84	9.04
2	100.17 ± 1.95	96.67	-3.5	-3.49	100.3	0.13	0.13	5.41
3	118.73 ± 1.08	117.37	-1.36	-1.15	121.17	2.44	2.06	2.99
Time of the push-off (s)								
1	0.64 ± 0.05	0.7	0.06	9.38	0.69	0.05	7.81	0.14
2	0.64 ± 0.12	0.59	-0.05	-7.81	0.57	-0.07	-10.94	0.33
3	0.67 ± 0.01	0.63	-0.04*	-5.97	0.64	-0.03	-4.48	0.03

Note: * – statistically significant change ($p \leq 0.05$).



Results of the study and discussion. Within the framework of the working hypothesis it was assumed that, depending on the specific nature of the content of the instruction from the coach ('for force' or 'for speed'), the athlete's nervous system would 'translate' this message into an internal motor-and-verbal code determining the priority of the goal «powerfully/quickly» and forming a specific motor programme ensuring an increased force or speed of the subsequent movement.

The results of the athletes' performance of the pedagogical test are presented in the Table.

First of all, let us note that the athlete under number 1 possesses a lower level of sporting and technical mastery than the athletes under numbers 2 and 3. In turn, the athlete under number 3 is ahead of the athlete under number 2 in the rating of the Cup of Russia and is conditionally the 'leader' in the group of athletes studied.

As follows from the results presented in the Table, when performing the jump with the set 'for force,' in the two athletes of higher qualification (numbers 2 and 3) a statistically significant increase in the force of the push-off is observed, whereas in the athlete under number 1 the indicators of force did not change statistically significantly. It should also be noted that only in the «leader», with the set 'for force,' were statistically significant changes also recorded in the indicators of power (which increased) and of the time of the push-off (which decreased).

For the future it should be noted that the athlete under number 2, when performing the jump with the set 'for force,' demonstrated the same tendencies (even though they proved to be statistically insignificant) as the leader: a reduction in the time of the push-off was recorded together with an increase in maximum speed; whereas in athlete 1 (with a lower level of sporting and technical mastery) the opposite tendencies were recorded: an increase in the time of the push-off together with a decrease in maximum speed.

It is also interesting to note that, with a statistically significant increase in the force of the push-off in athletes 2 and 3, no statistically significant changes in the magnitude of the displacement of the GCBM were recorded. It may be stated that the manifestation of greater force did not lead to a statistically significant increase in the height of the jump.

When performing the jump with the set 'for speed,' only the athlete under number 2 (average rating) demonstrated statistically significant changes in the

indicator of maximum speed, whereas in the athletes with a higher (number 3) and a lower rating (number 1) the differences recorded in the indicator of maximum speed proved to be statistically insignificant. At the same time, in the 'leader' (athlete 3) statistically significant changes were recorded in the indicators of force and power, and in power they were even more pronounced than those recorded earlier when performing the jump with the set 'for force.'

It was established that the athletes with a higher rating (numbers 2 and 3), when performing the jump with the set 'for speed,' demonstrate statistically significant gains in the indicator of the force of the jump. At the same time, in athlete 2 the gain in force is higher with the set 'for speed' than with the set «for force», whereas in the 'leader' the differences in the manifestation of the force of the jump with these two motor sets proved to be minimal.

As a prospect for further research it is worth noting that, when performing jumps with the set 'for speed,' the athletes with a higher rating continue (at the level of tendencies) to reduce the time of the push-off and to increase the magnitude of the upward displacement of the GCBM relative to the values shown with the set 'for force.'

Conclusions. The study conducted makes it possible to draw a number of conclusions and assumptions:

1. The effectiveness of motor sets depends on the level of sporting and technical mastery (the preparedness of the athlete): athletes who are insufficiently prepared but who possess a stable motor programme (a small spread of indicators in various types of jump) practically do not change their motor reactions under different motor sets; athletes with a high level of sporting and technical mastery respond to the sets with an increase in motor performance only in respect of force and power, but not of the maximum speed of the movement.

2. With the growth of sporting and technical mastery, the effect of various motor sets in respect of the indicators of motor performance will decrease because of the skill-based stabilisation of motor programmes (the 'leader' of the group demonstrates the minimum spread of indicators in jumps with various sets (the automatism of the motor programme), and the changes recorded in the attempts in the gains of the mean magnitude of the force of the push-off are considerably smaller in him than in the athlete who is inferior to him in level of mastery).



3. The athlete of an average level of preparedness – not a leader, but also not an also-ran at competitions – responds most effectively and adequately from the standpoint of motor reactions (force/speed of the jump) to various motor sets. We connect this fact with the circumstance that in such athletes the motor programme is not yet fully automated (a certain variability of the indicators is present), but at the same time a sufficiently high motor potential is available, which enables them to change their motor commands promptly in response to different motor sets.

4. The question of the influence of motor sets on the time of the realisation of the movement and on the magnitude of the displacement of the GCBM requires further study: the data obtained point to a hypothetically possible reduction in the time and an increase in the distance of the displacement of the GCBM in the transition from the set 'for force' to the set 'for speed.'

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The effectiveness of kickboxing techniques in winning a bout by knockout

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Abstract

Objective of the study is to identify the effectiveness of the kickboxing techniques that determine victory in a bout by knockout.

Methods and structure of the study. A video analysis was carried out of 86 professional bouts held under K-1 rules and ending in a knockout. The significance of the kickboxing techniques in achieving victory by knockout was calculated from the frequency with which a knockout was achieved by the technique applied.

Results and conclusions. It was established that the effectiveness of the high roundhouse kick and of the high hook in ending a bout by knockout is determined by striking the opponent's head. Strikes to the abdomen and thigh are also effective means of ending a bout by knockout. The least effective techniques were found to be the heel kick and the jumping punch.

Keywords: *kickboxing, knockout, techniques, effectiveness of strikes.*

Introduction. Kickboxing includes two varieties of bout – light-contact and full-contact, in which the force of the strikes delivered with the limbs is not limited. Full-contact kickboxing is in turn subdivided into classical full-contact, low-kick and K-1, the latter combining elements of Thai boxing, karate and other martial arts [2].

The fastest and most effective way of ending a bout is the knockout – a powerful strike depriving the opponent of the ability to continue the bout for a certain time (usually 10 seconds). The successful execution of an attack with a knockout blow delivered with the hand or the foot requires a high level of technical preparedness, flexibility and strength [3]. In order to carry out a knockout attack, the main task becomes the construction of a tactical scheme of the bout with account taken of the technical preparedness of the opponent [4].

The effectiveness of an attack depends not only on technical mastery but also on the strength, speed and endurance of the athlete. The psychological

preparedness and motivation of the athletes play an extremely important role [5].

The techniques of kickboxing include punches and kicks performed in various forms. The punches include jabs, crosses and hooks, as well as jumping punches and spinning back fists. Among the kicks used in a bout are front kicks, side kicks, roundhouse kicks, axe kicks, heel kicks and knee strikes [1]. The literature contains contradictory data on the most effective strikes for winning a bout by knockout.

Objective of the study is to analyse the effectiveness of the kickboxing techniques that determine victory in a bout by knockout.

Methods and structure of the study. A video analysis was carried out of 86 professional bouts held under K-1 rules and ending in a knockout. The age of the kickboxers varied from 19 to 32 years, and their length of kickboxing training averaged 7.3 ± 2.2 years.

The significance of the kickboxing techniques in achieving victory by knockout was calculated from



the frequency with which a knockout was achieved by the technique applied. The frequency of achieving a knockout as a result of applying a particular technique was taken to be the ratio of the number of executions of the technique that ended in a knockout to the total number of executions of the technique:

$$P(A) = n(A) / n,$$

where n is the total number of techniques performed; $n(A)$ is the number of knockouts in which attempts to perform technique A ended.

With a large number of cases, a consequence of the law of large numbers is the tendency of the frequency of an event towards its probability. In order to assess the accuracy and reliability of the estimate of the probability of a knockout, a confidence interval was constructed, the boundaries of which were determined with account taken of the specified confidence probability and of the statistical t -test for the normal distribution.

The kickboxing techniques were ranked in ascending order of the frequency of their use in ending a bout by knockout.

A two-sided test of the significance of structural indicators was used to compare the number and percentage share of bouts won by knockout with the application of various techniques. This made it possible to determine which techniques were applied more often than others.

Spearman's rank correlation test was applied to assess the relationship between two quantitative variables (length of training and the number of bouts won by knockout).

Results of the study and discussion. Length of training was not a statistically significant factor influencing the number of bouts won by knockout ($r=0.16$; $p<0.05$).

The kickboxers never once used jumping punches to win by knockout, and used the axe kick extremely rarely. The greatest differences in the frequency of application of the techniques were observed in respect of the least frequently applied strikes.

The assessment of the effectiveness of the kickboxing techniques effective for achieving a knockout showed their unequal value in creating knockout situations.

The hook to the head (high hook) and the high roundhouse kick (high kick) proved to be the most effective techniques for achieving victory in a bout by knockout, owing to the direct strike to the head causing a loss of spatial orientation. The head proved to be the part of the body most frequently subjected to punches and kicks, which led to numerous injuries among kickboxing athletes.

A video analysis of mixed martial arts (MMA) bouts showed that the majority of knockouts are achieved by a direct strike to the head, predominantly to the jaw. Kickboxers have a well-developed strength of the muscles of the upper limbs, which may account for the high contribution of punches to victory by knockout. The strength qualities of the upper limbs should therefore be developed above the average level.

Effective means of achieving victory in a bout by knockout also proved to be the low roundhouse kick (low kick) (9.3 %) and the straight punch to the body (9.1 %). In the case of the low roundhouse kick directed at the region of the thigh muscles, the knockout results from repeated strikes to one and the same point. Since as a result of multiple strikes the opponent's lower limb loses the ability to support the body weight, this leads to a loss of balance. An analysis of injuries in contact karate showed that more than 30 % of injuries to the lower limbs are caused by repeated kicks to one and the same area.

The effectiveness of the knee strike to the body may be explained by an accurate strike to the liver, which is innervated by the autonomic nervous system. This may also be the reason why 8.2 % of the bouts ending in a knockout resulted from the execution of a spinning kick to the body.

Effective in achieving a knockout were punches to the head and to the upper part of the torso (jab, cross, uppercut) and spinning back fists. When cor-

Table 1. Significance of the various techniques in the frequency of victories by knockout among kickboxers

Roundhouse kick to the head 0.523	Hook to the head 0.567	Spinning back fist 0.312
Straight punch to the head 0.489	Front kick to the body 0.306	Punches to the head and torso 0.365
Low roundhouse kick to the thigh 0.365	Straight punch to the body 0.452	Low roundhouse kick 0.465
Knee strike to the thigh 0.221	Knee strike to the body 0.345	Side kick 0.218
Heel kick 0.234	Axe kick 0.198	Jumping punch 0.246



rectly executed, both these techniques constitute powerful strikes directed at the head. The delivery of the spinning back fist is also preceded by a rotation of the torso, which additionally increases the force of the strike.

The front kick to the body proved to be just as effective as the spinning back fist. In addition, the heel kick, the knee strike, the axe kick, the jumping punch and the side kick occurred with a frequency of about 5 % among the techniques leading to victory by knockout.

Conclusions. An analysis of the results of the study showed that a knockout most often occurred as a result of a strike to the head. It is precisely this that explains the high effectiveness of such techniques as the high roundhouse kick and the high hook. In addition, strikes directed at the region of the abdomen and thigh also proved to be effective means of ending a bout by knockout. Among the least effective techniques were the heel kick and the jumping punch.

The application of technically correct strikes, as well as the repeated practice of the most effective techniques, are an integral part of the training process in kickboxing.

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Biomechanical 3d analysis in figure skating training: the axel jump case

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Abstract

Objective of the study is to develop and pilot a technique for modeling jump technique in figure skaters based on the method of biomechanical 3D analysis and quantitative assessment of the athlete's body moment of inertia using accessible software tools.

Methods and structure of the study. Joint coordinates were extracted from video recordings of jumps using the automatic pose estimation system MediaPipe Pose. Mass-inertial characteristics of body segments were calculated using Zatsiorsky-Seluyanov anthropometric tables. Individual skeletal 3D models were constructed in the Blender environment. The study was conducted during the 2025-2026 competitive season with the participation of 16 athletes.

Results and conclusions. A pilot test of the biomechanical 3D analysis method was carried out. The method allows for a visual representation of the athlete's posture in the key phases of the jump, comparison with a reference model, and assessment of the potential change in angular velocity of rotation when correcting grouping errors based on the law of conservation of angular momentum.

Keywords: figure skating, biomechanical 3D analysis method, Axel jump technique correction, pose estimation, moment of inertia, angular momentum.

Introduction. Multi-revolution jumps are among the defining elements of competitive programs in single figure skating. The angular velocity of rotation during the unsupported (flight) phase of the jump is determined by the compactness of the body position: the lower the body's moment of inertia, the faster the rotation [6]. Although a coach can visually assess grouping errors, it is impossible to quantify the extent to which a specific error in arm or leg position reduces the angular velocity of rotation using traditional methods.

Until recently, quantitative biomechanical analysis of figure skating jumps could only be performed in laboratory environments using multi-camera optical motion capture systems and force plates [4, 8]. Such equipment is inaccessible to the majority of sports schools. However, the advancement of single-camera automatic pose estimation algorithms [2] and affordable 3D modeling software [5] pro-

vides the necessary prerequisites for conducting quantitative analysis under routine training conditions.

Substantial experience in the biomechanical analysis of figure skating jumps has been accumulated in international research. This includes studies examining the characteristics of the takeoff phase in the double Axel jump as well as comprehensive summaries of the biomechanical fundamentals of figure skating movements [5]. Haraguchi and colleagues [6] proposed an automatic skater tracking system using PTZ cameras. While these works provide valuable scientific insights, they rely on laboratory-based equipment.

Research in domestic studies has focused on several areas: the biomechanics of the human musculoskeletal system [1]; the use of virtual educational environments and digital solutions in figure skating instruction [2, 3]; and techniques for correcting

multi-revolution jumps [4]. Novikova and colleagues [8] employed computer vision to evaluate exercise difficulty in figure skating. Nevertheless, these tools are restricted to qualitative assessment and do not permit a quantitative determination of the skaters' level of preparedness. Consequently, a gap persists between quantitative biomechanical analysis methods – which remain confined to laboratory settings – and the practical tools available to coaches in everyday training. The present research seeks to overcome this gap.

Objective of the study is to develop and pilot a technique for modeling jump technique in figure skaters based on the method of biomechanical 3D analysis and quantitative assessment of the athlete's body moment of inertia using accessible software tools.

Methods and structure of the study. In order to fulfill the aim and tasks of the study, jumps were recorded using a single camera operating at 120 frames per second (side view, positioned at the athlete's waist level). Three-dimensional joint coordinates were extracted from the video recordings employing MediaPipe Pose [6], an automatic pose estimation system capable of estimating depth (Z-coordinate) from single-camera footage. Using the extracted coordinates together with anthropometric

measurements of the athlete (total body mass, segment lengths), the mass-inertial properties of body segments were computed based on the Zatsiorsky-Seluyanov anthropometric tables as adapted by de Leva [1]. In contrast to the original tables – where segment landmarks are defined relative to bony protrusions – de Leva's adaptation recalculates these landmarks to joint centers, which aligns with the data format generated by pose estimation systems. A personalized skeletal 3D model (Armature) of the athlete was then built in the Blender environment for two critical poses: at the instant of take-off from the ice and during the in-flight grouping phase.

Results of the study and discussion. A pilot approbation of the proposed methodology was carried out on athletes holding the Candidate Master of Sports (CMS) qualification, aged 12-14 years. In total, 48 attempts of the Axel jump (2.5 revolutions) were processed. For each jump attempt, the following steps were completed: video recording; joint coordinate extraction using MediaPipe Pose; construction of an individual 3D model in Blender; and calculation of the body's moment of inertia at two key poses – specifically, at the instant of take-off from the ice and during the airborne grouping phase. The data processing workflow is presented in Figure 1.

Table 1 presents the calculated mean values of

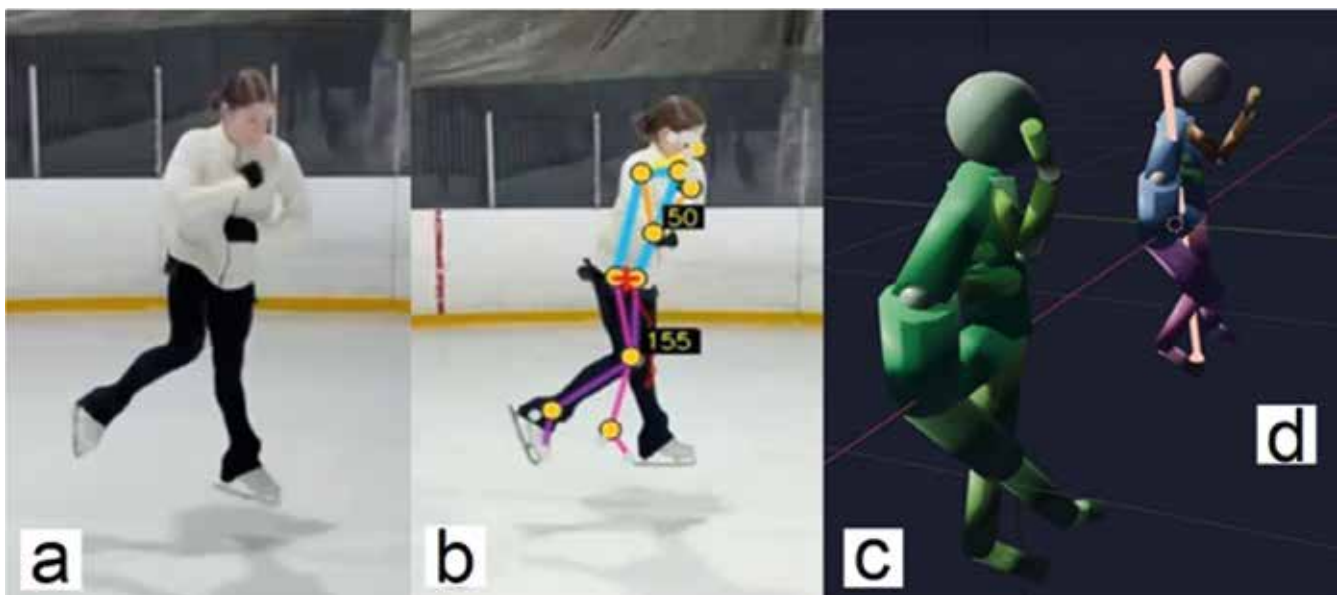


Figure 1. Comparison of 3D models of a figure skater during the airborne grouping phase. (a) Original video frame showing the jump in the grouping phase; (b) the same frame with the MediaPipe Pose skeletal model superimposed (33 key points); (c) individual 3D model of the skater built in Blender using MediaPipe coordinates and anthropometric measurements; (d) corrected posture, featuring elbows drawn toward the rotational axis and the free leg knee fully extended.



Table 1. The results of calculating the moment of inertia of the athlete's body

Parameter		Experimental group		Control group	
		Average value		Average value	
		Original	Adjusted	Original	Adjusted
Moment of inertia I, kg*m ²	before	0.43	0.41	0.48	0.43
	after	0.32	0.30	0.44	0.40
Reducing the moment of inertia, %	before	-	5.12	-	10.41
	after	-	4.08	-	9.73
Projected growth ω , %	before	-	-1.63	-	-12.71
	after	-	7.64	-	-4.08
The tilt of the axis of rotation, angle °	before	12.96	11.15	12.97	11.45
	after	6.08	6.02	11.19	10.34

Table 1. The results of calculating the moment of inertia of the athlete's body

Parameter		Experimental group		Control group	
		Average value		Average value	
		Original	Adjusted	Original	Adjusted
Elbow (left) from the axis, m	before	0.16	0.14	0.17	0.14
	after	0.14	0.14	0.16	0.14
Elbow (right) from the axis, m	before	0.17	0.14	0.17	0.14
	after	0.15	0.14	0.17	0.14
Knee (left), angle °	before	143.76	180.00	144.04	180.00
	after	169.64	180.00	156.66	180.00
Knee (right), angle °	before	148.10	180.00	147.73	180.00
	after	167.23	180.00	156.73	180.00
Torso tilt, angle °	before	11.28	0.00	11.29	0.00
	after	6.23	0.00	10.29	0.00

the key parameters – moment of inertia, reduction in moment of inertia, predicted angular velocity gain, and tilt of the rotational axis – for both the experimental and control groups, measured before and after the pedagogical experiment that employed the biomechanical 3D analysis method.

A comparison between the actual (current) grouping posture and the corrected posture revealed that the elimination of the identified errors leads to a decrease in the body's moment of inertia, which in turn corresponds to a predicted increase in angular rotational velocity. The detailed contribution of specific segment groups (e.g., arms, legs, trunk) to the overall change in moment of inertia is provided in Table 2.

Statistical analysis of the collected data – comprising descriptive statistics (mean, standard deviation) and the non-parametric Mann-Whitney (Wilcoxon) test for independent group comparisons

– revealed that 100% of the skaters in the experimental group increased their angular velocity during the multi-revolution jump, whereas 75% of the skaters in the control group either maintained or lost rotational speed.

Conclusions. In comparison with laboratory-based biomechanical analysis techniques, the proposed method is substantially easier to implement: it requires no specialized equipment, multi-camera motion capture systems, or force platforms. The body's moment of inertia is a key parameter affecting jump quality, yet it is not the sole determinant. To obtain a comprehensive, objective assessment of the unsupported (flight) phase, the moment of inertia should be evaluated alongside other relevant characteristics: flight time, angular rotational velocity, and the number of revolutions achieved. These parameters can be derived through various means – including laboratory motion cap-



ture systems, pose estimation algorithms, and inertial sensors placed on the skater's body. A combined analysis of all these parameters will enable a holistic, objective characterization of the jump flight phase. Future work plans include validation of the method on a larger sample of athletes across different skill levels, automation of data processing workflows, and adaptation of the approach to other complex-coordination sports.

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Identification of technical errors by bachelor's degree students when assessing the performance of defensive and blocking actions with the arms in kata karate

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Abstract

Objective of the study is to develop and trial a methodology for forming the ability to determine typical errors when assessing the technique of performing defensive and blocking actions with the arms in karateka specialising in KATA, with a view to forming professional competence 2 (PC-2) in the bachelor's degree students of sports universities.

Methods and structure of the study. The following were used to achieve the aim of the study: the method of analysis of the scientific and scientific-methodological literature, pedagogical observation, the method of expert assessment, and methods of the mathematical and statistical processing of data.

Results and conclusions. The process of professional formation rests on the cultivation of the personal qualities of the future coach, which, together with mental operations and practical actions, form a competent specialist. It should be taken into account that the professional competence which is defined as the ability to use psychological and pedagogical technologies in future professional activity, necessary for the individualisation of the teaching, development and upbringing of athletes and learners (PC-2), may be formed by using in the teaching of the students of sports universities targeted tasks on assessing the technique of performing the basic techniques and on identifying typical errors, in particular when performing defensive and blocking actions with the arms, so as to correct them promptly in the participants.

Keywords: *professional competences, criteria of assessment, typical errors, defensive and blocking actions, karateka students.*

Introduction. An analysis of the scientific and scientific-methodological literature, as well as of the documents regulating activity in the system of professional education for the preparation of coaches in a sport, made it possible to identify the orientation of the training of specialists in sports preparation, based on the competence-based approach. The content of the general educational programme is directed towards forming in learners at the bachelor's level the professional competences that will make it possible in the future to realise in coaching activity the knowledge obtained, the abilities acquired and the skills formed.

The professional competence consisting in the ability to use psychological and pedagogical technologies in future professional activity, necessary for the individualisation of the teaching, development and upbringing of athletes and learners (PC-2), is formed as special knowledge, abilities and skills are acquired, which are assessed by indicators of their attainment. At the same time, the indicators of the attainment of competences must be correlated with labour functions and, in their turn, must be measurable by means of the instruments available in the educational process [1, 2].

For a more precise assessment of the formation

of PC-2 in learners, a need arose for a more precise determination of the abilities that act as indicators of its attainment. These include the ability to assess correctly the level of mastery of the techniques of the basic technique of karate and the ability to determine, memorise and correct typical technical errors, which may be called special indicators of technical abilities and which are structural elements of this competence.

Objective of the study is to develop and trial a methodology for forming the ability to determine typical errors when assessing the technique of performing defensive and blocking actions with the arms in karateka specialising in KATA, with a view to forming professional competence 2 (PC-2) in the bachelor's degree students of sports universities.

Methods and structure of the study. The following were used to achieve the aim of the study: the method of analysis of the scientific and scientific-methodological literature, pedagogical observation, the method of expert assessment, and methods of the mathematical and statistical processing of data.

Eight second-year bachelor's degree students took part in the study (4 masters of sport, 4 candidates for master of sport). In parallel, control video recording was carried out during the immediate performance of the exercise using the electronic-optical programme «Coach's Eye», which makes it possible not only to record the temporal parameters of the movements to hundredths of a second, but also to view the performance of the defensive and blocking actions with the arms repeatedly in slow motion.

Results of the study and discussion. Within the framework of a simulation and activity game, the participants of the study performed various functions in turn: one of the group played the role of the 'performer', while the seven remaining students became 'experts' and assessed the level of technical preparedness of the karateka, who was required to perform technical actions of a defensive and blocking character with a high degree of speed [1]. The student-performer demonstrated three defensive and blocking actions with the arm:

- the 'sweeping' block with the forearm against a kick to the lower sector with a retreat backwards (Jap. HIKKOMI GEDAN BARAI UDE UKE) from the MOTO DACHI stance into the ZENKUTSU DACHI stance;
- the 'lateral' block with the forearm against a punch to the middle sector with a 'sliding' movement diagonally backwards (Jap. NANAME HIKIMI CHUDAN YOKO UDE UKE) from the MOTO DACHI stance into the MOTO DACHI stance;
- the 'rising' block with the forearm against a punch to the upper sector with a lunge forwards (Jap. IRIMI JODAN AGE UDE UKE) from the MOTO DACHI stance into the ZENKUTSU DACHI stance.

Compliance with the requirements for the technique of mastering defensive and blocking actions with the arms is one of the special indicators of the assessment of technical abilities in karateka [2]. When assessing the ability to command the technique of defensive and blocking actions with the arms, the student was invited to rely on the following five micro-indicators:



Figure 1. A block with the arm in combination with a withdrawal backwards (HIKKOMI CHUDAN YOKO UDE UKE) from the HACHIJI DACHI stance into the MOTO DACHI stance (here and hereafter: above – side view, below – front view)



Figure 2. A block with the arm to meet the opponent's action (IRIMI JODAN AGE UDE UKE) from the HACHIJI DACHI stance into the ZENKUTSU DACHI stance



1) the performance of a blocking action with the arm of the HIKKOMI UKE type in combination with a low-amplitude retreat backwards – defence by a block with a withdrawal – must begin before the beginning of the movement and end simultaneously with it (Figure 1), while the performance of a blocking action with the arm of the IRIMI UKE type in combination with a movement forwards – defence by a block directly to meet the opponent's action – must begin and end simultaneously (Figure 2);

2) the spatial accuracy of the blocking action with the arm, with the consecutive performance, in the necessary cases, of particular motor phases of the block: the use of the non-blocking arm assisting the effective performance of the block in its initial phase (Jap. SOETE UKE DANKAI) with the subsequent 'transfer from arm to arm' (Jap. WATASHITE UKE DANKAI), parrying (Jap. NAGASHI UDE UKE DANKAI) and deflection (Jap. SORASHI UDE UKE DANKAI);

3) the necessary dynamic potential of the concluding phase of the blocking action with the arm, using a powerful pronation or supination movement of the forearm (Jap. NEJIRI UDE UKE DANKAI);

4) the absence of superfluous movements and the preservation of balance when performing the movements in combination with the blocking action of the arm;

5) the preservation of the required norms of the final position of the block, with the demonstration, where necessary, of the required concentration of force (KIME) at the required point of the trajectory of the blocking action [3].

The student-experts were seated on a bench, holding in their hands a special protocol for recording typical errors, in which the names of the technical actions indicated had already been entered. One of the students, who played the role of the performer of the assigned technical action, performed it in combi-

nation with a movement, starting and completing it in the basic stances. Then the second student became the performer, while the first performer took the place of the second and became an expert. And in this way each student in turn played the role of the performer. The students performed each striking action twice: first standing facing the experts and then side-on, under conditions of a high-speed regime.

On completion of the initial testing, the participants of the study were offered a joint viewing of a video recording of the performance of several KATA by the Olympic champion of the Tokyo Games and five-time world champion, the Japanese athlete Ryo Kiyuna, with a detailed analysis of the same technical actions of the basic technique of karate, compliance with the requirements of which had secured him victory at these competitions. At the same time, the students' attention was focused on the defensive and blocking actions with the arms, with the identification of the motor operations and of their elements in which it is necessary to preserve the spatial and temporal parameters of the movements. The repeated viewing of the video recordings, including in slow motion, determined the understanding of the possible errors of karateka when performing defensive and blocking actions with the arms.

Subsequently, over the course of two months in the practical sessions, the students taking part in the study performed in turn various defensive and blocking actions with the arms, with the simultaneous recording of the errors committed, which were listed in the special protocols. In this way the students adapted to the role of experts, which enabled them not only to memorise the requirements for technical preparedness, but also to identify errors promptly in the actions of the performers.

The results of the final testing of the assessment of the technique of defensive and blocking actions

Table. Results of the identification of errors when assessing the technique of defensive and blocking actions with the arms by the student-experts in the student-performer in the initial and final testing (number)

Defensive and blocking action with the arm	Starting positions	Stages of testing		Uemp.
		Initial ($\bar{x} \pm \sigma$)	Final ($\bar{x} \pm \sigma$)	
HIKKOMI GEDAN BARAI UDE UKE	Facing the experts	1.68±0.10	4.59±0.18	2
	Side-on to the experts	1.77±0.13	3.88±0.14	4
NANAME HIKIMI CHUDAN YOKO UDE UKE	Facing the experts	1.59±0.16	4.61±0.20	2
	Side-on to the experts	1.32±0.17	4.04±0.21	3
IRIMI JODAN AGE UDE UDE	Facing the experts	1.34±0.15	4.52±0.13	2
	Side-on to the experts	1.54±0.13	4.00±0.22	2

Note: the indicators differ significantly at $p \leq 0.05$ if Uemp. > 15 and at $p \leq 0.01$ if Uemp. < 9.



with the arms in the student-performers make it possible to judge the effectiveness of the methodology proposed, since the number of errors detected by the student-experts increased more than twofold (see the Table).

Whereas in the initial testing the students were able to record only 1-2 errors, in the final testing they identified 4-5 errors in the performance of all the test tasks. In the end, the orientation of the educational experiment towards forming in the students the ability to identify typical errors in the performance of defensive and blocking actions with the arms by the athlete-performers of KATA proved to be justified, which is confirmed by the substantial improvement in the results of the testing.

Conclusions. The process of professional formation undoubtedly rests on the cultivation of the personal qualities of the future coach, which, together with mental operations and practical actions, form a competent specialist. It should be taken into account that the professional competence which is defined as the ability to use psychological and pedagogical technologies in future professional activity, necessary for the individualisation of the teaching, development and upbringing of athletes and learners (PC-2), may be formed by using in the teaching of the students of sports universities targeted tasks on assessing the

technique of performing the basic techniques and on identifying typical errors, in particular when performing defensive and blocking actions with the arms, so as to correct them promptly in the participants.

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Cognitive approach as a methodological basis for the application of neural network technologies in the training of specialists in adaptive physical culture

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Keywords: *professional training, adaptive physical culture, neural network, deduction, abduction.*

Abstract. To understand how neural network technologies can be integrated into the educational process, it is necessary to turn to the theoretical foundations of the cognitive approach, which offers a fundamentally different view of the nature of learning compared to the traditional knowledge paradigm [1]. Unlike the knowledge paradigm, where the emphasis is on the translation and reproduction of information, the cognitive approach considers learning as a process of constructing students' own cognitive schemas. The neural network model performs a dual function: on the one hand, it acts as an information processing tool, on the other hand, it encourages students to reflect on their own thinking strategies. Thus, the cognitive approach creates a conceptual basis for the introduction of neural network technologies in the training of specialists in adaptive physical culture, shifting the focus from knowledge transfer to the construction of cognitive schemes of professional activity.

Objective of the study is to theoretically substantiate the cognitive approach as a methodological basis for the use of neural network technologies in the training of specialists in adaptive physical culture through the organization of educational tasks in the full cognitive cycle 'concrete – abstract – concrete.'

Results of the study and discussion. The cognitive approach, in our opinion, creates a methodological basis for organizing the solution of educational tasks using neural network technologies. The peculiarity of this approach is that the finished result generated by the neural network does not have its own theoretical foundations. The model gives a plausible answer, but does not explain from what theoretical premises it is derived. The educational process based on cognitive logic naturally begins with the movement from the finished result to its foundations – that is, with analytical-regressive (abductive) reasoning. In this first phase, the student reconstructs the patterns on which the result is based and gradually reveals a concrete solution to an abstract theoretical basis.

At the same time, the true assimilation of knowledge, according to the principle of ascending from the abstract to the concrete (V.V. Davydov, E.V. Ilyenkov), occurs through the movement of thought from the restored general foundation to its concrete manifestations. Therefore, the analytical phase should be followed by a second deductive phase, which assumes that the student returns from the found foundation to the concrete one in order to verify the initial result of the neural network and transfer

the restored principle to new cases. Thus, the cognitive approach to working with neural network technologies is implemented as a complete cognitive cycle 'concrete – abstract – concrete,' in which inductive/abductive reconstruction and deductive verification act as complementary phases.

In the context of training specialists in adaptive physical culture, this cycle is of particular importance. A neural network can generate a rehabilitation program, select a set of exercises, and propose a method for correcting motor disorders. The first, analytical phase requires the future specialist to understand on what theoretical grounds the result is based, what patterns of development of people with disabilities are taken into account in it, what limitations and risks it carries. The second, deductive phase involves the use of already restored foundations to verify the correctness of the neural network's response and to justify decisions in new situations. It is the combination of these two phases that forms in the student not 'knowledge about,' but 'knowledge of why' as the ability not only to reproduce, but also to generate, as well as critically evaluate professional decisions.

Conclusions. The cognitive approach allows us to rethink the role of neural network technologies in the professional training of specialists in adaptive physical culture. From the perspective of cognitive logic, the organization of solving educational tasks involves two complementary phases: analytical (reconstruction of the foundations of the generated result, the movement 'from the concrete to the abstract') and deductive (verification of the result and the transfer of the restored principle to new cases, the movement 'from the abstract to the concrete.' Such a complete cycle allows rehabilitation programs, sets of exercises and methods of correcting the physical condition of people with disabilities generated by the neural network to form the ability of a future specialist to reconstruct their theoretical foundations, take into account the patterns of development of people with disabilities and deductively verify the correctness of the solution obtained.

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Features of the use of neural network technologies (AI) by specialists in therapeutic physical culture and rehabilitation when planning and conducting personalised sessions with adults

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Abstract

Objective of the study is to examine the features of the introduction of artificial intelligence (AI) tools into the professional activity of specialists in therapeutic and adaptive physical culture when conducting health-improving sessions with persons who have suffered an acute cerebrovascular accident (ACVA) and who are undergoing rehabilitation in the residual (late) period of the ACVA. In order to achieve the aims of the present study, an examination and analysis were carried out of the structure of users' queries – prompts – to AI, of the identification of the preferred neural networks (platforms), and also of the comparison of users' expectations with what was achieved in practice when following the automated recommendations of AI.

Methods and structure of the study. The research was carried out in three stages. At the first – ascertaining – stage an initial questionnaire survey of the respondents was conducted, represented by 88 specialists in physical rehabilitation and in therapeutic and adaptive physical culture (men and women aged 31–59 years, with more than 10 years of professional experience) working in rehabilitation centres, physical culture and health complexes and Moscow Longevity centres. At the second – formative – stage a training online seminar was organised, directed at forming competences in the field of prompt engineering. The participants were taught the method of constructing effective queries to artificial intelligence systems using a structured prompt formula. At the third, control stage, in order to verify the data obtained, a repeat questionnaire survey and a comparative analysis of the results before and after the training of the respondents were carried out.

Results and conclusions. Despite the active use of neural network technologies in their professional activity, specialists in therapeutic and adaptive physical culture note the limited capabilities of artificial intelligence in understanding the individual context and the depth of the tasks, in particular in diagnosing the functional state of patients and participants and in drawing up individual training programmes. A substantial factor limiting the potential of using artificial intelligence is the insufficient methodological preparation of specialists in the field of prompt engineering. Ignorance of the rules of constructing effective prompts for AI leads to an incorrect formulation of the task and, as a consequence, to the obtaining of irrelevant or incomplete results.

Keywords: *prompt, AI (artificial intelligence), therapeutic and adaptive physical culture, rehabilitation, participants and patients with ACVA, therapeutic and adaptive physical culture, prompt formula, prompt engineering.*

“Artificial intelligence works with data, but it does not possess understanding. It can defeat the world champion at Go, but it does not understand that it is playing a game. It does not know what ‘victory’ or ‘defeat’ means in the human sense. This is a colossal difference between computation and awareness.”

T.V. Chernigovskaya

Introduction. The words of the well-known Russian scholar in the field of neuroscience, psycholinguistics and the theory of consciousness, placed as the epigraph to the present article, very precisely emphasise

that in which artificial intelligence (AI) still lags behind the human being. Namely, the human mind perceives the surrounding reality as a totality of symbols, signs and meanings that are interconnected with one an-



other. AI is so far limited only to the syntactic level of the processing and reproduction of information: neural networks follow strict rules and algorithms, and they are still incapable of understanding semantic content, of grasping the deep meaning and aims of their analysis, or of grasping the context of the user's query [6, 7].

Despite this, the rapid penetration of neural network technologies (AI) into all spheres of human activity, including the physical culture, sports and health-improving sphere, should be noted [4]. The capabilities of AI already cope effectively with the processing of large arrays of data in analysing the volumes of training load and the indicators of functional state, and in planning and forecasting [1, 3]. At the same time, in order that AI should understand still better the context of the task set before it, it is necessary to adhere to certain rules of constructing queries – the prompt formula (Table 1).

Methods and structure of the study. The present study consisted of three consecutive stages, the structure and brief description of which are presented in Figure 1.

At the first, ascertaining stage, an initial questionnaire survey of the respondents was conducted, represented by 88 specialists in physical rehabilitation and in therapeutic and adaptive physical culture (52 men and 36 women aged 31–59 years, with more than 10 years of professional experience).

At the second, formative stage, a training online seminar for the specialists was organised, directed at forming in them competences in the field of prompt engineering [2]. The participants of the seminar were introduced to the prompt formula, were taught the method of constructing effective queries to artificial intelligence systems using it, and were shown by examples the difference in the results of constructing queries with and without the formula.

At the third, control stage, in order to verify and analyse the data obtained, we conducted a repeat questionnaire survey of the participants of the experiment with the aim of identifying the effectiveness of the proposed methodology of teaching the competences of working with AI.



Figure 1. Stages of the conduct of the study

Results of the study and discussion. The results of the first and third stages of the study are presented in Table 2 and in Figures 2-5.

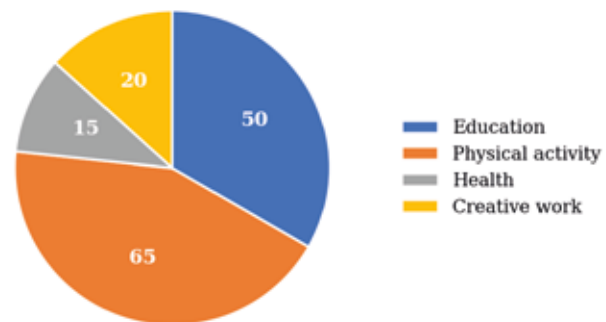


Figure 2. Ratio of all queries to AI by group

The statistical processing and mathematical analysis of the data of the first stage showed that, despite the high frequency of use of neural network services (AI) – they are applied by more than 77 % of the respondents both in their professional and in their per-

Table 1. The prompt formula and its components

Formula of an effective query (prompt) = Role + Context + Task + Constraints + Output format	
Component	Definition
Role	the definition of the persona or level of expertise on behalf of which AI is to act, in order to set the required style and depth of the answer.
Context	the background information and description of the situation necessary in order that the answer should be relevant to the specific circumstances.
Task	a clear description of the target action that is to be performed (the instruction).
Constraints	the established frameworks, rules and prohibitions narrowing the range of the search for a solution (limits on volume, stylistic prohibitions, specific requirements).
Output format	the requirements for the structure and appearance of the finished result (list, table, program code, essay).



Table 2. Comparative analysis of the questionnaire survey of the respondents (before and after the training webinar)

Comparative analysis of the questionnaire survey of specialists in therapeutic and adaptive physical culture, instructor-methodologists and rehabilitation specialists		
Questions of the questionnaire	First stage	Third stage
Do you use AI for professional and personal purposes?	77 %	90 %
Are you familiar with such a concept as the prompt formula? Of which components does it consist?	15 %	90 %
Which of the listed components do you usually use when addressing AI?		
Role (on whose behalf AI acts)	40 %	90 %
Context (description of the situation)	18 %	90 %
Task (what is to be performed)	90 %	90 %
Constraints (frameworks, rules, prohibitions)	40 %	90 %
Output format (appearance)	30 %	90 %
For the solution of which tasks do you most often turn to AI? / ratio of users' queries to satisfaction with the answer of AI (as a percentage)		
Tasks relating to professional activity		
Technology of applying rating scales, functional tests and trials in assessing rehabilitation potential	25 % / 51 %	39 % / 70 %
Obtaining information of a reference character	61 % / 75 %	88 % / 95 %
Rational selection of basic exercises	18 % / 55 %	40 % / 75 %
Drawing up loads and plans of rehabilitation sessions	19 % / 33 %	40 % / 75 %
Increasing motivation for therapeutic and adaptive physical culture sessions	25 % / 58 %	50 % / 80 %
Advice on the daily regime	39 % / 50 %	50 % / 80 %
Monitoring of motor activity	70 % / 82 %	85 % / 95 %
Analysis of the progress of results	22 % / 45 %	45 % / 80 %
Use of AI for personal purposes		
Self-education	50 % / 60 %	50 % / 80 %
Selection of a rational diet	32 % / 62 %	40 % / 85 %
Checking the spelling and style of a text	20 % / 50 %	30 % / 100 %
Time management (reminders / calendar / notifications)	46 % / 52 %	58 % / 80 %
Solving creative tasks	20 % / 42 %	25 % / 60 %

sonal activity – only 15 % are familiar with the rules of composing correct queries (prompts), and fewer than 10 % have heard of such a concept as the prompt formula.

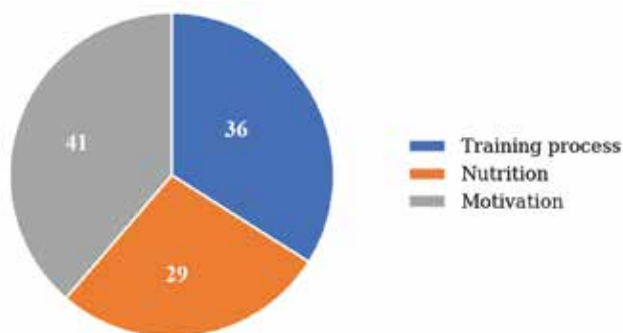


Figure 3. Percentage ratio of the desired and the obtained responses

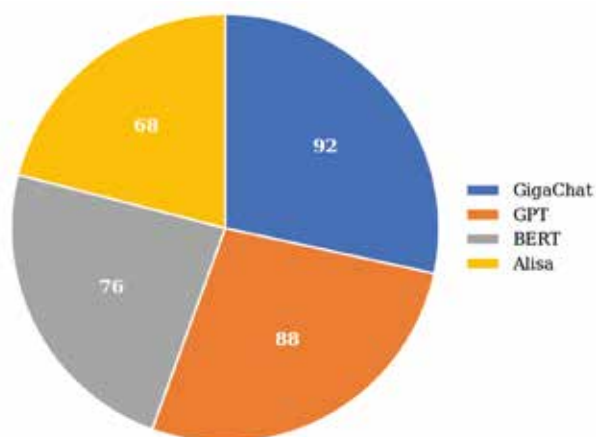


Figure 4. Rating of the most popular neural networks

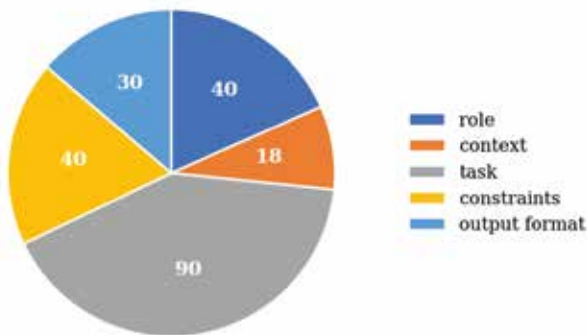


Figure 5. Most frequently used components of queries to AI

In this connection, fewer than 50 % of the answers generated by AI are recognised as useful. The conduct of the training webinar (the second stage), devoted to the study of the structure of the ideal query – the prompt – and of its components, led to a significant improvement in the indicators of interaction. A growth in the frequency of requests to the services was noted, as well as an increase in the level of users' satisfaction with the quality of their work with the neural networks.

Conclusions. Despite the active use of neural network services in their professional activity, specialists in therapeutic and adaptive physical culture note the limited capabilities of AI in understanding the individual context and the depth of the tasks, in particular in diagnosing the functional state of patients and participants and in drawing up individual training programmes.

A substantial factor limiting the potential of using artificial intelligence is the insufficient methodological preparation of specialists in the field of prompt engineering. Ignorance of the rules of constructing effective prompts for AI leads to an incorrect formulation of the task and, as a consequence, to the obtaining of irrelevant or incomplete results.

In order to increase the relevance of the answers generated and the effectiveness of the interaction of the specialist with the neural network, we consider it necessary to introduce a structured protocol for composing a query – a prompt – on the basis of the template 'role – context – task – constraints – format', which takes into account the fundamental difference between the deep thinking of the human being and the template-based processing of information by the neural network.

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Motor learning in elite badminton players with disabilities with account taken of the state of peripheral vision

UDC 796.035

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Abstract

Objective of the study is to determine the differences in the psychophysiological and technical indicators between badminton players with musculoskeletal disorders (MSD) and with intellectual impairment (II) with account taken of the indicators of the visual field, and on this basis to substantiate the application of differentiated approaches in the methodology of the motor learning of athletes.

Methods and structure of the study. Ten athletes took part in the research: candidates for master of sport and masters of sport aged 21-24 years, members of the national para-badminton team of Russia: 5 persons with MSD and 5 with II. The diagnostics of the simple visual-motor reaction was carried out on a device with the XLIGHT One 6 computer programme, and the assessment of the physical aspect of the strokes was carried out using an Intelligent Badminton Sensor 3.0 attached to the racket. Accuracy in ballistic movements was assessed by the control exercise 'Accuracy'.

Results and conclusions. Strong correlation relationships between the visual field and the technical indicators were revealed. Differentiated approaches to motor learning for athletes with intellectual impairment and with musculoskeletal disorders are substantiated.

Keywords: *peripheral vision, para-badminton, perimetry, motor learning, athletes with disabilities, MSD, II, speed and force of strokes, simple reaction time, Schulte table.*

Introduction. Para-badminton, as a games sport, places extreme demands on the various systems of the athlete's body. One of the key roles in the activation of sensorimotor and kinaesthetic functions is played by peripheral vision, which ensures the fixation and monitoring of the opponent's movement on the court, the speed of response in game situations and the differentiation of space [1].

In athletes of various games sports the visual field has its own features. For example, in athletes engaged in clay pigeon shooting, peripheral perception is characterised by a large magnitude of the visual field with a predominance of the left-sided monocular visual field [6], while in basketball players a direct connection has been revealed between the magnitude of the visual field, the quality of the performance of actions and the technique of thinking [3].

Through the visual field, in the process of observation, information about the opponent's actions enters

the mirror neuron system. Implicit learning makes it possible to transfer the observed kinematics automatically into one's own motor programme, reducing the cognitive load, whereas the explicit method makes it possible to analyse actions consciously with reliance on working memory and the verbalisation of rules [5].

Consequently, the methodology of motor learning should take into account not only the technical and tactical aspects of the sport, but also the psychophysiological mechanisms and deficits that the athletes have [2].

Objective of the study is to determine the differences in the psychophysiological and technical indicators between badminton players with musculoskeletal disorders (MSD) and with intellectual impairment (II) with account taken of the indicators of the visual field, and on this basis to substantiate the application of differentiated approaches in the methodology of the motor learning of athletes.



Methods and structure of the study. Ten athletes took part in the research: candidates for master of sport and masters of sport aged 21-24 years, members of the national para-badminton team of Russia: 5 persons with MSD and 5 with II.

All the athletes underwent a computerised ophthalmological examination (perimetry was carried out with a white stimulus). The state of the visual field and the stability of attention were assessed by the method of the 'Schulte tables' 7 7 [7]. The diagnostics of the simple visual-motor reaction was carried out on a device with the XLIGHT One 6 computer programme, and the assessment of the physical aspect of the strokes was carried out using an Intelligent Badminton Sensor 3.0 attached to the racket. Accuracy in ballistic movements was assessed by the control exercise 'Accuracy'.

Results of the study and discussion. The results of the study obtained are summarised in the Table.

The functional availability of peripheral signals in the athletes with MSD and with II is comparable ($p \geq 0.05$). In all the para-badminton players a moderate narrowing of the lower outer sector was revealed: in the athletes with MSD it amounts to 85.4° and in those with II to 83.5° , against a physiological norm of $90-100^\circ$. In 60 % of the athletes in both groups simple hypermetropic (long-sighted) astigmatism and a reduction in visual acuity of mild and moderate degree were revealed, which may lead to the appearance of errors when performing various strokes [4]. Colour perception in the athletes corresponds to the norm.

An analysis of the ballistic movements in the exercise 'Accuracy' showed that the athletes hit the designated sector 4-5 times out of 10 ($p \geq 0.05$).

A higher level of visual-motor coordination in the task with multicoloured signals was revealed in the para-badminton players with MSD ($p \leq 0.05$) in terms

Table. Indicators of the visual field, of the psychophysiological tests and of stroke technique in badminton players of different nosological groups (medians)

No.	Criterion	Indicator	Nosological group	
			MSD	II
1	Visual field 'Perimetry'	Lower outer segment (degrees)	85.4	83.5
2	Test 'Accuracy'	Number of hits out of 10 shuttlecock feeds, number of times	5	4
3	Simple reaction in 30 s (multicoloured), XLIGHT One 6 trainer	Mean reaction time (s)	0.7	0.97
		Total number of targets, units	28	22.5
4	Reaction in 30 s to the colour green, XLIGHT One 6 trainer	Mean reaction time (s)	1.26	1.45
		Total number of targets, units	18	14
		Number of errors (units)	1	3
		Targets missed (units)	1	4
5	Schulte table, 7×7	Identification of the numbers from 1 to 25, min	1.15	2.8
		Identification of the numbers from 1 to 49, min	3.45	6.4
6	Smash	Speed, km/h	162.7	128.4
		Force, N	18.7	10.5
7	Backhand	Speed, km/h	104.8	92.7
		Force, N	8	7.4
8	High-deep stroke	Speed, km/h	156.5	113
		Force, N	16.2	7.9
9	Forehand drop	Speed, km/h	83.7	77.2
		Force, N	5.4	5.4
10	Backhand drop	Speed, km/h	88	74.8
		Force, N (Me)	7.9	6.4
11	Forehand block	Speed, km/h	140.4	114.9
		Force, N (Me)	12.8	8.9
12	Backhand block	Speed, km/h	146.7	101.9
		Force, N	13.8	7.3



of reaction time (0.7 s against 0.97 s in those with II) and of the number of targets touched (28 units against 22.5 units in those with II). Visual-motor coordination in response to a green colour signal also predominates in the para-badminton players with MSD ($p \leq 0.05$): the indicators of speed of reaction are 0.19 s lower and the total number of targets is 4 units greater, while the para-badminton players with II made 3-4 times more errors and missed targets, which reduced effectiveness by 50 %. The reaction time to green stimuli increased in all the groups: in the athletes with MSD by 0.56 s and in those with II by 0.48 s. In physiology this effect is explained by the lower sensitivity to the colour green in the periphery of the retina. At the same time, in our study a lower sensitivity to the green signal was revealed in the para-badminton players with MSD – by 0.08 s.

In the para-badminton players with MSD the stability and speed of perception by the visual field of the numbers in the Schulte table (25) is higher by 1.65 min (1.15 min against 2.8 min in those with II, $p \leq 0.05$). The speed of perception of the numbers against a background of fatigue in the Schulte table (49) declines in all the groups: by 2.3 min in the athletes with MSD and by 3.6 min in those with II, the advantage remaining with the athletes with MSD ($p \leq 0.05$). Consequently, deterioration of the functional state of peripheral vision and cognitive deficit arise 1.8 times faster in the para-badminton players with II.

The speed-strength indicators in almost all the technical strokes, apart from the force of the backhand and the force of the drops, show inter-group differences ($p \leq 0.05$). The most pronounced lags of those with II are observed in the smash (speed reduced by 21 %, force by 44 %), in the high-deep stroke (speed reduced by 28 %, force by 51 %) and in the blocks (speed reduced by 18-31 %, force by 30-47 %).

Spearman correlation analysis on the combined sample ($n=10$ persons) showed the presence of:

1) a strong negative correlation between the reaction time to multicoloured stimuli and the speed of the smash ($r_s = -0.82$, $p=0.004$);

2) a strong positive correlation between the speed of reaction to the colour green and the state of peripheral vision when performing tasks varied in volume and intensity by the visual analyser in the Schulte table ($r_s = 0.79$, $p=0.006$);

3) a positive significant correlation between the visual field and the force of the high-deep stroke ($r_s = 0.68$, $p=0.03$);

4) a positive significant correlation between the visual field and the speed of the forehand block ($r_s = 0.727$, $p=0.05$) and the backhand block ($r_s = 0.997$, $p=0.05$).

The closeness of the relationships obtained confirms that functional visual dysfunctions of the visual field directly influence the technical preparedness of para-badminton players, particularly those with II. The narrowing of the visual field in the lower outer sector impairs the ability to monitor the opponent and to perform responsive actions directed at defence and the block.

The differentiated approach to motor learning, in accordance with the results of the study, consists in the following:

1) for athletes with II it is necessary to apply implicit methods of learning (through metaphors, analogies, imitation and game forms), gradually increasing the load from simple to complex stimuli;

2) for athletes with MSD it is necessary to apply the explicit method, exercises for developing saccadic eye movements into the lower sectors without turning the head, with moving peripheral objects; and to add training in the peripheral detection of a shuttlecock directed at the feet;

3) for all groups: exercises for expanding the functional field of attention (tachistoscopic peripheral stimuli); for athletes with astigmatism – to conduct peripheral vision training only in contact lenses selected by an ophthalmologist; and to apply red markers in the zones where the athletes most often make errors. At the same time it is necessary to take into account that in athletes with II the sensitivity of the visual cortex to the colour red may be heightened, as a result of which it optically appears closer and disrupts the perception of the depth of space [8].

Conclusions. The slight functional narrowing of the visual field in the lower outer sector in elite para-badminton players with MSD and with II has a positive significant correlation with the force of the high-deep stroke and with the speed of the forehand and backhand block.

Higher results in the psychophysiological indicators and in the speed-strength characteristics of the strokes are shown by the athletes with MSD. A strong negative correlation exists between the reaction time to multicoloured stimuli and the speed of the smash, and strong positive correlations exist between the speed of reaction to the colour green and the formation of visual fatigue, and between the visual field and



the technical indicators. The closeness of the interrelations revealed between the indicators makes it possible to regard the training of peripheral vision as a priority direction in the motor learning of para-badminton players and points to the need to apply a differentiated approach to para-badminton players with MSD and with II.

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The motivational and value potential of the discipline ‘physical culture’: statistics, analytics and assessment according to the data of a survey of students of Russia and Kazakhstan

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Abstract

Objective of the study is to determine the motivational and value potential of the discipline ‘Physical Culture’ on the basis of a survey of Russian and Kazakh students.

Methods and structure of the study. A survey of students of the universities of Russia and Kazakhstan (N=588) was conducted concerning the compulsory discipline «Physical Culture», including ‘Elective Courses in Physical Culture.’ Results and conclusions. A persistent dissonance was revealed between the institutional requirement (‘to obtain the credit’) and the personal goals of the students (‘health’, ‘tone’, ‘communication’): 61.8 % of the respondents consider the discipline non-compulsory and 44.3 % assess the standards as ‘a completely useless exercise,’ while 97 % of absences are documented ‘on grounds of illness.’ A content analysis of the open answers identified the key barriers: an inconvenient timetable and the personality of the teacher. Drawing on a three-stage model of the formation of a value attitude towards physical culture (‘I want’ → ‘I must’ → ‘I can’), it is shown that the majority of students (54 %) become stuck at the initial stage without achieving self-actualisation. A comparative analysis of Russia and Kazakhstan revealed no significant differences, which makes it possible to speak of the systemic character of the problem in the post-Soviet educational space. The question is raised of the need to revise the compulsory status of the discipline or to transform it radically.

Keywords: *physical culture at university, motivational and value orientations, students of Russia and Kazakhstan, reform of the discipline ‘Physical Culture.’*

Introduction. The compulsory discipline ‘Physical Culture’ (PC) – a legacy of the Soviet system of higher education – has been retained in the curricula of the universities of Russia and Kazakhstan without any serious conceptual revision for more than three decades [2, 10, 11]. Formally its aims are noble: the health improvement of the nation, physical perfection and preparation for professional activity. Informally – and our data confirm this – for the majority of students PC has turned into a ritual: to attend the prescribed hours, to pass the standards, to obtain the credit and to forget about it.

A question arises which many researchers prefer to avoid: ‘Is this compulsory status necessary?’ If the discipline does not form a stable motivation, if after the sessions only 12.7 % of students feel hap-

py and 61.8 % are in favour of abolishing its compulsory status – perhaps it is worth recognising that the traditional form has exhausted itself?

At the same time, the data obtained show that 73 % of students engage in physical activity independently and that 83.7 % consider that the compulsory status of the discipline ‘Physical Culture’ at university evokes rejection and resistance. The paradigm of compulsion has exhausted itself. It does not form an internal motivation, does not create a value attitude towards health and does not prepare students for independent motor activity after graduation. Moreover, it generates rejection and irritation and, as we shall show, a mass demand for the abolition of its compulsory status.

Objective of the study is to determine the motivational and value potential of the discipline ‘Physi-



cal Culture' on the basis of a survey of Russian and Kazakh students.

Methods and structure of the study. The theoretical basis of the study is the concept of the value-and-meaning regulation of behaviour of D.A. Leontiev [5], according to which stable behaviour is formed not by external pressure but by internal meanings. V. Frankl [12] emphasised that meanings are unique and cannot be imposed from outside. As applied to the discipline 'Physical Culture' this means that a student who attends the sessions 'because he has to' will cease doing so as soon as the external control disappears.

This is a psychological regularity: external control undermines internal motivation – a phenomenon described in detail in the self-determination theory of Deci and Ryan [14]. According to this theory, the satisfaction of the basic psychological needs for autonomy, competence and relatedness is a necessary condition for the formation of internal motivation and stable behaviour [14]. Research of recent years confirms that support for autonomy on the part of the teacher considerably increases the emotional engagement of students in physical culture sessions [15].

The alternative is a paradigm at the centre of which lies not control and compulsion but the creation of conditions for the realisation of physical potential on the basis of the student's self-development [6]. This paradigm includes three interconnected components:

- Support for autonomy – an optional or elective format of the discipline, the right to choose the type of motor activity (gym, team games, fitness, dance, martial arts, swimming) and a flexible timetable;
- Accompaniment of the development of competence (universal competence 7) – the replacement of unified standards by a portfolio of achievements in which individual progress is recorded rather than conformity to an abstract standard;
- The formation of relatedness – the creation of digital communities (for example, the authors' VKontakte community 'Physical Culture and Health') in which students can share their achievements, receive feedback and take part in challenges.

This paradigm changes the content of the discipline: what becomes compulsory is not 'to attend the hours and pass the standards', but care for one's own health and physical development, pre-

paredness and functional state, realised in a supportive environment [1, 9].

Contemporary research determines the change of the paradigm of physical education: thus, G.N. Ponomarev and co-authors come to the conclusion that a transition is necessary from regulated classroom sessions to the independent work of students on the basis of free choice [8]. L.I. Lubyshcheva, in the concept of sportisation, substantiates the transition to a personality-oriented model [6]. The research of A.A. Kovalev shows the effectiveness of using wearable devices for the personalised monitoring of motor activity [3]. A.A. Kryaklina and co-authors confirm that the digital environment of the university (fitness trackers, smart watches) increases students' motivation for training [4]. A.N. Yakovlev and co-authors note that in the post-Soviet space physical culture is becoming a powerful social factor requiring a revision of the approaches to teaching [13].

In previous works of the author [7] a model of the formation of a value attitude towards physical culture was proposed, comprising three stages. The first stage ('I want') – interest, but without stable behaviour. The second stage ('I must') – awareness of necessity, but with barriers. The third stage ('I act') – independent regular motor activity.

In the contemporary paradigm of physical education the majority of students become stuck at stage 2, never moving on to stage 3. The paradigm of support and accompaniment is intended to ensure this transition through the creation of conditions in which 'must' is transformed into 'want' and 'can'.

In accordance with the aim of the study, an anonymous online survey was chosen as the principal empirical method, making it possible to collect standardised quantitative data on the motivational and value orientations of a large number of respondents. The questionnaire included 20 questions (closed and open), grouped according to three criteria: the cognitive (knowledge of the benefit of physical culture), the emotional (feelings, experiences) and the behavioural (regularity, independent activity). The open questions were subjected to content analysis.

A total of 588 students of the 1st to 3rd years took part in the survey. The sample included students from eight universities: five Russian (500 persons) and three Kazakh (88 persons). The average



age was 18.7 years; 62 % were women and 38 % men. Health groups: 63 % – the main group, 22 % – the preparatory group, 15 % – the medical group.

Results of the study and discussion. To the question about the purpose of attending physical culture, 47.2 % of the students answered: 'To obtain the credit and to complete the semester without a debt'. Only 28.5 % named health improvement and 15.3 % physical perfection. At the same time, the majority of those surveyed consider that physical culture should not be a compulsory subject of the curriculum (61.8 %); a slightly smaller number of respondents consider that it should be included in the curriculum (29.2 %), and the remainder (9 %) are unsure of their answer (Figures 1 and 2).

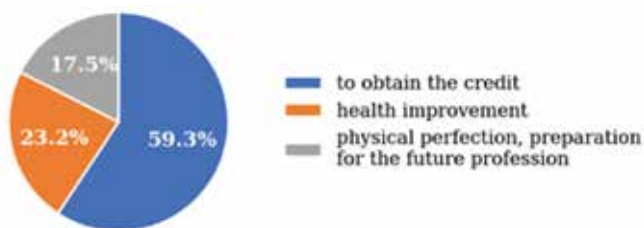


Figure 1. Results of the answer to the question 'What is the purpose of your physical culture sessions at university?'

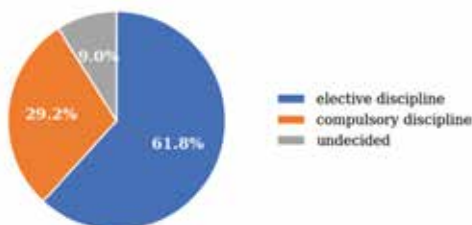


Figure 2. Results of the answer to the question 'Should the discipline of physical culture be compulsory?'

At the same time, in the open question about motivation for physical exercise outside the university the distribution is different: 52 % – the maintenance of tone and health improvement, 23 % – psychological release, 18 % – communication. And only 2 % – the credit.

Figure 3 presents the results of the answer to the question: 'Do physical culture sessions improve relations within the group?' A total of 69.6 % of the respondents answered in the affirmative and 30.4 % in the negative.

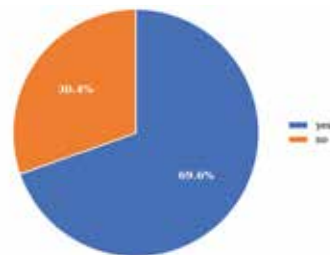


Figure 3. Percentage ratio of the respondents who consider that social interaction improves during physical culture sessions

The data obtained confirm the high socialising potential of the discipline 'Physical Culture.' For the majority of students the sessions act not only as a form of motor activity, but also as a significant platform for interpersonal communication, for the formation of team spirit and for the strengthening of social ties within the study group.

Figures 4 and 5 present the results of the answers to the questions about the independent motor activity of students outside the compulsory sessions.

Figure 4 reflects the answers to the question 'Do you engage in physical culture outside class time?': 31 % of the respondents answered 'yes, systematically', 42 % – 'yes, occasionally' and 27 % – 'no'. Thus, 73 % of the students display independent motor activity at least occasionally.

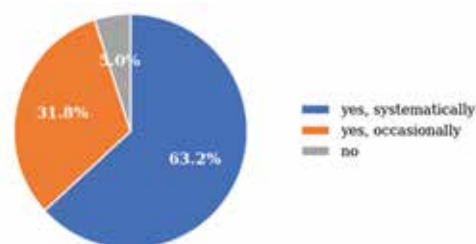


Figure 4. Results of the answer to the question 'Do you engage in physical culture outside class time?'

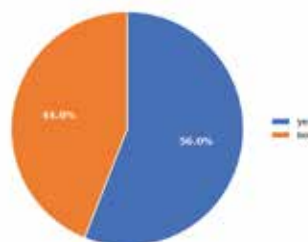


Figure 5. Results of the answer to the question 'Do you do morning exercises?'



This is an important indicator, showing that the overwhelming majority are already engaged in motor activity on their own initiative. However, their activity is unsystematic in character, which gives grounds for choosing pedagogical interaction in the form of accompaniment – guiding support that will help to convert occasional sessions into a regular practice.

Figure 5 reflects the answers to the question ‘Do you do morning exercises?’: only 23 % answered ‘yes’ and 77 % – ‘no’. The low percentage of regular morning activity shows that no stable health-forming behaviour has been developed. It is precisely here that support is needed, together with the creation of conditions and motivating environmental factors (digital reminders, group challenges, encouragement of small steps) that will help the student to take the first step towards systematic practice [3, 4].

Taken together, both figures demonstrate the readiness of students to carry out motor activity in independently chosen formats rather than within the framework of a compulsory and regulated discipline. The task of the discipline at university is to teach the student to maintain this independence by offering flexible formats (including digital ones), an optional status, individual trajectories and accompaniment. The transition to support and accompaniment (in essence, mentoring) will make it possible to turn the occasional activity of 73 % of students into a stable habit, and morning exercises from a rare exception into health-forming behaviour.

A comparison of the Russian and Kazakh students revealed no significant differences. The data are practically identical. The post-Soviet paradigm of physical education is reproduced in different countries irrespective of national features. This means that the solution too should be systemic – a change of the paradigm of the compulsory fulfilment of attendance requirements and the passing of standards to support and accompaniment in the self-actualisation of the physical potential of students.

Conclusions.

1. The paradigm of formal compulsion and regulated control in the physical education of students has exhausted itself. It does not form an internal motivation, does not satisfy the basic psychological needs for autonomy, competence and relatedness, and generates rejection and avoidance.

2. The physical culture teacher at university must cease to be a controller assessing the passing of standards and recording attendance. His new role is that of a mentor who accompanies the student, helps to build an individual trajectory for realising physical potential, supports independent activity and creates conditions for the transition from an external requirement (‘must’) to internal motivation (‘want’, ‘can’ and ‘act’).

3. The leading principle of physical education at university should be the independence and activity of the student, realised through pedagogical interaction in the format of accompaniment and support.

4. The comparative analysis of Russia and Kazakhstan revealed no significant differences, which testifies to the systemic character of the problem in the post-Soviet educational space and to the need for common approaches to its solution.

5. A change of paradigm is proposed – from compulsion to support and accompaniment – presupposing specific steps: a revision of the compulsory status of the discipline, the introduction of a choice of types of physical activity, the replacement of standards by a portfolio of achievements, and digital support (a VKontakte community, wearable devices). Only in this way will the discipline «Physical Culture» be able to become not a formal obligation but a resource for health-forming behaviour on the basis of the independence and activity of the student.

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The use of the means of functional training in preparing students for participation in the Festival of Universities of Physical Culture

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Abstract

Objective of the study is to substantiate theoretically and experimentally an approach to improving the physical preparation of young men for participation in the Festival of Students of Universities of Physical Culture by the means of functional training.

Methods and structure of the study. Twenty young men of a physical culture university aged from 18 to 21 years took part in the experiment. The testing was based on the programme of the Festival of Students of Universities of Physical Culture, which includes the standing long jump with a two-footed take-off, pull-ups on the high bar, the 1 km run and the stages of the professional obstacle course (the high jump, the dive roll and 5 consecutive forward rolls).

Results and conclusions. Functional training including complex physical exercises was used to improve the physical preparation of students for participation in the Festival of Students of Universities of Physical Culture. The advantage of using this approach in terms of the rate of improvement of the results studied was revealed.

Keywords: *physical preparation of young men, functional training, complex physical exercises, Festival of Students of Universities of Physical Culture.*

Introduction. An analysis of students' participation in the Festivals of Students of Universities of Physical Culture shows the strong and weak aspects of their preparation. Attention is drawn to the low level of the results of the participants in the qualifying rounds of the Festival held at the university, particularly in the strength events and in the professional obstacle course [5]. Proceeding from this, there is a need to improve the physical preparation of students for participation in the Festival.

Among the most effective methods of physical preparation is functional training. This method is directed not only at improving the physical abilities necessary in everyday life, but also ensures an increase in the functional capabilities of the body [2, 4]. In functional training, complex exercises stimulating the development of proprioceptive perception are used [1, 3].

Objective of the study is to substantiate theo-

retically and experimentally an approach to improving the physical preparation of young men for participation in the Festival of Students of Universities of Physical Culture by the means of functional training.

The following methods were applied in the study: theoretical analysis of the scientific and methodological literature, educational experiment, pedagogical testing (control tests) and methods of mathematical statistics.

Methods and structure of the study. The research was carried out on the basis of the Federal State Budgetary Educational Institution of Higher Education «Tchaikovsky State Academy of Physical Culture and Sport» (Tchaikovsky, Perm Region). The participants were 20 students of the 1st to 4th years, who were divided into two groups (a control group and an experimental group) of 10 persons each. The experiment was conducted from Febru-



ary to May 2025.

The diagnostics were carried out according to the results of testing that included the standing long jump with a two-footed take-off, pull-ups on the high bar, the 1 km run and the stages of the professional obstacle course (the high jump, the dive roll and 5 consecutive forward rolls). The results of the tests and the technique of performing the motor actions were analysed. As a result the students were divided into a control and an experimental group of 10 persons each, which had no significant differences in their initial results.

Results of the study and discussion. In the course of the experiment four measurements of stage-by-stage monitoring were carried out in order to assess the rate of achievement of the effects of the intervention and to choose the timing of the independent training session. The control and experimental groups trained three times a week for 90 minutes (twice in an organised form and once independently). Of interest is the rate of the dynamics of the results.

The control group trained independently in the gym, on cardio machines, on training devices and with free weights; stretching was performed.

In the experimental group the students were given functional training programmes, and together with the control group, in the organised form of the sessions, the technique in such exercises as the high jump, the dive roll and 5 consecutive forward rolls was improved (Table 1).

In the control group the methods of separate strength and cardio training using stable training devices and a linear load (the standard-repetition method) were applied. In the experimental group the methods of functional and interval training (cir-

cuit training, high-intensity interval training and proprioceptive methods) were applied, based on performing exercises on an unstable support and on the coordination and integration of movements.

In the experimental group the functional training included complex exercises, for example: counts 1-2 – assume a plank position, elbows on a balance cushion; counts 3-4 – sit in a V-sit position on the cushion, arms along the body; counts 5-8 – assume a side plank, elbow on the cushion, free arm along the body or abducted to the side; counts 9-12 – lie on the stomach, pelvis on the cushion, extend the legs and arms to the sides, lifting them off the floor, and hold the balance; counts 13-15 – sit in a V-sit position on the cushion, resting the hands on the cushion or the floor, and perform swings of both legs from side to side; counts 16-20 – assume a front support position with the feet on the cushion, alternately bringing the right knee to the right hand and the left knee to the left hand. Stand up and perform a 10-metre acceleration.

Table 2 presents the results of the four measurements of the testing of the young men. Owing to the use of parametric and non-parametric data in the study, and taking into account that the sample is fewer than 15 persons per group, the Wilcoxon test was used for the mathematical substantiation of the statistical significance of the differences observed between the samples.

An analysis of the results showed that by the end of the experiment the indicators of physical fitness had improved significantly ($p < 0.05$) both in the control and in the experimental group in all the tests. In comparing the inter-group results a significant difference was also noted. In the test of the standing long jump with a two-footed take-off, the gain in the

Table 1. Differences in the approaches to the physical preparation of the students of the control and experimental groups in the experiment

Indicators	Control group	Experimental group
Duration of training	3 times a week for 90 minutes	
Means of training	Cardio machines, training devices, free weights, stretching, high jumps, negotiating the professional obstacle course	Methodology of functional training (bodyweight exercises, free weights, exercises with BOSU and TRX, agility ladder, complex exercises), high-intensity interval training, high jumps, negotiating the professional obstacle course
Methods	Linear	Integrative
Intensity	High, submaximal	High, submaximal
Work / rest regime	Interval-repetition	Circuit + high-intensity
Work with equipment	Stable support	Unstable support
Development of physical qualities	Isolated	Comprehensive



Table 2. Dynamics of the physical fitness of the young men of the control and experimental groups

Control tests		$(\bar{x} \pm \sigma), (n=10)$				Δ	$\Delta \%$	p
		1st measurement	2nd measurement	3rd measurement	4th measurement			
Standing long jump (cm)	CG	263.1 $\pm$ 2.2	264.1 $\pm$ 2.3	265.4 $\pm$ 2.2	271.3 $\pm$ 1.8	8.2	3.1	<0.05
	EG	263.8 $\pm$ 1.9	265.9 $\pm$ 2.3	268.6 $\pm$ 2.0	278.1 $\pm$ 0.5	14.3	5.4	<0.05
Pull-ups (number of repetitions)	CG	20.1 $\pm$ 1.6	21.0 $\pm$ 0.8	21.8 $\pm$ 0.8	27.0 $\pm$ 0.5	6.9	34.3	<0.05
	EG	20.2 $\pm$ 1.4	22.0 $\pm$ 0.8	23.8 $\pm$ 0.6	28.7 $\pm$ 0.6	8.5	42.1	<0.05
1 km run (min)	CG	3.18 $\pm$ 0.09	3.15 $\pm$ 0.05	3.12 $\pm$ 0.05	3.11 $\pm$ 0.02	-0.07	-2.2	<0.05
	EG	3.24 $\pm$ 0.22	3.13 $\pm$ 0.06	3.09 $\pm$ 0.02	3.04 $\pm$ 0.01	-0.2	-6.2	<0.05
High jump (number of successes out of 10)	CG	5.9 $\pm$ 0.8	6.3 $\pm$ 0.5	7.3 $\pm$ 0.5	8.2 $\pm$ 0.2	2.3	38.9	<0.05
	EG	5.8 $\pm$ 0.8	7.1 $\pm$ 0.6	8.4 $\pm$ 0.5	9.2 $\pm$ 0.3	3.4	58.6	<0.05
Dive roll (number of successes out of 10)	CG	7.0 $\pm$ 0.5	7.0 $\pm$ 0.5	7.9 $\pm$ 0.4	9.4 $\pm$ 0.2	2.4	34.3	<0.05
	EG	6.9 $\pm$ 0.4	8.0 $\pm$ 0.2	8.8 $\pm$ 0.2	9.8 $\pm$ 0.2	2.9	42.0	<0.05
5 consecutive forward rolls (s)	CG	3.5 $\pm$ 0.1	3.5 $\pm$ 0.1	3.3 $\pm$ 0.1	2.9 $\pm$ 0.1	-0.6	-17.1	<0.05
	EG	3.4 $\pm$ 0.1	3.3 $\pm$ 0.1	3.0 $\pm$ 0.1	2.6 $\pm$ 0.1	-0.8	-23.5	<0.05

Note: CG – control group, EG – experimental group.

Table 3. Gain in the results of the testing of the young men of the control and experimental groups (%)

Control tests		2nd measurement	3rd measurement	4th measurement
Standing long jump (cm)	CG	0.38	0.87	3.1
	EG	0.79	1.8	5.4
Pull-ups (number of repetitions)	CG	4.5	8.5	34.3
	EG	8.9	17.8	42.1
1 km run (min)	CG	-0.9	-1.89	-2.2
	EG	-3.4	-4.6	-6.2
High jump (number of successes out of 10)	CG	6.8	23.7	38.9
	EG	22.4	44.8	58.6
Dive roll (number of successes out of 10)	CG	0	12.9	34.3
	EG	15.9	27.5	42.0
5 consecutive forward rolls (s)	CG	0	-5.7	-17.1
	EG	-2.9	-11.7	-23.5

control group amounted to 3.1 %, which is 2.3 % less than in the experimental group.

The results of the pull-ups improved in the experimental group by 42.1 %, which is 7.8 % more than in the control group. Positive shifts were also noted in the 1 km run (-2.2 % in the CG and -6.2 % in the EG). The greatest positive shift was in the high jump: 58.6 % in the experimental group and 38.9 % in the control group. A gain of 42 % was noted in the results of the dive roll test in the experimental group, which is 7.7 % more than the gain in the control group. In the test of 5 consecutive forward rolls the results improved (by 17.1 % in the CG and by 23.5 % in the EG).

As regards the dynamics of the results by measurement, let us present them in Table 3.

The gain in the results at the second measurement showed that in the experimental group positive shifts had already begun, which cannot be said of the results of the control group (for example, in the dive roll and 5 consecutive forward rolls tests). Approximately half of the gain in the results noted at the end of the experiment fell within the period up to the third testing.

Conclusions. The positive dynamics of the results of the testing of the young men make it possible to assert that the approach to improving physical preparation for participation in the Festival of Students of Universities of Physical Culture by the means of functional training contributes to raising the level of physical fitness and, consequently, the results of participation in the Festival.



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The influence of the combined application of various types of physical education sessions on the physical well-being of students

UDC 796.11



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Abstract

Objective of the study is to assess the influence of the combined application of a theoretical course, practical sessions and self-testing on satisfaction with motor activity, psychological comfort and the maintenance of motivation in students of management specialties.

Methods and structure of the study. The survey was conducted in physical education classes among first-year students during the first semester. The course consisted of 15 sessions combining three types of activity – lectures, sessions in mass sports requiring the application of the theoretical knowledge acquired, and practice in the self-testing of the participants.

Results and conclusions. Physical education classes that include the combined application of a theoretical course, practical training sessions and self-testing increase satisfaction with physical activity, contribute to the formation of collectivism and systematise the training process of students.

Keywords: *students of management specialties, motor activity, physical exercises, physical condition.*

Introduction. The determining factor of success in higher education is physical well-being, defined as a state that enables students to realise their abilities, to withstand stressful situations, to participate productively in the educational process and to make a certain contribution to the social life of the student community [3]. Owing to the considerable educational workload, which increases the risk of psychological and physical maladaptation, the physical well-being of students may decline substantially [1].

Maintaining and improving physical well-being requires systematic motor activity, which has a favourable effect on physical fitness, mental state and academic performance, something that to this day remains a difficult task under the conditions of an intensive educational process [5]. In turn, an increase in motor activity is achieved by creating a positive background for performing physical exercises, by varying the means of physical activity and by forming the

corresponding motivation for training [4]. University education should provide opportunities for obtaining positive experience of organising the student's physical activity.

Physical education at university possesses the necessary opportunities for forming a positive attitude towards physical activity, for achieving high results in training, and for fostering the habit of systematic physical exercise [2].

The majority of the studies carried out in this direction are concentrated on examining the influence of sports training, whereas the study of the effectiveness of physical education classes in improving students' attitude towards physical activity remains insufficiently investigated. Despite the tendency towards the optimisation of education by the means of digitalisation, physical education has considerable educational advantages precisely by virtue of its high motor activity.



Objective of the study is to assess the influence of the combined application of a theoretical course, practical sessions and self-testing on satisfaction with motor activity, psychological comfort and the maintenance of motivation in students of management specialties.

Methods and structure of the study. The survey was conducted in physical education classes among first-year students during the first semester. The course consisted of 15 sessions combining three types of activity – lectures, sessions in mass sports requiring the application of the theoretical knowledge acquired, and practice in the self-testing of the participants.

The content of the lectures included the anatomical and physiological foundations and questions of the methods of training on the basis of the competition rules of mass sports. The sportised sessions included game forms of physical activity (badminton, table tennis, volleyball), aerobic exercises to music, bodyweight strength training, double circuit training, skipping, bodyweight exercises and static muscle stretching (Pilates). The practice in measurement and self-assessment was carried out on the basis of assessing flexibility, muscular strength and the intensity of exercise by heart rate.

In total, 52 respondents completed the Google Forms questionnaire.

Attitude and motivation towards motor activity, the level of satisfaction with the sessions and the perception of a lack of physical exercise were assessed by means of the following questions: 'I enjoy engaging in physical activity', 'I feel physically inactive' and 'I make conscious efforts to be physically active', and were rated on a seven-point scale (1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree and 7 = strongly agree). Questions on the perception of the benefit of physical exercise, on physical well-being ('I perceive my physical condition on the whole as good'), on the quality of sleep ('I sleep peacefully') and on the quality of communication through physical

activity ('I feel that collective physical activity sessions help me to make contact with my fellow students') were also rated on a seven-point scale.

The systematic nature of motor activity was assessed by the responses to the following statements. 1) At present I do not engage in motor activity and do not plan to do so in the future. 2) At present I do not engage in motor activity, but I plan to begin in the near future. 3) I perform physical exercises irregularly, but I plan to increase the frequency of my sessions. 4) I have been engaging in physical culture regularly for less than 3 months. 5) I have been engaging in physical culture regularly for more than 3 months.

To assess the variety of the means of motor activity offered, the participants were asked to rate on a seven-point scale the statement: 'Thanks to the combined course I have gained more opportunities to choose a variety of physical exercises'.

It was investigated which of the types of session influenced to the greatest degree the change in the respondents' perception of health and physical exercise: the theoretical course, the practical sessions or the self-testing. Multiple choice was permitted.

The statistical analysis was carried out using Statistica 20.0 software. Statistical significance was set at the level $p < 0.05$.

Results of the study and discussion. After completing the combined course, satisfaction with motor activity ($w=3456$, $r=0.265$), interest in interpersonal communication while performing physical exercises ($w=5432$, $r=0.348$) and the systematic nature of physical culture sessions ($w=4683$, $r=0.521$) increased considerably. At the same time, the assessment of the quality of sleep declined ($w=1541$, $r=0.276$). The perception of a lack of physical exercise ($w=1029$, $r=0.149$), the striving to increase motor activity ($w=7639$, $r=0.231$) and the assessment of one's own physical condition ($w=2328$, $r=0.374$) did not change.

Satisfaction with motor activity correlated significantly with the assessment of the quality of sleep and

Table. Changes in students' perception of motor activity and of the benefit of physical exercise

Indicator	Before	After	p
Satisfaction with motor activity	4.7±0.2	6.8±0.4	< 0.05
Striving to engage in physical exercise	4.7±0.2	6.8±0.4	< 0.05
Assessment of one's own physical condition	4.7±0.2	6.8±0.4	< 0.05
Assessment of the quality of sleep	4.6±0.1	4.3±0.3	< 0.05
Sense of collective cohesion during physical culture sessions	3.6±0.3	5.5±0.5	< 0.05
Systematic nature of motor activity	2.5±0.4	4.8±0.2	< 0.05
Expansion of the means of motor activity that arouse interest	3.0±0.5	5.8±0.1	< 0.05



with the sense of collective cohesion during physical culture sessions ($r=0.678$). The striving to increase motor activity showed a significant connection with an improvement in the systematic nature of physical culture sessions ($r=0.546$). The striving to increase motor activity correlated significantly with the systematic nature of physical culture sessions and with the growth of preferences in the choice of physical exercises ($r=0.465$). The assessments of one's own physical condition and of the quality of sleep proved to be interrelated at a high level of significance. The systematic nature of physical culture sessions showed a high connection with the expansion of the means of motor activity ($r=0.412$).

The combined application of a theoretical course, practical sessions and self-testing increased the positive perception of motor activity, the sense of cohesion of the student community and the systematic nature of physical exercise. Taken together, these factors determine the success of forming in students the habit of systematic physical culture sessions.

In the process of physical culture sessions, an increase in the cohesion of the student community, closely connected with students' academic performance, is of important significance for first-year students.

Undoubtedly, the systematic performance of physical exercises is important for maintaining the physical and mental health of students; however, the formation of the habit of motor activity outside class time represents a complex task. Its solution presupposes the expansion of the means of physical activity, contributing to adherence to a motor regime, as is evidenced by the results of the survey at the end of the study.

The expansion of the means of physical activity that arouse interest brought about an increase in the desire to perform physical exercises, including aerobic exercises to music, bodyweight strength exercises, skipping and static flexibility exercises. Previous studies have shown that aerobic exercises of moderate intensity, exercises to music, strength exercises and stretching improve mental health and cognitive functions.

Since the quality of sleep is positively connected with physical condition, the key task for improving well-being, in addition to performing physical exercises, is sufficient sleep.

The sense of collective cohesion during physical culture sessions also improves physical condition; physical activity should therefore not be limited to the obligatory performance of individual exercises, but

should be conducted on the basis of communication between students in collective forms of physical culture and sports activity.

Additional analysis showed that after the completion of the physical education classes the female students more often felt a lack of physical activity and showed a smaller growth in the expansion of the means of motor activity that arouse interest than the male students.

Conclusions. Physical culture classes with first-year students of management specialties that include the combined application of a theoretical course, practical training sessions and self-testing increase satisfaction with physical activity, contribute to the formation of collectivism in the process of physical exercise, systematise the training process and expand the means of motor activity that arouse interest.

In order to achieve satisfaction with motor activity, psychological comfort and the maintenance of social motivation, it is expedient to include a variety of types of session, to expand the list of training exercises and to introduce collective forms of student sessions.

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The pedagogical potential of sports games in the motor development of children and adolescents in the people's Republic of China

UDC 37.037.1.



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Abstract

Objective of the study is to examine the pedagogical potential of sports games in the motor development of children and adolescents in China.

Results and conclusions. It is shown that sports and outdoor games have a comprehensive influence on the motor sphere of learners, contributing to the development of coordination, speed, agility, endurance, speed-strength qualities and visual-motor reaction. It is noted that the effectiveness of sports games is determined by age-appropriateness, the gradual increase in the complexity of the tasks, game motivation and the methodologically competent organisation of the sessions.

Keywords: *motor development, children and adolescents, the PRC, sports games, physical education, motor activity.*

Introduction. The motor development of children and adolescents is one of the important tasks of physical education. Basic motor skills, physical qualities, the coordination of movements and an interest in regular motor activity are formed at school age. The theory of physical culture emphasises that physical education should be directed towards the holistic development of the motor capabilities of learners [1, 4]. Of particular importance are the motor abilities of schoolchildren. V.I. Lyakh notes that their development depends on age, motor experience, the content of the sessions and the systematic nature of the pedagogical influence [3]. The means of physical education should therefore ensure a comprehensive influence on the motor sphere of the child. For China this problem is relevant in connection with the need to increase the motor activity and physical fitness of schoolchildren [6, 7].

Objective of the study is to examine the pedagogical potential of sports games in the motor development of children and adolescents in China.

Results of the study and discussion. Sports games represent a complex form of motor activity in which physical, technical, tactical, psychomotor and communicative components are interconnected [1]. They may therefore be used not only for teaching individual motor actions, but also for the comprehensive development of children and adolescents.

In the system of physical education, sports games require account to be taken of age, the level of preparedness, the gradual nature of instruction and the consistent increase in the complexity of the tasks [4]. This is particularly important at school age, when motor skills are at the stage of active formation.

Sports and outdoor games comprehensively develop speed, agility, coordination, endurance, visual-motor reaction, spatial orientation and the general motor base of children and adolescents [1, 2].

For school education in the PRC, the combination of sports and outdoor games is of particular importance. M. Hou regards them as an effective means of the physical development of learners aged 12-15 years in the system of school education in China [5]. This confirms the expediency of using game forms not only in sports preparation, but also in physical education lessons.

Sports games, in the opinion of V.I. Lyakh, develop coordination abilities through the need to react quickly, to restructure movements, to choose a position and to take motor decisions [3].

Sports games may be regarded as a means of increasing the motor activity of schoolchildren and their interest in physical culture. According to the data of Y. Liu, the problem of the insufficient physical activity of children and adolescents in the PRC remains relevant

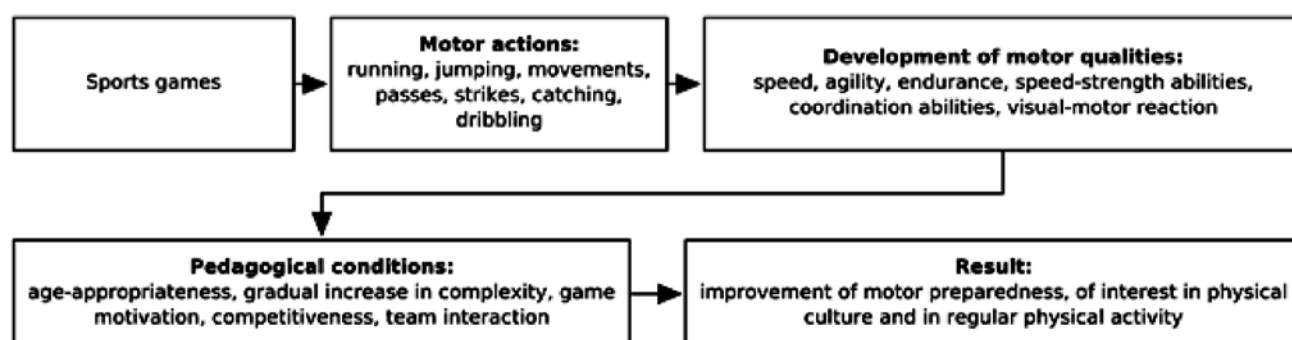


Figure. The pedagogical potential of sports games in the motor development of children and adolescents in the PRC (compiled by the author)

[6]. The study of Z. Zhu and co-authors also shows the need for the further improvement of the physical fitness of Chinese schoolchildren [7].

On the basis of an analysis of the scientific and methodological literature, the pedagogical potential of sports games in the motor development of children and adolescents in China may be presented in the form of a sequential scheme reflecting the connection between the content of the game activity, the motor qualities and abilities developed, the pedagogical conditions of the organisation of the sessions and the expected result (see the Figure).

The effectiveness of sports games depends on taking into account the age and preparedness of the learners, the gradual increase in the complexity of the tasks, the dosing of the load, competitiveness and the preservation of game motivation.

At the initial stage it is expedient to use outdoor games, relay races and simple ball games. At the age of 10-12 years a wider application of mini-football, basketball, badminton, table tennis and simplified forms of volleyball is possible. In adolescence the importance of educational and training games, team tasks and competitive forms increases.

Conclusions. Sports games possess considerable pedagogical potential in the motor development of children and adolescents in China. Their application contributes to the development of coordination, speed, agility, endurance and visual-motor reaction. In school physical education in China they are an effective means of increasing the motor activity and the interest of learners, provided that account is taken of age, that the complexity of the tasks is increased gradually and that game motivation is preserved.

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Improving the physical preparation of football players of student teams in the people's Republic of China

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Abstract

Objective of the study is to examine the problem of improving the physical preparation of football players of student teams in the People's Republic of China (PRC).

Results and conclusions. It is shown that contemporary football places high demands on the development of endurance, speed, speed-strength abilities, coordination and special playing working capacity. It is noted that in the conditions of student football the training process is complicated by the academic workload, the heterogeneous level of the players' preparedness and the limited volume of training time. The need for the comprehensive construction of physical preparation with account taken of competitive activity and of the specific nature of student teams is substantiated.

Keywords: *football, student teams, the PRC, physical preparation, endurance, speed-strength qualities, playing working capacity.*

Introduction. Physical preparation is one of the leading aspects of the preparation of football players, since it ensures the ability to perform playing actions effectively under conditions of high intensity, duels, accelerations, changes of direction of movement and increasing fatigue. In football, physical qualities are manifested not in isolation but in interconnection with the technical and tactical actions of the player [1, 2].

For the football players of student teams in the PRC this problem is of particular relevance. On the one hand, student football requires a sufficient level of special working capacity and readiness for competitive activity. On the other hand, the preparation of student footballers is carried out under conditions of academic workload, limited training time, varied sporting experience and an unequal level of the players' physical preparedness.

Objective of the study is to examine the problem of improving the physical preparation of football players of student teams in the People's Republic of China (PRC).

Results of the study and discussion. Contemporary football is characterised by the variable intensity of motor activity. The player performs a large number of accelerations, decelerations, sprints,

jumps, duels, movements without the ball and actions with the ball. The physical preparation of a footballer should therefore include the development of general and special endurance, speed, speed-strength qualities, agility, coordination and the ability to maintain the effectiveness of playing actions against a background of fatigue [3, 4].

Works on the theory and methods of football emphasise that physical preparation should be connected with the real structure of competitive activity. This means that the exercises should not only develop individual physical qualities, but should also ensure their transfer into playing actions: accelerations, making space, pressing, competing for the ball, shots, passes and changes of direction of movement [1, 2].

In student teams in the PRC, physical preparation has a number of specific features. The players combine academic and sporting activity, which limits the volume of training time and requires a rational selection of the means of preparation. In addition, the composition of student teams is often heterogeneous, since some of the footballers have experience of specialised preparation, whereas others possess predominantly a basic level of physical and technical readiness.

Table. Problem aspects and directions for improving the physical preparation of the football players of student teams in the PRC (compiled by the author)

Conditions of preparation	Problem areas	Ways of improvement
Academic workload	Shortage of time for preparation	Rational selection of the means of preparation
Different level of preparedness	Heterogeneity of physical abilities	Individualisation of training loads
Competitive activity	Decline in the effectiveness of actions under fatigue	Development of special endurance
Playing specificity of football	Weak connection between general and special physical preparation	Integration of physical and playing exercises

Among the principal problems of the physical preparation of the football players of student teams in the PRC are the insufficient individualisation of training loads and the weak connection between general and special preparation. This requires account to be taken of the differences in the level of endurance, speed, strength preparedness and recovery of the players, as well as a gradual transition from general developmental exercises to specialised means, for example repeated accelerations, interval tasks, exercises with changes of direction of movement and playing tasks in a restricted area.

The study of H. Jia shows the need for the scientific monitoring of the physical fitness of football players in the PRC and for the development of objective criteria for assessing speed, agility, jumping ability and other indicators [5]. The data of research on student football also confirm that purposeful physical preparation contributes to increasing the physical fitness and competitive effectiveness of players [6].

On the basis of an analysis of the scientific and methodological literature, the main problem aspects of the physical preparation of the football players of student teams in the PRC were identified and the directions of its improvement were determined (see the Table).

The principal directions for improving the physical preparation of the football players of student teams in the PRC are the development of general and special endurance, the increase of speed and speed-strength abilities, the improvement of coordination and agility, and the inclusion of physical exercises in the structure of playing tasks. Of particular importance are playing tasks in a restricted area, interval exercises with the ball, repeated accelerations, tasks involving changes of direction of movement and exercises modelling competitive situations.

The effectiveness of the physical preparation of student footballers depends on taking into account their academic commitments, level of preparedness, playing position, competition calendar and recovery. In this connection the training process should be not

only comprehensive but also flexibly manageable.

Conclusions. The problem of improving the physical preparation of the football players of student teams in the PRC is connected with the need to take into account simultaneously the demands of contemporary football and the conditions of student sporting activity. The physical preparation of the football players of student teams in the PRC should take into account the limited training time, the heterogeneity of the composition of the teams and the need for the individualisation of the load. Its improvement should expediently be carried out through the comprehensive development of endurance, speed, speed-strength qualities, coordination and special playing working capacity in connection with technical, tactical and playing tasks.

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Social support as a strategic factor in the integration of young athletes into the social environment

UDC 796.01



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Abstract

Objective of the study is to identify the factors impeding the social support and social integration of young athletes.

Methods and structure of the study. The principal method of collecting empirical data was an online survey of 78 coaches and methodologists of the «Sambo-70» Centre for Sport and Education. A questionnaire was developed which included the study of the factors impeding social integration and of sports educators' assessment of the measures of social support for young athletes.

Results and conclusions. The greatest difficulties of the social integration of young athletes are the disruption of the balanced relationship between sport and education, the absence of plans for the future, and chronic overload and stress as a consequence of systematic physical loads. Of the greatest significance among the measures of social support are the creation of opportunities for obtaining an education and the implementation of educational programmes with a flexible timetable.

Keywords: *system of preparing the sports reserve, social integration, social support, coaches and methodologists in the various sports, centre for sport and education.*

Introduction. Effective social support and accompaniment is a most important condition of the psychological well-being, sporting self-realisation and harmonious integration of the personality of young athletes into all spheres of social life. Alongside sports participation, particular importance in this context attaches to the education of young athletes, regarded not only as the intellectual basis of socialisation but also as a strategic factor of integration into the social environment connected with sport [3].

An integral component of the integrated system of sport and education is considered to be Olympic education, which conditions the growth of scientific interest in the problem of the social integration of athletes on the part of the international academic community.

Contemporary research emphasises the importance of psychological and social support in building a sporting career [1]. Increased attention is paid to questions of mental health, stress and emotional burnout, which are critical aspects of the process of

the socialisation of young athletes. Inclusion in the social environment is connected with the study of the distinctive features of the social adaptation of athletes at the various stages of sports preparation.

Despite the available scientific data, more detailed study is required of the questions of sports educators' understanding of the processes of the social formation of young athletes at the various stages of sports preparation, with account taken of the influence of the educational and training environment and of social upbringing; of the analysis of the effectiveness and content of integrated programmes of sporting, educational and leisure activity; and of the identification of the principal needs, ideals and motives of adolescents in the context of the sport they are mastering.

Objective of the study is to identify the factors impeding the social support and social integration of young athletes.

Methods and structure of the study. The principal method of collecting empirical data was an anony-



mous online survey based on a specially developed questionnaire covering the main aspects of coaches' assessment of the measures of social support, of the factors of social problems and of the factors impeding the social integration of young athletes. The questionnaire included questions with closed answer options (with multiple-choice options and rating scales for quantitative analysis), as well as questions with open answer options, making it possible to obtain in-depth data and to clarify the positions of the respondents.

A five-point rating scale was used to analyse the respondents' opinions on the significance of the various types of social support for young athletes: 1 – not significant; 2 – of little significance; 3 – moderately significant; 4 – sufficiently significant; 5 – very significant.

Descriptive statistics were used to summarise and present the results, including frequency analysis, the calculation of mean values and percentages, and the calculation of the chi-squared test (χ^2). The data analysis was carried out using Microsoft Excel and Statistica software.

Results of the study and discussion. The objective factors impeding the conduct of socialisation measures are subject to careful analysis with the aim of developing measures to overcome them, ensuring the effective realisation of socialising initiatives.

The ratio of the subjective judgements reveals sports educators' recognition of the obligatory nature of stable, comprehensive and officially established state support, creating a systemic basis for the successful social integration of young athletes.

The most significant factors of opposition were designated by the respondents as limited funding (38.6 %) and the absence of interest on the part of the athletes themselves (20.4 %).

The majority of the respondents noted the importance of integration into the social environment (45.6 %) and of the ability to combine sports participation with other spheres of life (32.5 %). The integration of sport with the educational, career-guidance and

personal spheres was regarded as a key condition of successful socialisation and as a significant factor of participation in all spheres of social life apart from sport. This approach reflects the concept of the dual orientation of a sporting career [2]. The absence of a common conceptual basis leads to a limited understanding of socialisation as being founded merely on the provision of financial support or psychological assistance, which in turn reduces the efforts to develop comprehensive programmes of the social integration of athletes, so that they do not correspond to the athletes' real requests and needs.

As the principal causes of the difficulties identified, those surveyed most often indicated the high level of stress experienced and the absence of free time (61.4 %), as well as the absence of state programmes of the socialisation of young athletes (36.8 %).

In general terms, the development of effective measures of social integration presupposes not only the identification of the key problem issues faced by athletes, but also the development of constructive forms of their social support.

According to the assessments of the sports educators, of the greatest significance among the measures of social support are the creation of opportunities for obtaining an education ($M = 4.3$), the implementation of educational programmes with a flexible timetable ($M = 3.8$) and career guidance with the choice of a profession ($M = 3.5$). The respondents thus noted the significance of practical forms of social support that ensure integration into social life already in the process of active sports participation and that contribute to further professional self-realisation.

The study reveals the pro-social role of the state in the process of the social adaptation of young athletes. The respondents express confidence in the need for the active participation of state structures, above all in the funding of the process of socialisation (46.4 %) and in the creation of opportunities for obtaining an education in parallel (24.6 %).

Table 1. Factors impeding social integration

Factors of negative influence	Number of responses	
	n	%
Limited funding	48	61.4
Insufficient number of specialists	8	9.8
Absence of state support	12	15.8
Absence of interest on the part of the athletes themselves	29	36.8
Absence of interdepartmental coordination	18	20.7



Table 2. Assessment of the significance of the measures of social support for young athletes

Form of support	Score					M
	1	2	3	4	5	
Individual consultations with a psychologist	2	20	26	18	12	3.2
Educational programmes with a flexible timetable	3	6	17	26	26	3.8
Courses on developing communication skills	6	9	13	27	23	3.4
Participation in volunteering or social projects	9	18	23	18	10	3.0
Mentoring programmes run by former athletes	7	18	22	14	17	3.2
Psychological support	7	15	23	16	17	3.3
Career guidance and choice of a profession	6	10	19	24	19	3.5
Creation of opportunities for obtaining an education	4	0	7	24	43	4.3

In the list of the principal causes of the difficulties of social integration that arise, the leading factor identified was insufficient attention on the part of state and municipal structures to the social support of young athletes (37.3 %). The demand on the part of the sporting community for systemic, legally established state participation extending beyond individual measures is thus objective in character.

Conclusions. The principal participant in the process of socialisation is perceived to be the state bodies responsible for the funding and implementation of the training and educational programmes of young athletes.

The greatest difficulties faced by young athletes in the context of social integration are the disruption of the balanced relationship between sport and education, the absence of plans for the future, and overload and stress. Of the greatest significance among the measures of social support are the creation of opportunities for obtaining an education, the implementation of educational programmes with a flexible

timetable, and career guidance with the choice of a profession.

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Sports cinema as a factor in the integration of sports into popular culture

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Abstract

Objective of the study is to study sports cinema as a separate genre, to compare various historical processes in popular culture, in which Cinema transforms the perception of sport from a highly specialized activity to a universal cultural code.

Methods and structure of the study. Using comparative analysis, structural-logical methods, and content analysis of open sources, we explored the role of sports cinema in popular culture both internationally and in developed countries.

Results and conclusions. Since Hollywood played a leading role in world cinema, setting the tone and standards for quality filmmaking, genre formats also relied on Hollywood films, which popularized sports themes within established film genres. However, sports cinema in developed countries is based on studio policies, public demand, and government support.

Sports cinema allows us to consider not only genre films and documentaries, but also sports motifs in other genres and, accordingly, their integration into popular culture, which is expressed in the functions of sports films include myth-making (creating heroic narratives), socializing (transmitting values), and commercialization. Sports and film festivals are held by countries as platforms for cultural exchange, and sports films, in turn, allow them to reflect sociocultural processes, convey certain ideals and norms of society, shape or break social stereotypes, and highlight cultural specifics that reflect regional history through the prism of sport. The interrelationship between cinema and popular culture has led to the popularization of sports, and therefore a healthy lifestyle, as well as established, traditional, and new sports.

Keywords: *sports cinema, popular culture, sport, sports theme, society, kinds of sports, cinematography, film, sports-related topic.*

Introduction. Sport, originally a field of physical improvement and competitive practice, had by the end of the 20th century firmly established itself as a crucial element of global popular culture. This transition was driven by the development of digitalization and globalization, which has seen popular culture embrace digital and video content (cinema, TV series, reality shows, vlogging, short video formats), the music industry, popular literature and comics, internet culture (social media, memes, gaming and streaming platforms), sport as entertainment, as well as brands and fashion [6].

In popular culture, the ongoing process of conceptualizing sport in works of art, as in cinema, plays a special role, as cinema, with its widespread recognition due to its broad public reach, possesses a powerful potential for emotional impact and the ability to create large-scale visual images. Since mass culture

is not only a consumable product but also one that actively influences consciousness, sports cinema demonstrates exemplary social relations to society, and athletes as products of the internalization of the objective premises of their eras [3]. This is precisely why films about sports, especially in Soviet society, served educational, propagandistic, and value-forming functions.

The relevance of the study is determined by the need to study the mechanisms of cultural diffusion, where sport acts as an object, and cinema is an effective mediator of its penetration into the everyday life of society.

Objective of the study is to study sports cinema as a separate genre, to compare various historical processes in popular culture, in which Cinema transforms the perception of sport from a highly specialized activity to a universal cultural code.



Methods and structure of the study. The study utilized a mixed-methods approach, combining quantitative and qualitative methods, to examine the place of sports cinema in popular culture globally and in developed countries, including an analysis of contemporary Russian sports cinema and its connection to broader political and ideological messages as factors shaping cultural society.

Results of the study and discussion. Sociologist D. Bell defines mass culture in post-industrial and information societies as a specific way of organizing everyday consciousness through the construction of a specific system of signs and language, serving as a means of achieving mutual understanding among all members of society [2]. Cinema is perceived as a leisure activity, therefore, the sports genre is adapted using certain cinematic tools not only to foster the interconnectedness of social elements but also to promote the perception of the ideological values of sport in the life of society.

In his study, "Sport, Cinema and the Modern World," Neil Archer examines the relationship and broader implications of two of the most popular cultural practices to emerge since the late 19th century: cinema and sport, arguing that the sport genre belongs uniquely to the modern stage of cinema's development. Such modern technologies create the conditions for the emergence of cinema alongside sport, and argues that sport is a phenomenon that then defines and shapes cinematography [8].

Globally, sports films are created based on the director's national and personal identity. Hollywood cinema, which has ingrained sports films into its pop culture, plays a special role in cross-cultural storytelling [8]. Therefore, the more popular a film, the greater the influence of its plot and characters on popular culture. Indeed, any film, as a commercial product, strives to achieve maximum box office receipts and enter the global market. Therefore, film copyright holders strive to identify public preferences to generate demand. Cultural integration generates commercial impact. A successful film can spark a sharp surge of interest in the sport it depicts. For example, after the release of the first Rocky film (1976), the United States saw a significant increase in the number of people involved in boxing and running. A similar effect was produced in the Russian Federation by the film Going Vertical («Three Seconds», 2017), which sparked a new wave of interest in basketball. Events dedicated to sports films create platforms for cultural dialogue and com-

munity building. They celebrate shared human experiences and support emerging artists, increasing fan and artist engagement. For example, the International Sports Film Festival (ISF) is held with the support of the Russian Ministry of Culture and the Moscow Department of Sports to promote awareness of sports heroes through cinema, support and award the best Russian and international films, and ensure broad audience access to sports films.

US film industry policy is based on the preferences of society and culture. At the same time, there is opposition to Hollywood cinema within the global film community, as Hollywood's genre-creation model is based on a strong studio strategy and intercompany competition. It is not based on external influences, but solely on the cultural space of autonomous film production. This differs from the model of independent film studios in the US and other countries, which strive to preserve cultural identity and resist the dominance of American cinema since World War I.

The United States popularized sports not only in cinema but also on television, as sports are ubiquitous in the American and foreign audiovisual space, where American audiovisual products are also widely broadcast. Such activity is not observed in European countries. For example, France is not oriented toward and does not follow an industrial cultural strategy like the United States. In this context, distinct from the studio, the process of genre creation also undergoes expansion, but it adds new features and characteristics, sometimes achieved by blending national and American elements, to existing national genres [9]. In the context of the French market, this concept has no clear structure. Thus, so-called "boxing films" refer both to comedic works and to fights broadcast in cinemas for two weeks after release.

However, Hollywood films have created a viewer's desire for entertainment content, while sports documentaries lack sufficient audience demand. Therefore, sports in cinema is complemented by other genres. That is, the theme of sports exists between genres that emerged from previously established categories. For example, American scholars offer the following list of well-known categories, based on the work of Tim Dirck and other American researchers: action, adventure, comedy, crime/gangster, drama, epic/historical, horror, musicals, science fiction, war films, westerns [8]. Most of these genres emerged at the end of the silent film era: melodrama, western, horror, comedy, action, and adventure, from adventure films to war



films. The growth in the number of films and their diversity, associated with different audiences, prompted analysts to develop subcategories that can also be defined by plot structure – that is, by characters, plot, and context, thereby stratifying genres [4].

This is why the sports film genre occupies an intermediate position, as it is not defined by a plot or theme. Most often, sport is used as a key component of the script, leading to the formation of subcategories such as sports drama, sports biography, sports comedy, etc. However, modern researchers [4, 18, 10] define sports films as a separate category. This has been facilitated by the increasing importance of sports films in European cinematography, both in terms of the number of films released and their influence on global society [4]. Therefore, considering genre as a product of the interaction of language (film product) and institution (sport), it is necessary to identify the attributes of this art form, which include aesthetic, ideological, and socio-economic aspects, which undoubtedly have a significant mutual influence on popular culture and the development of various sports.

Sports films act as a mythologizing tool for the creation and maintenance of cultural myths. Sports cinema successfully exploits archetypal plots, adapting them to contemporary realities. The concept of the "hero's journey," developed by American researcher Joseph Campbell in his book "The Hero with a Thousand Faces" (1949), serves as the basis for describing the biographies of athletes and the stories of team victories [5]. Sports films often employ elements of this framework, in which the hero goes through a series of stages, experiencing internal and external transformations. This idea can be seen in films such as *Any Given Sunday* (1999), in which a coach unites the team and leads them to victory, and *Moneyball* (2011), in which a baseball team overcomes challenges on the way to its goal.

Since sports cinema encompasses a broader concept, encompassing sporting motifs across various film categories, it can be argued that sports films have also influenced the fashion industry. Iconic film characters like Rocky Balboa, who popularized the hoodie, and Bad News Bears have become style icons thanks to their unique outfits and accessories. Fashion choices depicted on screen often become trends that permeate mainstream fashion, demonstrating the influence of sports films on popular culture beyond the world of sports. Furthermore, the sports fashion industry thrives on fan engagement, making storytelling

a key factor in entertainment. Films inspire merchandise creation, public events, and foster sports fandom that extends far beyond live game broadcasts – a phenomenon well-documented in studies of the transformation of fan experiences on matchday.

The promotion of films becomes a subject of international competition among various countries through the visualization of their achievements on global screens and at festivals. Thus, sports films have influenced not only popular culture within the country in which a particular sport dominated, but also played a significant role in the popularization of international sporting events. Sports games have acted as a tool of cultural capital in the international arena, where the Olympic Games became the pinnacle of the politicization of international sporting competitions, which influenced the content of films [4]. Films such as: "2 Chariots of Fire" (1981), "Going Vertical" (2017), "The Gabrielle Douglas Story" (2014), celebrated the Olympic Games, capturing the spirit of sportsmanship and showcasing the diverse range of athletic talent from around the world. These films sparked interest in the Olympic Games and other international competitions, generating enthusiasm and support on a global scale [7].

Importantly, films explore the identity of athletes as community leaders [2]. Cinema creates a pantheon of new heroes whose names become household words. Athletes like Muhammad Ali, Michael Jordan, and Valeri Kharlamov are immortalized not only through their achievements but also through their on-screen portrayals: Ali (2001), the documentary series *The Last Dance* (2020), and *Legend No. 17* (2013), which shape their iconic status for generations to come. Sports films often address racial, social, economic, and gender issues through the lens of sports storytelling, becoming platforms for cultural dialogue. They help challenge stereotypes and give voice to marginalized communities, expanding public discourse.

Sociologist A. Miller believed that "...from the late 1920s until the beginning of World War II, the genre of sports films appeared on the American college campus, significantly influencing the formation of the American dream" [10, p. 1222]. One of the factors that influenced the spread of college football films in the United States in the 1930s was the fact that scholarships for students from lower social classes have become more accessible [10]. Moreover, sports cinema serves an important socializing function, conveying key values to society: discipline, the will to win, re-



spect for the opponent, and the importance of teamwork, which are absorbed by the audience much more effectively than through direct propaganda, since cinema is perceived as a leisure activity. Sports films begin to construct an idealized image of an athlete who overcomes not only physical but also social barriers. An example is the Rocky franchise (1976-2018), in which the main character, Rocky Balboa, personifies the "American dream." Through perseverance and hard work, he rises from the social bottom to the heights of fame. This narrative goes far beyond boxing, becoming a universal story about the strength of the human spirit. Thus, the depiction of sports in cinema becomes a metaphor for life's struggle, understandable to any viewer, regardless of their knowledge of a particular sport.

Representations of overcoming trauma and defeat are particularly important. For example, the film *Moneyball* (2011) shifts the focus from physical strength to intellect and strategy, expanding the concept of victory. The underdog stories in *Miracle* (2004), about the US hockey team, inspire hope and belief in the possibility of success despite the odds, which resonates with a wide audience.

In a given nation, at a given time, one or another sport dominated, and various factors (social and sporting preferences, stereotypes, mentality, the director's vision, censorship in individual countries, political directions, etc.) determined different approaches to the storyline and the main idea of the film [7].

At different periods, cinema has emphasized different sports. For example, in the Russian Federation, the film *"Ice"* (2017) popularized women's figure skating; in the UK and US, *"Rush"* (2013) celebrated auto racing; *"Chariots of Fire"* (1981) celebrated track and field; and sports dramas often combined features of other genres (musicals, war films). Thus, sports cinema strives to create new or eliminate old cultural trends, influencing public perceptions of sports, introducing or showcasing the development of new sports, challenging stereotypes, and revealing new facets of this phenomenon.

Films can present sport not only as a physical activity but also as a complex social phenomenon, encompassing emotional challenges, internal conflicts, and social aspects. Contemporary Russian cinema has seen a trend toward reimagining elements of Soviet style, combining features of sports genres with family saga narratives and war film motifs. Furthermore, contemporary sports cinema actively explores

themes of inclusivity and gender equality. For example, the American film *"A League of Their Own"* (1992) or more recent films about women's sports, such as the Indian film *Mary Kom* (2014), touch upon the important social issue of female inequality, contribute to the destruction of stereotypes and popularization of previously marginalized areas, integrating them into the mainstream.

The representation of sports in cinema can reflect large-scale social changes, political shifts, and shifts in societal values. Indeed, sports films can convey the values of patriotism, collectivism, mutual support, and mutual assistance to mass audiences. For example, Russian cinema emphasizes such values as patriotism, collectivism, mutual support, mutual assistance, self-realization, and personal responsibility for results. Unlike some Western projects, which may emphasize talent or charisma, Russian sports films emphasize the importance of hard work, regular training, and a strong character. Moreover, the sociocultural values conveyed to viewers vary depending on the historical context.

At the federal level, the sport is an integral part of culture and serves as a tool for shaping a national idea. Russia has adopted ideological principles regarding sports from Soviet cinema, including the desire to showcase the country's leading role in all forms of activity, including the Olympic Games, to the global community through the lens of cinema. Therefore, Russian films are eligible for support from the Ministry of Culture, and the sports genre, with its patriotic significance, enjoys special privileges, reflected in the organization of festivals and the provision of state support for projects in this field.

Conclusions. Sports in cinema has evolved from a documentary and adaptation to public demand to a vehicle for ideology and social need for mass audiences. Cinema is becoming a catalyst that launches marketing processes and facilitates the institutionalization of sports to a new level of popularity.

Sports cinema plays a key role in integrating sports into popular culture, fulfilling several functions: popularizing sports, shaping values and norms, influencing public consciousness, and creating new cultural trends. In the context of the state's contemporary demand for patriotic values, sports cinema is becoming the ideal medium for its embodiment. Russian scholars note that the film industry, in general, is today the most vibrant manifestation of popular art, as it is accessible to viewers, most powerful in terms of impact



due to its multimodality, and is also socially significant [1]. The Russian Ministry of Culture participates in the development of sports cinema by organizing festivals and, in some cases, by providing state support for projects in this area.

An analysis of the role of sports cinema suggests that it is not simply a reflection of reality, but an active factor in shaping the cultural landscape. Through mythologization, the transmission of values, and commercial stimulation, cinema effectively integrates sport into the core of popular culture. It transforms sporting events and personalities into universal symbols, understandable without special training, and creates a strong public demand for sports-related content. As a result, the boundary between professional sports as an industry and sports as an element of everyday culture is blurred, making them an integral part of modern life.

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Effectiveness of the introduction of children's fitness technologies into the training process of sports sessions with children of preschool age

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Abstract

Objective of the study is the empirical confirmation of the effectiveness of the introduction of children's fitness technologies into the process of training children at the initial stage of preparation in technically complex sports.

Methods and structure of the study. Methods of the analysis and synthesis of theoretical research and of programmes and a survey of coaches ($n=62$) were used; ranking and testing were carried out, and methods of mathematical statistics were applied. In 2024-2026, on the basis of the children's and youth sports schools of Saint Petersburg, 4 educational experiments in different sports were conducted, in which 114 children aged from 5 to 7 years took part.

Results and conclusions. In the course of the study, by means of a comprehensive analysis of training programmes, a retrospective review of scientific and methodological sources and a sociological survey (questionnaire) of respondents from among the coaching staff, the identification was carried out of the priority physical abilities determining success in competitive activity in the seven most representative technically complex disciplines.

The results of the survey of the coaching staff testify that the content of the training process at the stage of initial preparation objectively demonstrates the need for the modernisation of pedagogical approaches, the introduction of innovative technologies and the revision of established methodological stereotypes, determined by the deterioration of the somatic status of the contemporary child population. In the course of the studies conducted, the most significant motor abilities and specific (sensorimotor) qualities significant for the seven most widespread sports were identified. The expediency of integrating the means of children's fitness into the structure of the training sessions of young athletes is empirically substantiated, with the aim of exerting a selective influence on the coordination and conditioning abilities that are of priority for the particular specialisation, which will ensure the optimisation and increased effectiveness of initial sports preparation.

Keywords: *technically complex sports, children's fitness, preschool children, programme and methodological support, motor abilities.*

Introduction. In many technically complex sports the age of recruitment of children into sports sections has changed substantially at the present stage. Beginning training at preschool age is conditioned by the need for the lengthy mastery of specific motor abilities and for the creation of a foundation for subsequent technical improvement. However, in the practice of the sports and health-improving preparation of children of this age there are practically no scientifically substantiated programmes taking account of the psychophysiological features of this population [7].

An analysis of the scientific and methodological literature and many years of coaching experience show

that, although individual aspects of the application of general developmental and specially preparatory exercises for preschool children have been sufficiently studied, a systemic approach to designing the content of sessions at this stage of training has still not been developed.

Coaches often mechanically transfer the content of the programmes of initial sports preparation to sessions with children aged 4-7 years, which leads to an unjustified forcing of loads, a growth in injuries, a decline in motivation and the premature dropping out of participants from the sports section [2]. Parents, lacking objective criteria of effectiveness, not infrequently



orient themselves towards external results, which aggravates the situation and creates additional pressure on the child and the coach.

Thus, in the practice of preparing young athletes in technically complex sports the following contradictions may be identified: between the striving of coaches to retain their cohort and the unjustified copying of training methods intended for adult athletes; between the wish to identify gifted children and the forcing of loads leading to early illnesses, technical errors and sometimes injuries; and between the expectations of parents and the absence of adequate ideas about age norms and the real capabilities of their children.

In recent years an active introduction of fitness technologies and children's fitness programmes into the sphere of children's sport has been observed [4, 5, 6]. Such directions as dance and game gymnastics, fitness aerobics and others offer a variety of means and methods adapted to the age features of children. A child's activity should be varied, interesting and engaging, and fitness programmes may be used at the stage of initial preparation both to optimise the development of the most significant physical qualities and as an instrument of the health-preserving development of the personality and of the formation of an interest in sporting activity [4, 5 and others].

Objective of the study is the empirical confirmation of the effectiveness of the introduction of children's fitness technologies into the process of training children at the initial stage of preparation in technically complex sports.

Methods and structure of the study. Methods of the analysis and synthesis of theoretical research and of programmes and a survey of coaches (n=62) were used; ranking and testing were carried out, and methods of mathematical statistics were applied. In 2024-2026, on the basis of the children's and youth sports schools of Saint Petersburg, 4 educational experiments in different sports were conducted, in which 114 children aged from 5 to 7 years took part.

Results of the study and discussion. In the course of the study, by means of a comprehensive analysis of training programmes, a retrospective review of scientific and methodological sources and a sociological survey (questionnaire) of respondents from among the coaching staff, the identification was carried out of the priority physical abilities determining success in competitive activity in the seven most representative technically complex disciplines. On the basis of the empirical data obtained, a hierarchical structure of the significance of the qualities identified was constructed, the results of the ranking of which

Table 1. Ranking of the priority physical and special abilities in technically complex sports

No.	Motor abilities / special qualities	PLACE						
		Acrobatic rock and roll	Ballroom dancing	Sports aerobics	Artistic gymnastics	Rhythmic gymnastics	Synchronised swimming	Figure skating
Motor abilities								
1	Coordination of movements	1	1	1	1	1	1	1
2	Strength	4	6	2	2	3	3	3
3	Flexibility	3	3	3	3	2	2	5
4	Speed	5	4	5	5	4	5	4
6	Endurance	2	5	4	6	6	6	6
7	Vestibular stability	6	2	6	4	5	4	2
Special qualities								
1	Emotionality	3	2	1	5	4	3	5
2	Musicality	1	1	4	3	1	2	2
3	Sense of rhythm	2	3	2	1	3	1	1
4	Artistry	4	5	3	4	2	5	4
5	Choreographic ability	5	4	5	2	5	4	3



are systematised in Table 1.

According to the results of the ranking of the survey responses, for each sporting discipline the dominant rank belongs to the coordination abilities. Then, in descending order, follow flexibility, strength, vestibular stability and speed, while the lowest rank is assigned to the factor of endurance, which indicates its least representation in the structure of preparedness in comparison with the qualities listed above. These data are consistent with the results of the research of other authors, who note the leading role of coordination abilities in technically complex sports [1, 5 and others]. Special qualities such as a sense of rhythm (1st place), musicality (2nd place) and emotionality (3rd place) are of very high significance, particularly in sports rock and roll, rhythmic gymnastics and ball-room dancing. Artistry and choreographic ability were placed 4th and 5th, with a small difference between them.

In order to test the effectiveness of applying the means of children's fitness in the training process of young athletes, 4 educational experiments were conducted. In each of them from 28 to 30 children took

part, divided into two groups. In the experimental groups, sets of exercises from various children's fitness programmes (authors – E.G. Saykina, Zh.E. Firileva, S.V. Kuzmina) were introduced into the training process: the dance and game gymnastics programme 'Sa-Fi-Dance,' 'Entertaining Gymnastics,' «Fitness Aerobics» and the fitball aerobics programme 'Dances on Balls' [4]. In the control groups the content of the training sessions included the traditional set of means and methods.

In the course of the trial of the experimental programme for preparing young athletes engaged in sports rock and roll, sets based on a synthesis of the exercises of the dance and game gymnastics programme 'Sa-Fi-Dance' and of fitness aerobics were introduced into the training. The main emphasis of the exercises applied was shifted towards the correction and progressive development of the specific motor skills determining a high result in this sport. A positive gain was obtained in many indicators. The results proved to be significantly higher in the experimental group in comparison with the control group (Table 2).

The inclusion of the means of children's fitness in

Table 2. Results of the educational experiment on the application of the means of fitness in the training process of young rock and roll dancers (5-6 years)

No.	Motor abilities / tests	CG (n=14) M±m	EG (n=14) M±m	p
1	Coordination (restructuring of movements) (points)	3.54±0.12	4.21±0.08	< 0.05
2	Strength of the arm muscles (number of repetitions)	11.1±0.85	13.4±0.62	< 0.05
3	Speed-strength (jump, cm)	110.4±3.21	128.6±2.45	< 0.05
4	Strength of the abdominal muscles (number in 1 min)	14.2±0.91	14.5±0.88	> 0.05
5	Flexibility (forward bend, cm)	11.4±0.74	12.6±0.51	> 0.05
6	Speed (frequency of movements, number of repetitions)	18.2±0.44	19.6±0.31	< 0.05
7	Coordination (shuttle run, s)	15.2±0.22	12.7±0.35	< 0.05
8	General endurance	70.0±1.8	75.0±1.6	< 0.05

Table 3. Indicators of the testing of the physical abilities of sports aerobics athletes aged 5-7 years after the educational experiment

No.	Motor abilities	Control group (n=15) M±m	Experimental group (n=15) M±m	P <
1	Vestibular stability (points)	4.28±0.08	4.53±0.08	<0.05
2	Speed (number of repetitions)	19.8±0.5	21.2±0.4	<0.05
3	Coordination of movements (points)	3.78±0.12	3.44±0.10	<0.05
4	Flexibility (cm)	16.5±0.8	18.7±0.6	<0.05
5	Aerobic endurance (index)	63.0±2.4	69.5±1.7	<0.05
6	Dynamic strength (number of repetitions)	15.2±1.0	18.2±0.8	<0.05
7	Static strength (s)	1.08±0.18	1.32±0.22	>0.05
8	Explosive strength (cm)	31.2±1.2	34.7±0.9	<0.05



Table 4. Indicators of the testing of the physical abilities of young rhythmic gymnasts aged 5-6 years after the educational experiment

No.	Motor abilities	CG (n=14) M±m	EG (n=14) M±m	P <
1	Coordination abilities (points)	4.4 ± 0.2	5.0 ± 0.2	<0.05
2	Flexibility (cm)	-3.9 ± 0.4	-5.2 ± 0.4	<0.05
3	Strength of the abdominal muscles (number of repetitions)	26.8 ± 0.7	28.8 ± 0.7	<0.05
4	Coordination abilities: hand motor skills with an apparatus (conv. units)	17.4 ± 0.4	18.6 ± 0.4	<0.05
5	Speed-strength: jumping ability (cm)	134.0 ± 2.5	141.2 ± 2.5	<0.05
6	Aerobic endurance (index)	59.5±1.9	64.0±1.6	<0.05
7	Vestibular stability (s)	7.0 ± 0.2	8.6 ± 0.3	<0.05
8	Speed (s)	7.3 ± 0.17	6.8 ± 0.15	<0.05

the training process of young rock and roll dancers contributed to a statistically significant improvement in the indicators of coordination abilities, of the strength of the arm muscles, of speed-strength qualities, of speed and of general endurance ($p<0.05$). This confirms the effectiveness of integrating children's fitness programmes into the training of athletes of preschool age.

As a result of the second educational experiment involving young sports aerobics athletes, more substantial and significant gains in all the indicators studied were obtained in the EG. Sets of exercises from the programmes 'Entertaining Gymnastics' and 'Fitness Aerobics' were integrated into the work with the experimental group. A comparison of the indicators of the EG and the CG is presented in Table 3.

The application of children's fitness programmes in sports aerobics ensured a significant improvement in vestibular stability, speed, coordination, flexibility, aerobic endurance, and dynamic and explosive strength ($p<0.05$).

The third experiment was conducted in the process of preparing young rhythmic gymnasts (girls aged 5-6 years); the means of children's fitness from the programmes 'Fitness Aerobics' and 'Entertaining Gymnastics' were used in it. Improvements occurred in all

the indicators in the experimental group (Table 4).

The experimental group in rhythmic gymnastics significantly surpassed the control group in all the indicators ($p<0.05$). The most pronounced changes were noted in coordination, flexibility and vestibular stability.

In the fourth experiment, which was conducted with young artistic gymnasts, sets of exercises from the programmes 'Entertaining Gymnastics' and 'Fit-ball Aerobics' were included in the preparation programme. The results obtained for the gain in the indicators of motor abilities confirmed their effectiveness in all the tests ($p<0.05$). The greatest gain was noted in the indicators of flexibility, speed-strength abilities and endurance (Table 5).

Conclusions. Summarising the results of the educational experiments, it may be stated that the application of children's fitness programmes in the training process of young athletes in various technically complex sports ensures a statistically significant improvement in key motor abilities. This is consistent with the opinion of a number of authors [1, 3, 5], who note that fitness may be used in different sports and not only at the stage of initial specialisation but also at other stages of the training process, in order to address both general and particular tasks (warm-up, general

Table 5. Indicators of the testing of the physical abilities of young athletes after the educational experiment (artistic gymnastics)

Indicators (tests)	CG (n=14) M±m	EG (n=14) M±m	P <
Flexibility, forward bend from the starting position of sitting with legs apart (cm)	6.8 ± 0.8	10.7 ± 0.53	<0.05
Coordination abilities, shuttle run (s)	9.18 ± 0.1	8.6 ± 0.17	<0.05
Speed-strength abilities, standing long jump (cm)	135 ± 4.22	150 ± 2.67	<0.05
Strength, press-ups in the prone position (number of repetitions)	12.1 ± 1.92	15.64 ± 1.03	<0.05
Speed-strength abilities, lifting the torso in 30 s (number of repetitions)	15.2 ± 1.07	21 ± 0.98	<0.05
Endurance, 6-minute run (m)	698.18 ± 7.11	822.73 ± 35.45	<0.05



and special physical preparation, emotional release, rehabilitation and recovery).

The study conducted confirms that the introduction of children's fitness programmes into the training process of young athletes at the sports and health-improving stage in technically complex sports is an effective means of developing the priority motor abilities, which is particularly important under the conditions of early specialisation.

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Features of the application of digital technologies in the physical culture sessions of elderly persons

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Abstract

Objective of the study is to identify and substantiate theoretically the features of the application of digital technologies in the physical culture sessions of elderly persons.

Methods and structure of the study. An analysis was carried out of Russian and foreign experience of applying information and intelligent technologies in physical culture and health-improving work with elderly people (more than 150 open web sources); a pilot monitoring of the readiness of elderly participants to use digital instruments was conducted on the basis of the physical culture and health-improving groups of the city of Kazan (376 persons).

Results and conclusions. Generalised groups of digital means were identified according to the character of the health-improving task addressed in the physical activity of elderly persons: means of monitoring functional state and biofeedback, means of organising and accompanying motor activity, means of personalising the load, means of monitoring technique and preventing risks, and communicative assistants.

On the basis of the analysis carried out, the organisational aspects of the effective application of digital technologies in the physical culture and health-improving activity of elderly persons were outlined: the conduct of educational courses in digital literacy, digital consulting, and the provision of the safety, ergonomics, ethics and accessibility of digital technologies.

Keywords: *digital technologies; artificial intelligence (AI); neural networks; health improvement; elderly age; motor activity.*

Introduction. The demographic ageing of the population is one of the important social tendencies of the 21st century. According to the data of the World Health Organisation, by 2030 every sixth inhabitant of the planet will be over 60 years of age, which substantially increases the relevance of the problem of preserving the health, motor activity and quality of life of elderly persons. Systematic physical culture and health-improving activity is recognised as one of the most effective non-pharmacological means of preventing age-related diseases, of slowing down involutional processes and of maintaining the functional state of the body [3].

In parallel with the processes of the ageing of the population, the rapid development of digital technologies is taking place. Of particular significance in recent years are the technologies of artificial intelligence and

machine learning: computer vision systems, large language models and predictive analytics. These instruments open up fundamentally new possibilities for the personalisation of health-improving programmes, for the automated monitoring of the technique of performing exercises and for the monitoring of functional state [1, 2]. At the same time, their application in work with elderly persons requires special pedagogical substantiation, since the effectiveness of technologies is determined not so much by their technical characteristics as by the pedagogical features of their application. It is this that determines the relevance of the present study.

Objective of the study is to identify and substantiate theoretically the features of the application of digital technologies in the physical culture sessions of elderly persons.



Methods and structure of the study. The theoretical basis of the study consists of the concepts of personalised physical activity (Bouchard, Blair, Haskell, 2012) and of gerontopedagogy (V.I. Slobodchikov). An analysis was carried out of Russian and foreign experience of applying information and intelligent technologies in physical culture and health-improving work with elderly people (more than 150 open web sources); a pilot monitoring of the readiness of elderly participants to use digital instruments was conducted on the basis of the physical culture and health-improving groups of the city of Kazan (86 persons).

Results of the study and discussion. Age-related changes in elderly persons affect all the systems of the body: muscular strength, flexibility and coordination abilities decline, cardiorespiratory function deteriorates and neuromuscular transmission slows down. These features require the individualisation of physical loads, the continuous monitoring of state and the provision of safety. Digital technologies, supplemented by the possibilities of artificial intelligence, make it possible to address these tasks at a qualitatively new level [2, 4, 5, 6].

An analysis of the information sources made it possible to identify the following generalised groups of digital means according to the character of the health-improving task addressed in the physical activity of elderly persons.

1. Means of monitoring functional state and biofeedback. Fitness trackers, smart watches, heart rate monitors and balance platforms with sensors ensure the objective tracking of the load, of heart rate, of saturation, of the number of steps and of the quality of movements. Intelligent algorithms of data processing make it possible to identify anomalies in the state of health and to give warning of risks [6].

2. Means of organising and accompanying motor activity. Applications and video platforms (Silver Sneakers GO, MyFitnessPal), as well as game and balance training devices (Wii Balance Board, Nintendo Switch Sports), broaden the accessibility of sessions, increase motivation and overcome territorial barriers.

3. Means of personalising the load. Neural network recommender services (Fitbod, Freeletics AI Coach, FitnessAI), on the basis of data on age, state of health and level of preparedness, form individual training programmes and adjust them as data accumulate.

4. Means of monitoring technique and preventing risks. Computer vision systems (MediaPipe, OpenPose, YOLO) recognise the movements of the par-

ticipant from the video stream and assess the technique of performing the exercises; predictive analytics (Walabot Home by Vayyar, SafelyYou) forecasts the risk of falls, of exacerbations of chronic diseases and of overloads, which makes it possible to adjust the programme of sessions in good time.

5. Communicative assistants. Yandex's «Alisa» and voice assistants based on GigaChat and ChatGPT accompany the participant, remind him or her of the sessions, answer questions and act as an instrument of digital communication.

On the basis of the analysis carried out, it is possible to update the pedagogical features of the effective application of digital technologies in the motor activity of elderly persons.

1. The organisation and conduct of educational courses in digital literacy. The pilot monitoring showed that 64 % of elderly persons (60+) use smartphones, but only 28 % have independently installed specialised applications, which require basic digital skills.

2. Digital consulting with the aim of personalising the sessions with account taken of the state of health, of developing recommendations, and of pedagogical support and monitoring.

3. The provision of the safety, ergonomics, ethics and accessibility of digital technologies. When using various technological means, the features of the state of health of elderly persons should be taken into account.

For example, the structure of the introduction of technologies into a health-improving session may include:

- the preparatory part – breathing exercises and a warm-up with audio accompaniment, monitoring of heart rate by means of wearable devices;
- the main part – interactive coordination training devices, video models, computer vision systems for the correction of technique;
- the concluding part – relaxation and breathing applications, the recording of the final indicators of heart rate and respiratory rate, the automatic generation of an AI report on the dynamics of state.

This approach ensures the didactic integrity of the session and corresponds to the physiological regularities of the recovery of the body of the elderly person.

Conclusions. Digital technologies, supplemented by the means of artificial intelligence, represent an independent pedagogical toolkit that substantially broadens the possibilities of the health improvement of elderly persons.



The systematisation of technologies into groups makes it possible to integrate them into the sessions in a meaningful way, in accordance with the tasks addressed, and to develop the pedagogical features of their application in the health improvement of elderly people. The prospects of the research are connected with the development and trialling of a methodology for using digital technologies and AI in physical culture and health-improving groups of the 60+ age category, with an analysis of the dynamics of motor activity, of functional state and of quality of life.

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