Improving the effectiveness of serves by elite volleyball players through the differentiation of muscular effort

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Abstract

Objective of the study is to improve the effectiveness of the serve among elite volleyball players by developing their ability to precisely modulate muscle effort through the use of specialised exercise programmes.

Methods and structure of the study. Serve performance indicators were assessed based on competition data: for the main team 'Dynamo-LO' – in the Russian Men's Volleyball Championship, and for the reserve team 'Dynamo-LO-2' – in the Russian Youth League. Parameters characterising technique, situational conditions and the direction of serves among skilled volleyball players were analysed. 10 matches involving leading teams were analysed using the professional software Data Volley 4Pro. The athletes' baseline fitness level was determined through pedagogical testing. The ability to differentiate muscle effort was assessed using a DK-140 hand dynamometer, which allowed for the measurement of the accuracy of reproducing specified force levels (25%, 50%, 75% of maximum effort). The experimental part included specialised exercise blocks aimed at developing upper body strength and force discrimination sensitivity. 24 qualified volleyball players took part in the study.

Results and conclusions. It was established that the qualified volleyball players of the 'Dynamo-LO 2' team perform a placement serve more frequently than a power serve during competitive play. The performance indicators of the skilled volleyball players from the 'Dynamo-LO-2' team show statistically significant differences from those of the players from the 'Dynamo-LO' team across all six analysed characteristics. It was found that it is advisable to identify four narrowly focused sets of exercises for developing the ability to differentiate muscle effort (using TRX loops, resistance bands, medicine balls and volleyballs). Among the skilled volleyball players of the 'Dynamo-LO-2' team, a positive trend was observed in the number of placement and power serves, the effectiveness of their execution, and a reduction in the number of errors during their execution.

Keywords: *muscle effort, volleyball, performance, blocking exercises.*

Introduction. When serving, the ability to differentiate between levels of force determines the quality of the force applied and the accuracy of the strike on the ball [2]. The ability to distinguish spatial parameters is a factor in the accuracy and appropriateness of an athlete's movements in all team sports [1]. This ability is developed through specialised training and correlates directly with the athlete's level of skill [4]. The effectiveness of competitive performance depends directly on the athlete's developed ability to control the parameters of time, space and muscular effort [3, 5].

Experimental, narrowly focused sets of tasks ensure the simultaneous development of strength qualities and the ability to differentiate muscle effort, which has a positive effect on the accuracy and effectiveness of the serve. These indicators of increased effectiveness can serve as benchmarks for structuring the training process.

Objective of the study is to improve the effectiveness of the serve among elite volleyball players by developing their ability to precisely modulate muscle effort through the use of specialised exercise programmes.

Methods and structure of the study. Serving performance indicators were assessed based on competition data: for the first team, 'Dynamo-LO',

in the Russian Men's Volleyball Championship; and for the reserve team, 'Dynamo-LO-2', in the Russian Youth League. Parameters characterising technique, situational conditions and the direction of serves among skilled volleyball players were analysed. 10 matches involving leading teams were analysed using the professional software Data Volley 4Pro. The athletes' baseline level of fitness was determined through pedagogical testing. The ability to differentiate muscle effort was assessed using a DK-140 hand dynamometer, which allowed for the measurement of the accuracy of reproducing specified force levels (25%, 50%, 75% of maximum effort). The experimental part included specialised exercise blocks aimed at developing upper body strength and force discrimination sensitivity. 24 qualified volleyball players took part in the study.

Results of the study and discussion. Table 1 provides a clear overview of the performance metrics for serving between the two volleyball teams.

It has been established that highly skilled volleyball players, regardless of the type of serve they use, execute it with greater effectiveness. The performance metrics of the 'Dynamo-LO' team show statistically significant differences in all six metrics compared to those of the 'Dynamo-LO-2' team.

During the testing (Table 2), baseline indicators of muscle effort differentiation were determined across the volleyball groups, revealing significant differences between the two teams.

We then devised four specialised sets of exercises to develop the ability to differentiate muscle effort (using TRX straps, resistance bands, medicine balls and volleyballs). The load was adjusted by changing the length of the TRX straps, the resistance of the elastic bands, the angle of effort, grip variations, the number of repetitions and sets, and the duration of ball exercises.

The training programme included two exercises from blocks 2, 3 and 4, with 30 minutes allocated to this in the main part of the session. Exercises to develop dynamic strength in the arm muscles (Block 1), lasting 10 minutes, were performed at the end of the main part or at the start of the final part of the session. The indicators of muscle effort differentiation in the volleyball players following the experiment are presented in Table 3.

Table 1. Serving performance of volleyball players in the descriptive experiment

Indicator	Team (X±Sx)	
	Dynamo-LO	Dynamo-LO-2
Number of planned digs	20,22±36,7	75,4±58,08
Conclusion on the difference	p≤0,05	
Number of errors during dig planning	1,4±2,55	5,6±6,5
Conclusion on the difference	p≤0,05	
Effectiveness on planned digs (%)	41,5±31,29	36,85±9,5
Conclusion on the difference	p≤ 0,05	
Number of power digs	80,33±60,5	47,2± 46,5
Conclusion on the difference	p≤ 0,05	
Number of errors during power dig planning	16±12,1	17,6±15,3
Conclusion on the difference	p≤ 0,05	
Effectiveness on planned power digs	38,25±12,8	33,1±10,2
Conclusion on the difference	p≤ 0,05	

Table 2. Indicators of muscle effort differentiation in groups of volleyball players

Indicator	Results (X±Sx)		Student's t-test	P-value	Conclusion regarding differences
	Dynamo-LO	Dynamo-LO-2			
Max. strength (kg)	53,0±7,44	49,92±7,4	2,4	0,004	p≤0,05
Max. strength with eyes closed (kg)	51,6±6,8	46,4±8,9	2,6	0,001	p≤0,05
25% of max. strength	25,58±8,4	19,6±4,8	2,3	0,002	p≤0,05
50% of max. strength	31,5±11,4	27,8±5,95	2,2	0,007	p≤0,05
75% of max. strength	40,5±7,5	37,08±5,74	2,3	0,003	p≤0,05

Table 3. Indicators of muscle effort differentiation during the experiment

Indicator	Period	Results (X±Sx)		Student's t-test	P-value	Conclusion regarding differences
		EG				
		X	Sx			
Max. strength (kg)	Before the experiment	49,92	7,40	-0,9	0,037	p≤0,05
	After the experiment	52,5	6,40			
	Difference	+2,58	-1			
Max. strength with eyes closed (kg)	Before the experiment	46,4	8,9	-0,78	0,043	p≤0,05
	After the experiment	49,08	7,75			
	Difference	+2,68	-1,15			
25% of max. strength	Before the experiment	19,6	4,8	0,84	0,04	p≤0,05
	After the experiment	18,25	3,25			
	Difference	-1,35	-1,55			
50% of max. strength	Before the experiment	27,8	5,95	0,76	0,045	p≤0,05
	After the experiment	26,33	3,20			
	Difference	-1,47	-2,75			
75% of max. strength	Before the experiment	37,08	5,74	-0,65	0,041	p≤0,05
	After the experiment	38,41	4,07			
	Difference	+1,33	-1,67			

Table 4. Group performance (EG) before and after the experiment

Indicator	Team (X±Sx)	
	EG before	EG after
Number of planned digs	75,4±58,08	87,57±32,96
Conclusion on the difference	p≤0,05	
Number of errors during dig planning	5,6±6,5	6,57±3,4
Conclusion on the difference	p≤0,05	
Effectiveness on planned digs (%)	36,85±9,5	46,85±7,88
Conclusion on the difference	p≤ 0,05	
Number of power digs	47,2± 46,5	48,0± 44,49
Conclusion on the difference	p≤ 0,05	
Number of errors during power dig planning	17,6±15,3	13,8±11,19
Conclusion on the difference	p≤ 0,05	
Effectiveness on planned power digs	33,1±10,2	46,9±7,34
Conclusion on the difference	p≤ 0,05	

The indicators of changes in discriminative sensitivity point to statistically significant positive changes, which confirm the effectiveness of the exercise programmes in the training process.

A comparison was made of the final indicators of serving effectiveness in the experimental group (Table 4).

It has been established that the effectiveness of both the planned serve and the jump serve has increased significantly. The number of errors on the jump serve has also decreased.

Conclusions. It has been established that the experienced volleyball players of the 'Dynamo-LO-2' team use the placement serve more frequently than the power serve during matches. The performance indicators of the skilled volleyball players of the 'Dynamo-LO-2' team show statistically significant differences from those of the players of the 'Dynamo-LO' team in all six characteristics analysed.

It has been determined that the dynamometric indicators at 75% of maximum force, relative to the calculated values, show the smallest deviations in both

teams. The task of exerting 55% of maximum force appears to be difficult. The task of exerting 25% of maximum force appears to be the most difficult for the athletes. Deviations in dynamometer readings at 25% of maximum force are greatest in the two teams.

It has been found that it is appropriate to identify four specialised sets of exercises for developing the ability to differentiate muscle effort (using TRX loops, resistance bands, medicine balls and volleyballs). It was established that an increase in maximum hand muscle strength is accompanied by changes in the indicators of muscle effort differentiation at 25%, 50% and 75%.

Among the skilled volleyball players of the 'Dynamo-LO-2' team, a positive trend was observed in the number of float serves and power serves, the effectiveness of their execution, and a reduction in the number of errors during their execution.

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The competitiveness of elite gymnasts during the Olympic cycle amid changes to competition rules

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Abstract

Objective of the study is to determine the impact of the new Competition Rules for men's artistic gymnastics for the 2025–2028 Olympic cycle on results at continental championships and the World Championships.

Methods and structure of the study. The first stage involved analysing changes to the Competition Rules for men's artistic gymnastics for 2025–2028 compared with the previous Olympic cycle. The second stage involved an analytical comparison of the results of leading gymnasts following the XXXIII Olympic Games in Paris and the 2025 World Championships. The third stage involved determining the competitiveness of Russian gymnasts following their admission to International Gymnastics Federation tournaments under neutral status.

Results and conclusions. It has been established that the gymnasts from the top teams at the 2024 Paris Olympics remain leaders in the post-Olympic year. They secured leading positions at continental championships and won a total of six gold medals out of seven at the 2025 World Championships. The modernisation of the competition rules for the 2025–2028 Olympic cycle has led to increased competition between elite gymnasts and less high-level athletes; however, the D score for programme difficulty continues to make a significant contribution to victory. Russian gymnasts managed to win one medal at the World Championships – a bronze for D. Marinov on the parallel bars – whilst demonstrating the team's high potential in the fight for victory and podium places at the next World Championships and the 2028 Olympics in Los Angeles.

Keywords: *international federation, Olympic cycle, elite gymnasts, competition rules (Code of Points).*

Introduction. The technical committees of the FIG (International Gymnastics Federation) present a new edition of the Competition Rules on the eve of each Olympic cycle. Unlike the women's rules, the men's rules for 2025–2028 have undergone radical changes. It is therefore relevant to examine how the world's leading gymnasts have adapted to these significant changes following the continental championships in Asia, Europe and the Pan-American Games, as well as the 2025 World Championships in Jakarta (Indonesia).

Objective of the study is to determine the impact of the new Competition Rules for men's artistic gymnastics for the 2025–2028 Olympic cycle on results at continental championships and the World Championships.

Methods and structure of the study. The first stage involved analysing changes to the competition rules for men's artistic gymnastics for the 2025–2028 period, compared with the previous Olympic cycle. The second stage involved an analytical comparison of the results achieved by leading gymnasts at the XXXIII Olympic Games in Paris and the 2025 World Championships in Jakarta. The third stage involved assessing the competitiveness of Russian gymnasts following their admission to FIG competitions under a neutral status (AIN).

Results of the study and discussion. The post-Olympic year in men's artistic gymnastics was marked, first and foremost, by the results of the 53rd World Championships in Jakarta (Indonesia), where, in accordance with the regulations, there was no team competition. At the same time, the strongest teams were determined at the three 'major' continental championships in Asia, Europe and the Pan-American region [4, 5, 8]. The top teams based on the results of the Paris Games [3]: Japan (1), China (2), the USA (3)

and Great Britain (4) confirmed their dominance at the 2025 continental tournaments (Table 1). However, in online competition, the Asian teams retained the upper hand. Given that three teams – the participants in the 2028 Games in Los Angeles – will be determined at the 2026 World Championships, the four teams mentioned above will be competing there for three team Olympic licences. Naturally, the Russian team could join them, provided they qualify for the World Championships via the 2026 European Championships. However, the European Gymnastics Union, contrary to the recommendations of the FIG, does not yet allow Russian gymnasts to compete in its tournaments. In the individual all-around, among the three winners of the continental championships, the title also went to the Asian representative S. Oka – the overall champion of the 2024 Olympics, who also competed in Jakarta but did not win a medal there (Table 2).

The results of the 2025 World Championships, both in the individual all-around and in the individual events, should be viewed in the light of the changes that the Technical Committee has 'introduced' into the Competition Rules for 2025–2028. The main changes to the Rules include, firstly, a reduction in the number of elements counted towards the total difficulty score (D) from ten to eight [1, 2]. This requirement will, to some extent, level the playing field in the D score – and consequently in the final score for the performance – between elite gymnasts, whose results will be significantly reduced, and less high-calibre athletes. Take, for example, Zhang Boheng, the silver medallist in the all-around at the 2024 Games. At the Olympics, his total score was 86.599 points, with a total difficulty of 36.3 [6], which is significantly lower than the results he achieved (while also finishing second) at the 2025 World Championships (Table 3). Secondly, the desire to increase the difficulty of dismounts, thanks to the bonus for 'special requirements', which is equal to the difficulty (D) of the dismount. A typical example from the World Championships is D. Wittenburg's (USA) victory on the rings. Although not a 'specialist' on this apparatus, he managed to beat three former world champions in the final. This was achieved in part thanks to an extremely difficult dismount – a bent-knee triple back somersault (D = 0.9 points). Here, we should also mention the Russian gymnast D. Marinov, who won the team's only medal at the World Championships – a bronze on the parallel bars – also thanks to

Table 1. Results of the top national teams at the 2025 continental championships

Country							Total
2025 European Championship (Leipzig, Germany, 26–31 May 2025)							
1 United Kingdom (GBR)	42.699	40.199	41.699	43.132	40.433	39.366	247.528
2025 Asian Championships (Jeonju, South Korea, 5–8 June 2025)							
1 Japan (JPN)	42.133	40.799	41.466	42.065	43.098	43.432	252.993
2 China (CHN)	39.099	40.599	42.466	42.366	41.199	42.533	248.262
2025 Pan American Championships (Panama, 12–15 June 2025)							
1 United States (USA)	40.750	38.300	39.500	42.400	40.200	37.650	238.800

Table 2. Results of the top gymnasts at the continental championships and the 2025 World Championships

Gymnast, country							Total
2025 European Championship (Leipzig, Germany, 26–31 May 2025)							
1 Asil Adem (TUR)	13.466/ 4.9	12.833/ 4.5	14.766/ 5.7	14.300/ 5.6	13.500/ 4.8	13.533/ 4.6	82.398/ 30.1
2025 Asian Championships (Jeonju, South Korea, 5–8 June 2025)							
1 Oka Shinnosuke (JPN)	14.333/ 5.4	13.866/ 5.1	14.000/ 5.3	13.866/ 4.8	14.666/ 5.6	14.400/ 5.4	85.131/ 31.6
2025 Pan American Championships (Panama, 12–15 June 2025)							
1 Felix Dolchi (CAN)	13.650/5.5	11.850/ 4.2	13.000/ 5.2	14.200/ 5.2	13.550/ 5.3	13.900/ 5.7	80.150/ 31.1
The 53rd World Championships 2025 (Jakarta, Indonesia, 19–25 October 2025)							
1 Daiki Hashimoto (JPN)	14.000/ 5.3	13.966/ 5.7	13.566/ 5.2	14.466/ 5.2	14.433/ 5.6	14.700/ 5.9	85.131/ 32.9
2 Zhang Boheng (CHN)	13.600/ 5.4	13.700/ 5.2	14.600/ 5.5	14.200/ 5.2	13.933/ 5.2	14.300/ 6.0	84.333/ 32.5
3 Noah Zaifert (SUI)	13.866/ 5.0	14.000/ 5.6	13.066/ 4.2	13.733/ 4.4	14.066/ 5.7	14.100/ 5.7	82.831/ 30.6

Note: The denominator represents the difficulty (D score) of the programmes and jumps.

Table 3. Results in the individual competition and individual all-around events at the 53rd World Championships in 2025

Type of competition	Gold	Silver	Bronze
Individual all-round	Hashimoto D., JPN. [**6**] 85.131/32.9	Zhang Boheng, CHN. [**2**] 84.333/32.5	Zaifert N., SUI. [**21**] 82.831/30.6
	Jarmen J., GBR. [**3**] 14.866/6.3	Whitehouse L., GBR. [**6**] 14.666/6.1	Yulo K., PHI. [**1**] 14.533/5.9
	Hong Yangmin, CHN. [-] 14.600/5.6	Khachatryan M., ARM. [-] 14.600/5.8	Huups P., USA. [-] 14.566/6.0
	Wittenburg D., USA. [-] 14.700/6.0	Asil A., TUR. [**5**] 14.566/5.7	Lan Xinyu, CHN. [-] 14.500/5.9
	Yulo K., PHI. [**1**] 14.866/ 5.6, 5.2 **(0.1)**	Davtyan A., ARM. [**2**] 14.833/ 5.2, 5.2 **(01, 0.1)**	Chepurny N., UKR. [**6**] 14.483/ 5.2, 5.2
	Zou Jingyuan, CHN. [**1**] 15.300/6.0	Tsunoagai T., JPN. [-] 14.500/5.8	Marinov D., AIN. [-] 14.466/5.9
	Malone B., USA. [-] 14.933/6.4	Hashimoto D., JPN. [-] 14.733/6.2	Fraser J., GBR. [-] 14.700/6.3

Note: The denominator represents the difficulty (D score) of the routines and jumps.
In round brackets: bonus points for a clean landing ('on the board');
in square brackets: result at the Games of the XXXIII Olympiad in 2024.

a dismount such as a double back somersault in a tuck position with a 360° twist (D = 0.7 points).

Thirdly, there has been a significant reduction in the base value (D score) of the base jumps. For example, Olympic champion K. Yulo scored 15.116 points in the final in Paris (with a total difficulty score of 11.6 for his two jumps). At the 2025 World Championships, having won this event and performed the same two jumps, their total difficulty was 10.8, resulting in a correspondingly lower final score. Fourthly, these Rules also provide for a new bonus (0.1 points) for a precise landing on all apparatus (with the exception of the pommel horse). At the World Championships, only two gymnasts in the vault final (K. Yulo and A. Davtyan) can be said to have 'benefited' from this bonus. It is possible that this new bonus will be a decisive factor in the future when gymnasts of virtually the same elite level are competing.

Table 3 presents the results of the winners and medallists at the 53rd World Championships in the all-around and six individual events, from which key conclusions can be drawn regarding the performances of potential leaders for this Olympic cycle. Gymnasts from the four leading nations mentioned above won 62% of all the medals awarded. In terms of gold medals, this figure rises to 86% (i.e. six out of seven gold medals). The gymnasts from the USA are particularly noteworthy. For the first time since the 1979 World Championships, two Americans have managed to win individual events. Moreover, B. Malone has become world champion on the horizontal bar for the second time (following 2022). It is worth noting the age range of the champions. On the one hand, 19-year-old Hong Yangmin is a newcomer to the World Championships, whose greatest achievement to date was second place at the 2025 World Cup stage in Doha. On the other hand, 31-year-old veteran D. Wittenburg, for whom this 'gold' is his third medal from World Championships. Moreover, he won his previous medal – a 'bronze' – ten years ago in the vault at the 2015 Championships. Long-standing leaders confirmed their top-class form: D. Hashimoto – world champion in the individual all-around in 2022–2023, overall champion at the 2021 Tokyo Games; Zou Jingyuan – two-time Olympic champion (2021, 2024), world champion in 2017, 2018 and 2022 on the parallel bars [7].

A significant factor in the victory of all world champions in the all-around and individual events, with the exception of the pommel horse, was the difficulty of the routines – a D score that exceeded those of the medallists. Consequently, the trend towards more complex routines, even though they consist of only eight elements scored by the judges, will dominate the 2025–2028 Olympic cycle. Furthermore, the World Championships clearly demonstrated a trend among a number of gymnasts to move away from 'versatility'

towards 'specialisation' in a single apparatus. For instance, the 2025 European all-around champion, A. Asil, competed in only one apparatus – the rings – to win a medal at the World Championships. M. Khachatryan and P. Huups have long been competing in a single priority apparatus – the pommel horse. It is worth highlighting the unfortunate situation involving A. Dolgopyat from Israel – the winner of the 2021 Olympics and the 2023 World Championships in the floor exercise – who could have been in contention for a medal in this event at the World Championships in Jakarta. However, the Indonesian government did not issue entry visas to the country for the entire Israeli delegation, including A. Dolgopyat.

Russian gymnasts, competing under neutral status, performed admirably at the official FIG tournament after more than three years of suspension from events such as the Olympics, World Championships and World Cups. The 2025 Russian champion, D. Marinov, achieved a respectable seventh place in the all-around despite being unable to perform all the difficult elements in the rings routine due to a shoulder injury. Although he had finished the qualifying round in a higher fourth place. In addition, D. Marinov progressed to the finals on three apparatus, where he finished: third on the parallel bars; seventh in the vault; and eighth on the horizontal bar. Two more Russian gymnasts earned the right to compete in the finals: M. Yakubov – sixth place in the vault; Vl. Polyashov – sixth place on the parallel bars, which demonstrates their high potential.

Conclusions. It is clear that the gymnasts from the strongest national teams at the 2024 Olympics remain the leaders in the post-Olympic year. They secured top positions at the continental championships and won a total of six out of seven gold medals at the 2025 World Championships. The modernisation of the competition rules for the 2025–2028 Olympic cycle has led to increased competition between elite gymnasts and less high-calibre athletes; however, the difficulty score continues to play a significant role in determining victory. Russian gymnasts managed to win one medal at the World Championships – a bronze for D. Marinov on the parallel bars – whilst demonstrating the team's high potential in the fight for victory and podium places at the next World Championships and the 2028 Olympics.

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Analysis of the characteristics of throwing techniques in martial arts

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Abstract

Objective of the study is to identify the biomechanical characteristics of technical and tactical movements based on an analysis of the trajectories of the centres of gravity of various segments of the athlete's body.

Methods and structure of the study. During a match, the athlete performs movements, including those influenced by a force field. To characterise the field, a model comprising 14 segments of the human body was used. Using artificial intelligence, programmes have been developed that enable the calculation of the trajectories of the centres of gravity of the body segments and the saving of the resulting data to separate files.

Results and conclusions. Based on the trajectories of the centres of gravity of the body segments, the nature of the force field at various points in space was determined. Analysis of these trajectories has provided objective insights into the execution of technical and tactical movements by highly skilled athletes, enabling the exploration of new approaches to designing the training process. The use of the proposed analysis in the training process will improve the performance of students in competitive activities and increase their motivation to continue practising martial arts.

Keywords: *martial arts, analysis, judo, technical and tactical training, characteristics.*

Introduction. Technical and tactical training in combat sports is a constant focus for coaches and athletes [1, 5, 6]. It is vital to analyse opponents' bouts in a timely manner, identifying the nuances that are utilised in the process of developing and executing techniques [2, 3]. Undoubtedly, it is important to pay attention to lost matches in order to identify the causes of defeat and avoid mistakes in the future. This is not always possible based on a visual analysis of the bout. However, an adequate analysis of the athlete's body movements using the proposed methodology solves this problem. To understand the essence of the action, it is necessary to select the appropriate set of characteristics that would allow for an accurate description of the biomechanics of the constituent movements [4, 7].

Objective of the study is to identify the biomechanical characteristics of technical and tactical movements based on an analysis of the trajectories of the centres of gravity of various segments of the athlete's body.

Methods and structure of the study. During a match, the athlete performs movements, including those influenced by a force field. To characterise the field, a model comprising 14 segments of the human body was used. Using artificial intelligence, programmes have been developed that enable the calculation of the trajectories of the centres of gravity of the body segments and the saving of the resulting data to separate files.

Results of the study and discussion. Based on the shape of the trajectories of the body segments' centres of gravity, it is possible to draw conclusions about the nature of the force field at various points in space. It is also possible to track the movement of each body segment and note the nuances of movement which are not usually taken into account when viewing a video recording.

Below is an example of an analysis of the force field in which an athlete operates. However, the parameters that should be included in the analysis are determined

a) b) c) d) e)

Figure 1. Phase one: Drawing the opponent's attention to the right with a feint

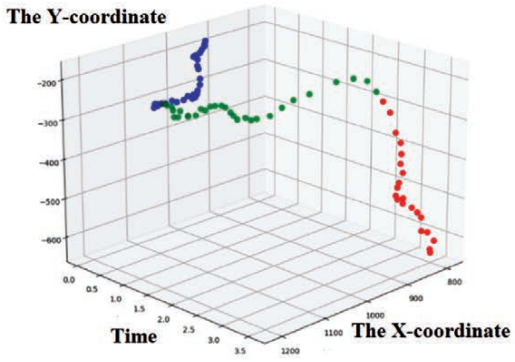
a) b) c) d) e)

Figure 2. Phase two. Driving the opponent to the left

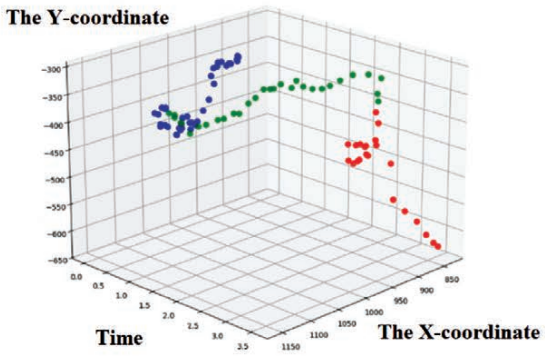
a) b) c)

d) e)

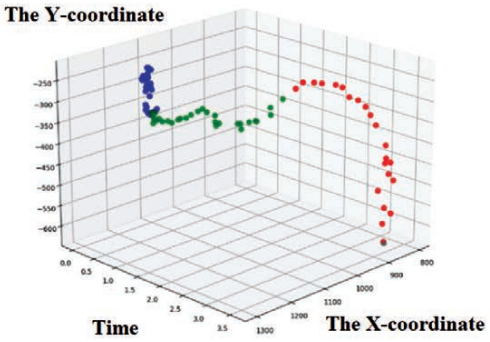
Figure 3. Phase three. Executing the throw



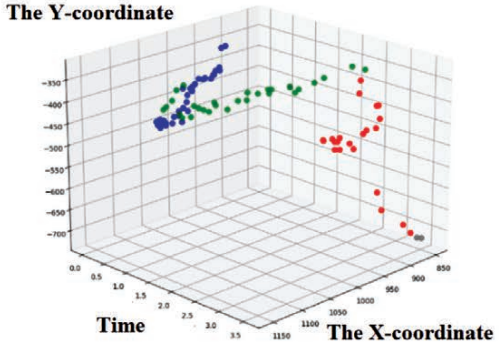
a) The trajectory of the head's CG



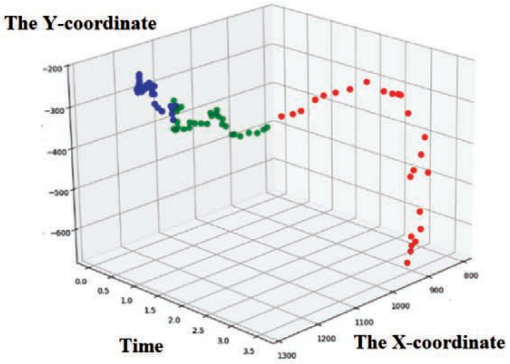
b) The CG trajectory of the left shoulder



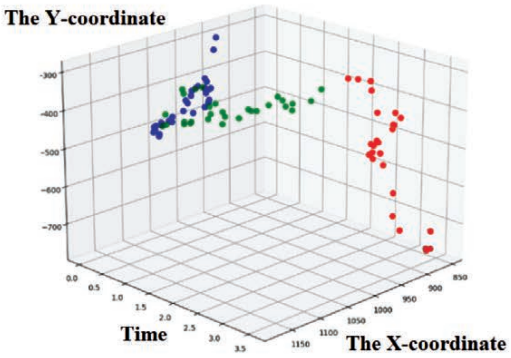
c) The CG trajectory of the right shoulder



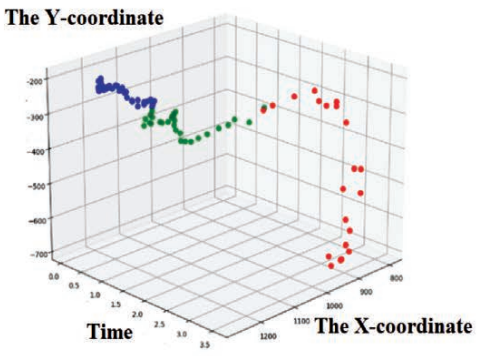
d) The CG trajectory of the left forearm



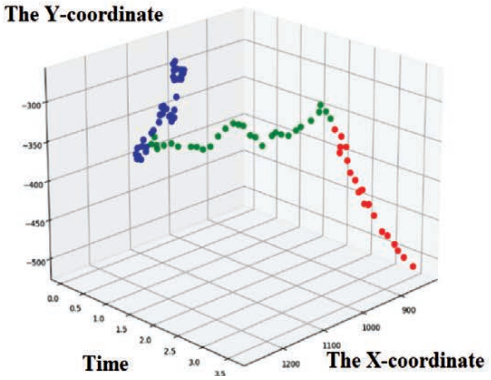
e) The CG trajectory of the right forearm



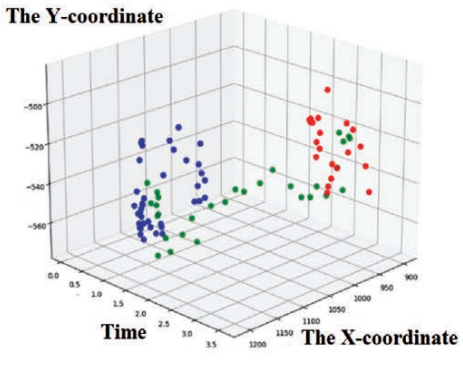
f) The CG trajectory of the left wrist



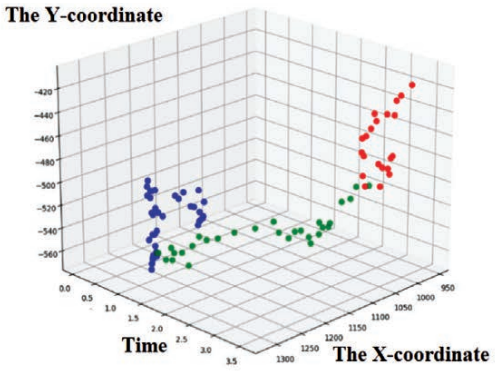
g) The CG trajectory of the right wrist



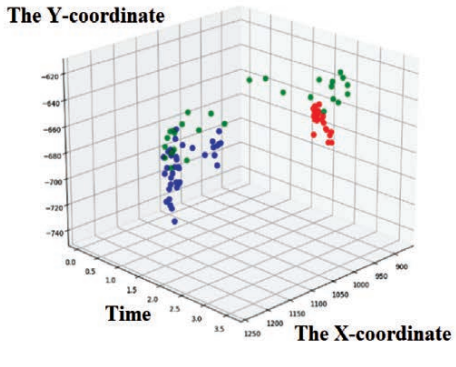
h) The CG trajectory of the torso



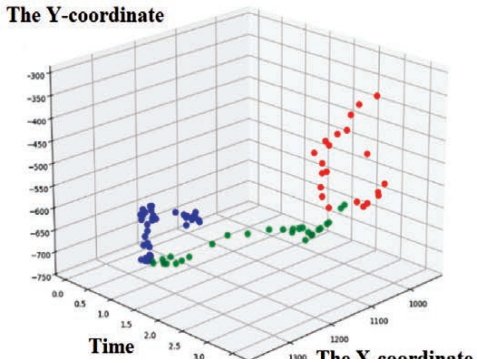
i) The CG trajectory of the left thigh



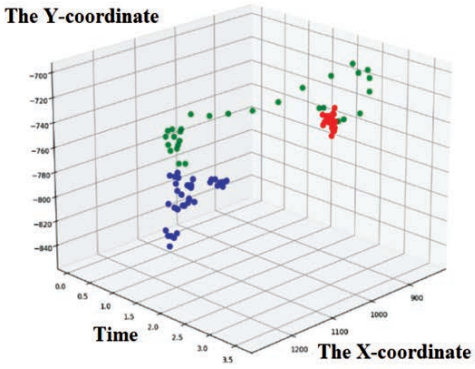
j) The CG trajectory of the right thigh



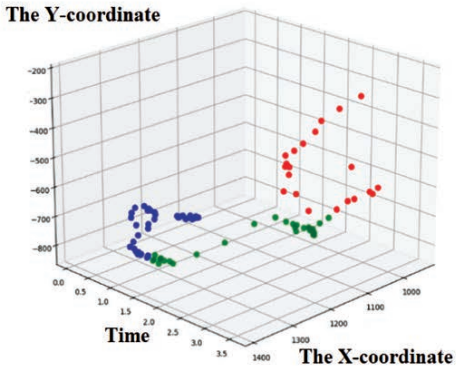
k) The CG trajectory of the left lower leg



l) The CG trajectory of the right lower leg



m) The CG trajectory of the left foot



n) The CG trajectory of the right foot

Figure 4. Trajectories of the centres of gravity (CG) of body segments

not by a strictly regulated methodology, but by the specific situation under investigation.

The analysis was conducted on a video recording in which Dorsel Yandzu demonstrated a lift throw, similar in structure to the judo Yama-arashi throw technique [8]. A 3.56-second segment was extracted from the recording. It comprises three phases:

- movement to the right, distracting the opponent with a sweep;
- movement of the opponent to the left, with the aim of accelerating the opponent;
- execution of the throw.

The trajectories of the centres of gravity of all 14 body segments were used for the analysis.

Figure 1 shows the first phase of the technical-tactical action.

Figure 2 shows the second phase of the technical-tactical manoeuvre, which involves a 'sprint' to the left.

Figure 3 illustrates the throwing phase.

Figure 4 shows the trajectories of the body segments throughout the entire technical movement. The first phase is shown in blue, the second in green, and the third in red.

The force field within which an athlete moves is not

uniform. Different parts of the body move along different trajectories. However, in a number of cases, the shape of these trajectories is similar. This is due to the specific characteristics of the technical and tactical manoeuvre being performed. These characteristics cannot be identified through visual analysis. It is precisely by the shape of the trajectories of the centre of gravity of a particular body segment that the direction of the force field's action can be determined.

Pedagogical observations have shown that, whilst practising on a non-resisting partner, trainees successfully master the technical action, but in competitions they are plagued by failures. In this case, it is necessary to compare the trajectories of the centres of gravity of the trainee's body segments with those of an experienced athlete and determine in which phase the trainee's centre of gravity trajectory differs from that of the experienced athlete, followed by the correction of the error.

When analysing the technical and tactical manoeuvre shown in the video recording, it can be assumed that the trainees are applying insufficient force when throwing their opponent off balance, with the result that the technique is not executed. It is likely that the attacking wrestler is not effectively 'accelerating' the opponent. Consequently, the attacked opponent lacks speed and, as a result, momentum. In this case, the trajectories of the body segments in the second phase of the movement differ from those of an experienced athlete. Furthermore, if we obtain the values of the speeds and accelerations of the trainee's body segments in the case of insufficient acceleration, these too will most likely differ from the values of speeds and accelerations in an experienced wrestler.

Let us consider the phase of the throw itself, for example, the trajectories of the centres of gravity of the right shoulder and forearm (Figure 1c, e). If these trajectories are compared with the video recording, it can be confidently stated that the right shoulder and right forearm perform a rotational movement. It is possible to assess the change in the values of the angular velocity of the centres of gravity and the angular acceleration. In the event of errors in the preceding phases of the movement, these characteristics will differ from those of a correctly executed throw.

Conclusions. The force field within which a wrestler moves whilst performing technical and tactical manoeuvres is not always uniform. It varies at different points in space. This demonstrates that it is incorrect to regard a wrestler as a single material point. One should consider the centres of gravity of the body segments as a collection of material points, study their biomechanical characteristics, and obtain a refined picture of the force field within which the fighter moves.

By analysing the trajectories of the centres of gravity of body segments, one can gain an objective understanding of the details of how highly skilled athletes perform technical and tactical actions and explore new approaches to structuring the training process. In particular, techniques should be selected for study in accordance with the specific characteristics of the participants' morpho-functional indicators and their level of general and specialised physical fitness, which is particularly important in youth sport.

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Assessing the level of mental skills among young athletes at different stages of physical training in sports radio direction-finding

UDC 796.05 : 159.9

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Abstract

Objective of the study is to develop mental skills at various stages of the long-term training of young athletes in sports radio direction-finding.

Methods and structure of the study. The research was conducted during training sessions involving 95 athletes from the Russian Federation's youth national team in sports radio direction-finding, competing in the young men's, young women's, junior men's and junior women's age groups, including 12 Masters of Sport, 31 athletes holding a first-class rank and the title of Candidate Master of Sport, 41 athletes holding third- and second-class ranks, and 11 athletes holding a youth rank. The athletes were asked to respond to 48 statements, which assessed the level of development of 12 different mental skills on a 7-point scale.

Results and conclusions. It has been established that, throughout the entire long-term training process for both young men and junior men, as well as young women and junior women, mental skills – specifically 'self-confidence' and 'anxiety management' – are of the utmost importance.

Keywords: *athletes, sports radio direction-finding, physical training, mental development, development, level.*

Introduction. Sport orienteering is a technically demanding sport in which athletes perform a significant amount of mental work whilst enduring considerable physical and emotional strain. In solving the problems that arise during the competition, the degree of development and refinement of mental processes – such as attention, memory, perception, thinking, imagination and the ability to analyse – plays a major role. The abundance of unpredictable situations during the race and the awareness of the significant role of chance in locating radio transmitters require the athlete to mobilise their full potential, above all their mental resources [2, 3].

It is precisely for this reason that the success of psychological preparation carried out during the training process depends on an understanding of the functioning of the psyche as a whole, as well as of mental processes, mental properties and mental state in particular; this ultimately affects the final outcome of competitive performance in sports radio direction-finding [2].

Mental processes are categorised as cognitive, emotional and volitional. Cognitive processes include sensation, perception, memory, attention, thinking, etc. The manifestation of emotions and volition within mental processes lies in the specific characteristics of the subject's response. Whilst emotional response is a primary (unconscious) form of psychoregulation, volitional regulation is a form of active (conscious) control over purposeful activity [1].

A mental skill is understood as the ability to use cognitive processes to achieve set goals. It is an important element of psychological preparation, the development of which is determined by the ability to manage one's psychophysiological state and mental activity.

However, the current level of development of mental skills among athletes in sports radio direction-find-

ing has not been studied, which makes the topic of our research a pressing one.

Objective of the study is to develop mental skills at various stages of the long-term training of young athletes in sports radio direction-finding.

Methods and structure of the study. In order to comprehensively assess the level of psychological preparedness, mental skills were identified and an assessment was carried out using the Ottawa Mental Skills Assessment Test (OMSAT) to identify the athlete's strengths in mental preparation (K.A. Bochaev, D.V. Bondarev, L.M. Dovzhik, 2023) [4].

The structure of the test comprises twelve mental skills representing various aspects of an athlete's psychological readiness: determination; diligence; self-confidence; stress resilience; anxiety management; relaxation; mobilisation; concentration; resistance to interference; visualisation; ideomotor skills; planning.

In November 2024, during training camps held at federal sports training centres in Sochi, Kislovodsk and Alushta, athletes of various ages and skill levels took part, which made it possible to determine the level of psychological preparedness characteristic of the various stages of long-term training in sports radio direction finding.

A total of 95 athletes from the Russian Federation's youth national team in orienteering took part in the experiment, comprising the following age groups: junior men aged 17–19 (M19 – n=22), junior women aged 17–19 (W19 – n=13), boys aged 15–16 (M16 – n=23), boys aged 13–14 (M14 – n=13), girls aged 15–16 (W16 – n=16), boys aged 13–14 (M14 – n=8), including 12 Masters of Sport, 31 athletes holding the Candidate Master of Sport and 1st class rankings, 41 athletes with 3rd and 2nd class rankings, and 11 athletes holding junior class rankings.

The athletes were asked to respond to 48 statements that assessed the level of development of 12 different mental skills on a 7-point scale.

Results of the study and discussion. The results obtained during the study using the Ottawa test [4] are presented in Table 1.

In order to clearly illustrate the trends in the development of mental skills at various stages of long-term training in sports radio direction-finding, the research results have been presented in pie charts, as shown in Figures 1 and 2. Analysis of the results showed that among 13–14-year-old boys, the highest scores were recorded for the following mental skills: self-confidence – 5.4±1.0; determination – 5.0±0.9; anxiety management – 5.0±1.1. At this stage, mental skills such as visualisation (4.9±0.8) and planning (4.9±1.1) also show fairly high scores. At the same time, boys aged 13–14 do not yet possess sufficient skills to respond adequately to various stressors (stress resilience, 4.2±0.7), nor do they possess sufficient skills to maintain or restore concentration in the presence of distracting factors (noise immunity, 4.1±0.6) (Table 1, Fig. 1).

Table 1. Indicators of the level of development of throwing skills among boys and girls of various age groups in sports radio direction-finding, standardised scores ($\bar{X} \pm \sigma$)

Mental skill	Age group, age					
	young men, juniors			young women, juniors		
	13-14 years	15-16 years	17-19 years	13-14 years	15-16 years	17-19 years
Determination	5,0±0,9	5,1±1,1	4,9±0,9	5,2±0,9	5,1±1,2	5,0±1,0
Hard work	4,7±1,1	4,4±1,2	3,9±1,1	4,3±1,6	4,8±1,2	3,6±0,9
Self-confidence	5,4±0,8	5,6±0,7	5,9±0,3	5,3±1,0	5,2±1,1	5,3±0,9
Stress resilience	4,2±0,7	4,4±1,3	5,0±1,0	3,9±0,5	4,1±0,7	4,5±0,4
Anxiety management	5,0±1,1	5,1±1,3	5,8±0,9	5,1±1,2	5,1±0,8	5,3±1,2
Relaxation	4,6±0,6	4,6±1,1	4,7±1,3	3,8±0,4	4,0±0,8	4,6±0,9
Mobilisation	4,7±0,8	4,9±1,0	5,1±0,9	4,7±0,8	4,7±0,9	4,8±0,8
Concentration	4,4±1,0	5,1±1,3	5,2±1,2	4,5±0,4	4,6±0,5	5,0±0,7
Distraction resistance	4,1±0,6	4,5±1,0	4,6±0,8	3,7±0,9	4,1±0,9	4,0±1,3
Imagination	4,9±0,8	5,1±1,2	4,9±1,1	4,3±0,7	4,7±0,7	4,9±0,5
Ideomotor skills	4,6±1,0	4,5±1,1	4,2±1,3	3,9±1,2	4,3±1,0	4,4±0,6
Planning	4,9±1,1	4,5±1,3	4,4±1,2	4,1±0,9	4,6±1,1	4,6±1,1

Figure 1. The development of mental skills in juniors and young athletes at various stages of long-term training in sports radio direction-finding

Among 15–16-year-old young men, as with 13–14-year-olds, the highest scores for mental skills were recorded for self-confidence (5.6±1.0), determination (5.1±1.1) and anxiety management (5.1±1.3). In addition, there is an increase in the ability to direct and sustain attention on goals and processes critical to achieving results (concentration, 5.1±1.3) and the ability to creatively form and utilise specific motor imagery and images of victory (imagery, 5.1±1.2).

When analysing the data for the strongest juniors aged 17–19, it should be noted that the highest values for both young men and young women are achieved in the mental skills of self-confidence (5.9±0.3) and anxiety management (5.8±0.9). At this stage of training, high scores are also observed for the mental skills

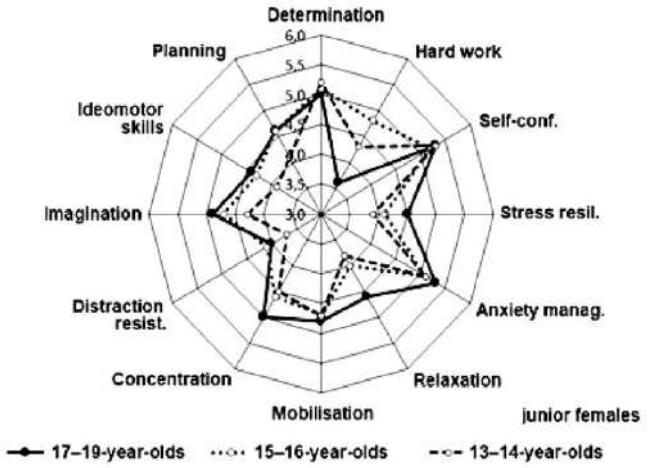

Figure 2. The development of mental skills in junior and young women at various stages of long-term training in sports radio direction-finding

of concentration (5.2±1.2), mobilisation (5.1±0.9) and stress resistance (5.0±1.0).

It should be noted that in the male age groups, a negative trend is observed in the development of mental skills such as diligence (M14 – 4.7±1.1; M19 – 3.9±1.1), ideomotor skills (M14 – 4.6±1.1; M19 – 4.2±1.3), and planning (M14 – 4.9±1.1; M19 – 4.4±1.2).

An analysis of the maximum scores for mental skills in female age groups indicates that these values are significantly lower than in male age groups (Table 1).

The highest scores among young women aged 13–14, as well as among young men of the same age, were recorded for mental skills: self-confidence – 5.3±1.0; determination – 5.2±0.9; anxiety management – 5.1±1.2. Significant scores at this stage for mental skills are mobilisation (4.7±0.8) and concentration (4.5±0.4). Young women of this age do not yet possess the ability to maintain or restore concentration in the presence of distractions (distraction resistance, 3.7±0.9) (Table 1, Fig. 2).

For young women aged 15–16, as in the previous stage of long-term training, the highest scores for mental skills are self-confidence (5.2±1.1), determination (5.1±1.2) and anxiety management (5.1±0.8).

Analysing the indicators for junior athletes aged 17–19, it can be noted that the highest scores are achieved in the mental skills of self-confidence (5.3±0.8), anxiety management (5.3±1.2), determination (5.0±1.0) and concentration (5.0±0.7).

As in the male age groups, a negative trend in the development of the mental skill of diligence is observed in the female groups (F14 – 4.3±1.6; F19 – 3.6±0.9).

Conclusions. Throughout the entire process of long-term training, both males and junior male athletes, as well as for female athletes and junior female athletes, are the mental skills that characterise an athlete's confidence in achieving their goals and the presence of an inner belief in their own abilities (self-confidence), as well as the ability to adapt to situations that cause emotional arousal (anxiety management).

In young male athletes, mental skills characterised by confidence in achieving one's goals (self-confidence); the ability to cope with stress (stress resilience); the ability to adapt to situations causing deep feelings of excitement, fear and anxiety (anxiety management); the ability to focus attention (concentration); maintaining or restoring concentration in the presence of numerous distractions (distraction resist-

ance) differ significantly ($p<0.01 – 0.05$) depending on sporting ability. Among girls and junior athletes, depending on their level of sporting proficiency, there are statistically significant ($p<0.05$) differences in indicators of mental skills: the ability to cope with stress (stress resilience); the ability to purposefully reduce the level of psychophysiological arousal (relaxation); the ability to focus attention (concentration) and to form mental images of sporting victory based on previously acquired experience (imagery). The development of the remaining mental skills does not show a significant correlation ($p > 0.05$) with the stage of athletic training or the athlete's level of proficiency.

The results of the study showed that the development of mental skills is an important element of psychological preparation in sports radio direction-finding, and the assessment of their development is an effective mechanism for managing this process.

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Improving the aerobic and anaerobic capacity of kickboxers through polarised training

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Abstract

Objective of the study is to determine the effectiveness of polarised training for kickboxers during the preparatory period, based on the integrated development of the athletes' aerobic and anaerobic capacities.

Methods and structure of the study. During the preparatory period, prolonged low-intensity exercise was combined with the execution of techniques at high speed. Following five training sessions aimed at developing general endurance, speed-strength training was conducted to maximise the speed and power of punches and kicks. The following parameters were measured: maximum and anaerobic power; power decline index; and maximum oxygen consumption (MOC).

Results and conclusions. Polarised training improves kickboxers' anaerobic capacity to a greater extent, whilst aerobic energy supply mechanisms improve to a lesser extent. When planning further training, greater attention should be paid to developing kickboxers' aerobic capacity.

Keywords: *elite kickboxers, maximum oxygen consumption, polarised training, training process.*

Introduction. When planning a training programme for kickboxers, it is essential to take the competition calendar into account, as this allows for the training of athletes to be tailored to the different phases of the annual training cycle. Athletes must be in peak physical condition in April–May, as this is when the season's most important competitions take place, as well as in September ahead of the European and World Championships. Selection for the national team takes place after the completion of each macrocycle [1].

The preparatory period, during which the foundations of general and specific physical fitness are laid, plays a decisive role in an athlete's annual training cycle [2]. The body's basic capacity for adaptation, acquired during the preparatory period, determines the nature of tolerance to specific training and competitive loads, the informative indicators of which are individual physiological parameters providing information on the athlete's current condition. For effective planning of subsequent training periods, it is advisable to carry out systematic monitoring of physiological indicators and the dynamics of their changes during the preparatory training period [4].

As the season's main competitions approach, the demands on a kickboxer's speed-strength qualities increase significantly. High-intensity and high-volume speed-strength training loads can cause excessive fatigue in athletes [3]. Polarised training, which allows for the inclusion of individual high-intensity sessions against a background of large volumes of low-intensity training as early as the general physical stage of the preparatory period, optimises the tolerance of physical exertion without reducing the effectiveness of the development of speed-strength qualities in kickboxers.

Objective of the study is to determine the effectiveness of polarised training for kickboxers during the preparatory period, based on the integrated development of the athletes' aerobic and anaerobic capacities.

Methods and structure of the study. 16 highly qualified kickboxers, specialising in the full-contact

and low-kick ring disciplines, took part in the study. 8 athletes formed the experimental group, and 8 formed the control group.

During the preparatory training period, prolonged low-intensity workouts were combined with high-speed training techniques. Following five training sessions aimed at developing general endurance, speed-strength training was conducted with a partner of greater body mass to maximise the speed and power of punches and kicks. As the athletes' fitness improved, the duration of the speed-strength training sessions was increased.

Standardisation of the training conditions was achieved by ensuring that the total training volume, recovery periods, daily routine and diet were identical for participants in both the experimental and control groups.

The participants' anaerobic capacity was determined using a 30-second Wingate test on a Monark-894E cycle ergometer. The following parameters were measured: maximum power (Pmax); average anaerobic power (Pavg); and the power decline index at 30 seconds of exercise.

Aerobic capacity was determined by the maximum oxygen consumption (MOC).

The level of physical fitness was assessed based on the results of the standing long jump, 4 10 m shuttle run and 1000 m run.

Results of the study and discussion. An analysis of the study results shows that the greatest improvement in anaerobic capacity was observed in the experimental group, whose maximum power output was 11.8±2.7 W/kg, with an average value of 8.6±0.9 W/kg. In the control group, the indicator under study increased to 8.2±3.7 W/kg, with an average value of 6.9±0.7 W/kg.

When comparing the results of the participants at the end of the study, it can be noted that the participants in the experimental group achieved the best results. The most significant differences were observed in the indicators of anaerobic capacity in the athletes of the experimental and control groups.

Maximal oxygen uptake indicates significant differences between athletes in the experimental and control groups. The best results were demonstrated by the kickboxers in the experimental group, whose VO2max was 63.8±8.2 ml/kg/min. The maximum oxygen consumption in the control group was 51.6±9.1 ml/kg/min.

Based on the comparative analysis, it can be concluded that the dynamics of aerobic capacity among the experimental group participants, as assessed by VO2max, surpasses in both absolute values and dynamics the results of the control group athletes, in which the kickboxers achieved lower VO2max values. The inclusion of prolonged low-intensity exercises in the polarised training programme facilitated the activation of aerobic mechanisms supporting muscular activity. In particular, the peak values recorded in the 1000 m run by athletes in the experimental group are associated with an increase in functional capacity during the late stage of the preparatory period.

In tests of anaerobic capacity, participants in the experimental group showed better results than those in the control group. The results of the anaerobic tests performed by athletes in the EG are due to an increase in maximum and average anaerobic power, and stabilisation of the power decline index. Consequently, the objectives of polarised training during the preparatory period of the annual macrocycle are achieved on a new functional basis – through the strengthening of

Table 1. Indicators of physical and functional fitness in kickboxers

Indicator	EG	CG	t
Maximum power, W/kg	11,8±2,7	8,2±3,7	5,8
Average anaerobic power, W/kg	8,6±0,9	6,9±0,7	4,2
Power decline index, %	41,3±7,7	50,6±9,7	2,6
MOC, ml/min/kg	63,8±8,2	51,6±9,1	3,7
Standing long jump, cm	243,5±42,7	239,6±36,5	2,9
4 × 10 m shuttle run, s	9,4±0,5	10,5±0,2	5,2
1000 m run, s	225,4±51,4	231,1±43,6	3,1

established links between power, speed and the tempo of kickboxers' striking actions.

The results of other tests improved as fitness levels increased, which attests to the effectiveness of the training process. The greatest progress was observed in shuttle runs and the standing long jump, which is achieved through the polarised intensity of training by means of focused and short-term exposure to high-intensity loads as early as the initial stage of the preparatory period.

Conclusions. A training programme that is rationally planned and implemented during the preparatory phase of the annual macrocycle enables the effective improvement of both aerobic and anaerobic energy supply mechanisms for muscular activity in kickboxing.

Polarised training increases kickboxers' anaerobic capacity to a greater extent, whilst aerobic energy supply mechanisms improve to a lesser extent. When planning further training sessions, greater attention should be paid to developing kickboxers' aerobic capacity.

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The specifics of strength training for elite female wrestlers

UDC 796.82

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Abstract

Objective of the study is to evaluate and analyse the effectiveness of using high-repetition and statodynamic modes of muscular activity among highly skilled female wrestlers during their physical preparation for sporting competitions.

Methods and structure of the study. The experiment was conducted at the Comprehensive School of Higher Sports Excellence in St Petersburg, involving 22 highly skilled female wrestlers. Baseline measurements were taken before the start of the experiment, and again after 3 and 6 months. The main mechanism for utilising the statodynamic mode in the developed programme was the inclusion of additional sets performed with minimal weight and a reduced range of motion, without relaxation of the working muscle, and with a high number of repetitions.

Results and conclusions. The results of the pedagogical experiment showed that a high-repetition training regime, used as a supplement to strength training as part of periodic adjustments to training loads, is an optimal and effective approach for reducing body fat and increasing muscle mass in female wrestlers during their training. A statistically significant improvement in results was observed after six months of the pedagogical experiment in most of the tests studied in the experimental group using a statodynamic training regime.

Keywords: *wrestling, female wrestlers, physical training, competitions, performance, muscle activity.*

Introduction. Modern wrestling is characterised by a rapid increase in the physical fitness requirements for highly skilled athletes. An analysis of current practice shows that dynamically adjusting training loads to take account of the specific nature of the competitive period helps to improve sporting performance [1–2, 6]. In this regard, it is essential to identify the most effective methods for organising the training process, which ensure readiness for competitive demands, stimulate adaptation processes, and maintain optimal performance levels depending on the stage of preparation. Research by Russian scientists confirms that simply increasing the volume and intensity of training loads does not guarantee high sporting results [3–5].

Objective of the study is to evaluate and analyse the effectiveness of using high-repetition and statodynamic modes of muscular activity among highly skilled female wrestlers during their physical preparation for sporting competitions.

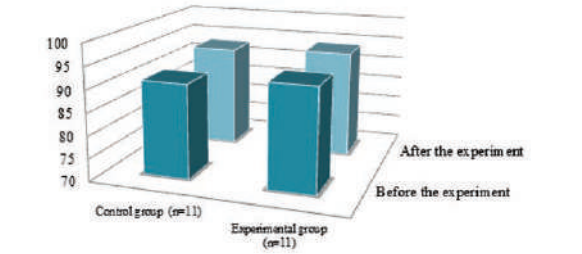
Methods and structure of the study. The study involved a review and analysis of scientific and methodological literature, a questionnaire survey, sports-pedagogical testing, and a pedagogical experiment.

The experiment was conducted at the Comprehensive School of Higher Sports Excellence in St Petersburg, involving 22 highly skilled female wrestlers. The athletes were divided into a control group and an experimental group, with 11 participants in each. The athletes in the control group trained using standard methods, whilst the experimental group followed a specially designed programme. Baseline measurements were taken before the start of the experiment, and again after 3 and 6 months. The main mechanism for utilising the statodynamic mode in the proposed programme was the inclusion of additional sets performed with minimal weight and a reduced range of motion, without relaxing the working muscle, and with a high number of repetitions. These sets were per-

formed after 4–5 strength sets, in the classic style. The following exercises were included as the programme's core exercises: pull-ups, bench press, classic squat, seated dumbbell press, Romanian deadlift, bent-over barbell row, and stationary bodyweight lunges. To adjust the training load, a short range of motion was used, with a time under load of 30–45 seconds. During the recovery period between sets, exercises targeting other muscle groups were performed.

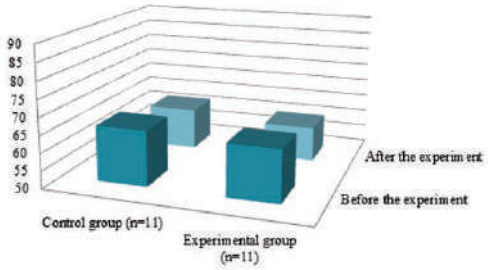
Results of the study and discussion. The results of the questionnaire survey indicate that the athletes are aware of the need to adjust training loads according to the stages of preparation. The results of the experiment demonstrate the effectiveness of the programme developed, which incorporates statodynamic approaches into the training process for female wrestlers.

Strength indicators and muscle mass in the experimental group of female wrestlers increased significantly compared to the control group, whilst waist circumference decreased (Table 1). The results of the experimental phase demonstrate the effectiveness of incorporating statodynamic approaches into the training process for the development of muscle mass and strength in female athletes.



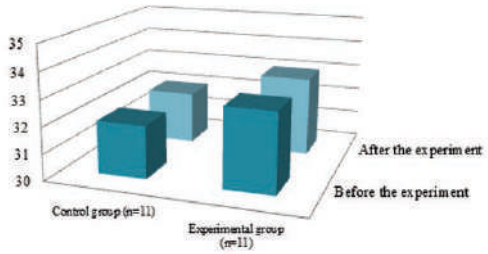
	Control group (n=11)	Experimental group (n=11)
Before the experiment	91	93
After the experiment	93	94

Figure 1. Comparative results of chest circumference measurements in the control and experimental groups (cm)



	Control group (n=11)	Experimental group (n=11)
Before the experiment	66	65
After the experiment	62	60

Figure 2. Comparative results of waist circumference measurements in the control and experimental groups (cm)

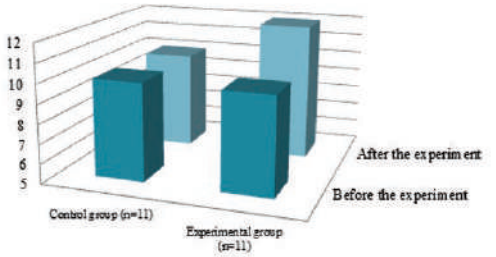


	Control group (n=11)	Experimental group (n=11)
Before the experiment	32	33
After the experiment	32	33

Figure 3. Comparative results of biceps circumference measurements in female athletes in the control and experimental groups (cm)

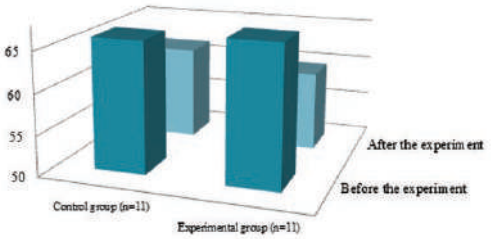
Table 1. Results of a 6-month educational experiment

Exercises and measured parameters	Before the experiment			After 3 months			After 6 months		
	Control group (n=11)	Experimental group (n=11)	p	Control group (n=11)	Experimental group (n=11)	p	Control group (n=11)	Experimental group (n=11)	p
Pull-ups (in 1 min)	11±2	10±4	>0,05	11±3	12±3	>0,05	9±2	11±3	<0,05
Bench press: 30% of body weight (in 1 min)	10±2	10±3	>0,05	12±2	14±3	<0,05	10±2	12±2	<0,05
Classic squat 40% of body weight (in 1 min)	16±2	17±3	>0,05	18±2	21±2	<0,05	16±2	20±2	<0,05
Weight (kg)	66,1±6	67,1±7	>0,05	71,2±9	69,2±9	<0,05	61,6±5	59,7±5	<0,05
Waist circumference (cm)	66±6	65±6	>0,05	67±4	66±6	>0,05	62±3	60±2	<0,05
Chest circumference (cm)	91±5	93±3	>0,05	94±6	94±3	>0,05	93±6	94±3	<0,05
Bicep circumference (cm)	32±2	33±1	>0,05	33±3	34±2	>0,05	32±3	33±2	>0,05



	Control group (n=11)	Experimental group (n=11)
Before the experiment	10	10
After the experiment	10	12

Figure 4. Comparative results for the number of repetitions of the exercise (barbell press) in the control and experimental groups



	Control group (n=11)	Experimental group (n=11)
Before the experiment	66,1	67,1
After the experiment	61,6	59,7

Figure 5. Comparative results of weight measurements for female athletes in the control and experimental groups (kg)

The results of the control measurements demonstrate the effectiveness of the developed method for adjusting training loads for highly skilled female wrestlers.

Conclusions. The results of the pedagogical experiment indicate that a high-repetition regime, when used in conjunction with strength training involving periodic adjustments to training loads, is an optimal and effective component of the training programme for reducing body fat and increasing muscle mass in female wrestlers. During the experiment, a statistically significant improvement in results was observed after six months of the pedagogical experiment in most of the tests studied within the experimental group using a statodynamic training regime.

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Organising the recovery process within the annual training cycle for elite basketball players

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Abstract

Objective of the study is to conduct an experimental evaluation of a model for organising the recovery process for student basketball players with competitive experience within a one-year training cycle.

Methods and structure of the study. The following methods were employed in this research: analysis and synthesis of scientific and methodological literature, questionnaires, factor analysis, pedagogical experiments, modelling, testing, and methods of mathematical statistics.

The study was conducted at the Volga State University of Physical Culture, Sport and Tourism, Kazan (experimental group) and the Orel State University named after I.S. Turgenev, Orel (control group). 30 qualified basketball players, members of university national teams, took part in the experiment, divided into two groups of 15 people each.

Results and conclusions. In the experimental group, a specially developed model for organising the recovery process was applied, whilst the athletes in the control group carried out recovery activities independently, following their coach's recommendations. The effectiveness of the model for organising the recovery process was tested as part of a pedagogical experiment by examining changes in the indicators of physical, technical, functional and psychological fitness among qualified basketball players:

Physical fitness: in the experimental group, improvements in general and specific physical fitness indicators were recorded in the following ranges: 2.29–23.06% and 4.12–10.70%, respectively.

Technical fitness: in the experimental group, improvements in technical fitness indicators were recorded within the following range: 34.32–61.80%.

Functional fitness: in the experimental group, improvements in functional fitness indicators were recorded within the following ranges: respiratory system (spirometry) 12.55–21.62%; overall fitness (Wingate test) 10.26–23.12%; heart rate response to exercise 6.98–9.66%; Romberg's test (stability platform) 13.84–37.69%, respectively.

Psychological fitness: in the experimental group, improvements in psychological fitness indicators were recorded within the range of 8.93–25.56%.

Improvements in all indicators studied were less pronounced in the control group.

The experimental model developed allows for the integration of recovery measures into the training process of elite basketball players, taking into account the loads they undergo (training and competitive), as well as the characteristics and specifics of the training periods within the annual cycle. The effectiveness of the model was verified by assessing changes in the indicators of physical, technical, functional and psychological fitness of skilled basketball players, where a more significant improvement in results was observed in the experimental group compared to the control group in virtually all indicators studied. Thus, based on the results of the study, it can be concluded that the model for organising the recovery process for skilled basketball players in university basketball teams has proven its effectiveness following its trial.

Keywords: *basketball players, high level of skill, organisation, model, physical recovery process.*

Introduction. It is now clear that the intensity of matches and training loads in university basketball is on a par with that of professional sport. The athletic training of elite basketball players at universities involves high training and competitive loads, which significantly impact the effectiveness of training and hinder the recovery process. This calls for a review of approaches to organising recovery measures, with an emphasis on a comprehensive approach [2, 4].

A survey of specialists and athletes revealed that the recovery methods used are often monotonous and fragmented, confirming the need to review existing practices and to seek out and implement more effective approaches.

At the same time, the factor analysis we conducted identified the key components of sporting proficiency in skilled basketball players, such as speed-strength endurance, coordination abilities, functional and general endurance. The effective development of the aforementioned components requires a comprehensive approach to the selection of recovery methods.

A review of the literature revealed no studies dedicated to the comprehensive application of recovery methods in student basketball. This indicates a gap in this area of scientific research; however, as many experts note, for effective training and the achievement of high results, regardless of the sport or the athletes' level, the body must be adapted to high loads [1, 3, 5].

Objective of the study is to conduct an experimental evaluation of a model for organising the recovery process for student basketball players with competitive experience within a one-year training cycle.

Methods and structure of the study. The following methods were employed in this research: analysis and synthesis of scientific and methodological literature, questionnaires, factor analysis, pedagogical experiments, modelling, testing, and methods of mathematical statistics.

The study was conducted at the Volga State University of Physical Culture, Sport and Tourism, Kazan (experimental group) and the Orel State University named after I.S. Turgenev, Orel (control group). 30 qualified basketball players, members of university national teams, took part in the experiment, divided into two groups of 15 people each.

Results of the study and discussion. Taking into account a review of the literature, the opinions of experts and athletes, and the results of the factor analysis conducted, a model was developed for organising the recovery process for elite basketball players on university teams within an annual training cycle. The model comprised the following components: objectives, content, process, monitoring and evaluation, and outcomes:

1. The objective block formulates the goals and objectives. The aim of the model is to achieve a balance between physical load and the body's capabilities through the comprehensive use of specially selected recovery methods.

2. The content block describes specially selected recovery methods (11 sets of recovery methods) which have specific effects: relaxing, toning, stimulating and supportive.

3. The procedural section describes the application of recovery programmes within the annual training cycle for elite basketball players, taking into account the characteristics of the preparatory period (shortened timeframe) and the specifics of the competitive period (the round-robin system of major competitions and the presence of an inter-match training interval).

4. The monitoring and assessment section defines indicators (physical, technical, functional and psychological readiness) and the criteria for their assessment.

5. The results section describes the outcomes achieved.

To test the effectiveness of the developed model, a pedagogical experiment was conducted involving two groups of qualified basketball players: an experimental group (EG) and a control group (CG), each comprising 15 athletes. In the experimental group, a specially developed model for organising the recovery process was implemented, whilst the athletes in the control group carried out recovery activities independently, following the coach's recommendations.

The effectiveness of the model for organising the recovery process was assessed by studying changes in indicators such as the physical, technical, functional and psychological fitness of the qualified basketball players.

Physical fitness was assessed using indicators of general physical fitness (GPF) and specific physical fitness (SPF).

In terms of GPF indicators, an improvement ranging from 2.29% to 23.06% was recorded in the experimental group, and from 0.89% to 2.52% in the control group, respectively.

In terms of SPF indicators, an improvement ranging from 4.12% to 10.70% was recorded in the experimental group, and from 1.09% to 1.6% in the control group, respectively.

Technical proficiency was assessed using the following indicators: 'Number of two-point shots', 'Two-point shot percentage', 'Number of three-point shots', 'Three-point shot percentage'.

In the experimental group, improvements in technical fitness indicators were recorded in the range of 34.32–61.80%, whilst in the control group they ranged from 3.22% to 5.88%, respectively.

Functional fitness was assessed using the following tests and trials: respiratory system (spirometry), general work capacity (Wingate test), heart rate (HR) response to exercise, and the Romberg test (stability platform).

In the respiratory system assessment indicators (spirometry), an improvement ranging from 12.55% to 21.62% was recorded in the experimental group, and from 2.91% to 3.71% in the control group, respectively.

In the indicators assessing overall physical fitness (Wingate test), an improvement ranging from 10.26% to 23.12% was recorded in the experimental group, and from 2.02% to 3.23% in the control group, respectively.

In the indicators assessing the heart rate response to exercise, an improvement ranging from 6.98% to 9.66% was recorded in the experimental group, and from 0.42% to 1.57% in the control group, respectively.

In the Romberg test on a stabilisation platform, an improvement was recorded in the experimental group ranging from 13.84% to 37.69%, and in the control group – 0.93–1.85%, respectively.

Psychological readiness was assessed using tests such as: 'Traffic Lights', 'Tapping Test', 'Snake', and 'Tremor'.

In the experimental group, improvements in psychological readiness indicators were recorded in the range of 8.93% to 25.56%, whilst in the control group, improvements ranged from 1.87% to 0.22%, respectively.

Thus, the experimental group showed more significant improvements in virtually all indicators studied compared with the results of the control group.

Conclusions. Based on the findings of this study, it can be concluded that the experimental model developed allows for the integration of recovery measures into the training process of elite basketball players, taking into account the loads they undergo (training and competitive) as well as the characteristics and specific features of the training periods within the annual cycle. The effectiveness of the model was tested by assessing changes in the indicators of physical, technical, functional and psychological fitness of skilled basketball players, where a more significant improvement in results was observed in the experimental group compared to the control group for virtually all indicators studied. Thus, based on the results of the study, it can be concluded that the model for organising the recovery process for skilled basketball players in university basketball teams has proven its effectiveness following its trial.

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A model for assessing the effectiveness of swimming technique in the training of young sprint swimmers

UDC 797.21

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Abstract

Objective of the study is to develop a model of swimming technique based on anthropometric factors, strength, power and the kinematic characteristics of young swimmers.

Methods and structure of the study. The study involved 24 young male swimmers aged 12.5±0.9 years, with 3.5 years' experience in competitive swimming, who regularly participate in regional competitions. A factor model of swimming technique effectiveness has been developed, taking into account current data on the factors determining the performance of young swimmers during the training phase of their preparation.

Results and conclusions. The factor model of swimming technique efficiency includes variables relating to total force, hydrodynamic power and the kinematic efficiency of the stroke, which account for 68.7% of the performance of young swimmers.

Keywords: *training phase, performance indicators, swimmers, anthropometry, kinematic characteristics.*

Introduction. Most studies on the athletic performance of swimmers are based on the development and validation of correlation and regression models of the training process. This provides insight only into the degree of association between training stimuli and training outcomes, without revealing the mechanisms by which training factors exert their effects. The method of proof in studying the phenomena of adaptation to training load involves calculating the coefficients of equations describing functional relationships.

Previous studies have identified a positive and significant correlation between elbow extension strength and push-off force in the final phase of the stroke. It has also been demonstrated that, compared to training conducted solely in the pool, an integrated programme of strength training on land and in water significantly improves the performance of young swimmers.

When developing specifically targeted training methods, it is assumed that swimming technique depends on the level of muscle strength development and, consequently, influences the improvement of competitive performance. Despite the apparent validity of this assumption, there is as yet no formalised evidence for this hypothesis in the literature. On the one hand, improvements in strength and power appear to be associated with increased performance; however, there is a lack of comprehensive knowledge regarding the interrelationships between the characteristics under investigation and their quantitative contribution to competitive results.

Objective of the study is to develop a model of swimming technique based on anthropometric factors, strength, power and the kinematic characteristics of young swimmers.

Methods and structure of the study. The study involved 24 young male swimmers aged 12.5±0.9 years, with 3.5 years' experience in competitive swimming, who regularly participate in regional competitions.

The sporting result of the main competitive event, the 100 m freestyle, was selected as the criterion for the effectiveness of the training process and, consequently, as the dependent variable.

Hydrodynamic power in water, strength and power on land, as well as kinematic and anthropometric characteristics, were measured.

Hydrodynamic swimming power Ps was selected as the independent variable; to assess this, active resistance (Ra) was first calculated using the velocity perturbation method [3]. Each swimmer swam two 25-metre freestyle laps at maximum speed, both with and without an additional hydrodynamic body. Ra was calculated using the formula:

$Ra = R_b v_b v^2/v^3\text{-}v_b^3$, where R_a (N) is the active drag on the swimmers at maximum speed, R_b (N) is the drag on the additional hydrodynamic body with a predetermined drag coefficient, and v_b and v (m/s) are the swimming speeds with and without the additional hydrodynamic body.

The value of Ps was calculated using the formula [5]:

$P_s = D_a \times v$, (2)

where P_s is the hydrodynamic power required to overcome drag (W); Da is the active drag (N); v is the speed (m/s).

Strength and power on land were measured during a medicine ball throw (weighing 1 kg and with a circumference of 0.72 m) over the head. A Doppler radar with an accuracy of ±0.04 m/s within a 12° field of view from the device was used to measure the throw velocity. The radar was positioned 1 m behind the athlete at the height of the protruding part.

Forearm flexion strength was measured using a seated barbell lift test, with the barbell raised to the point where the elbows were bent.

The kinematic parameters selected for measurement were 25 m swimming speed and stroke efficiency. Each swimmer performed three 25-metre freestyle heats at maximum speed. Between heats, the swimmers rested for 30 minutes to allow for full recovery. The average value of the three heats was used for analysis.

A speedometer cable was attached to the swimmer's belt. A 12-bit resolution data acquisition board was used to transmit data (f = 50 Hz) from the speedometer to the software interface. The data was exported to signal processing software and filtered using a low-pass filter with a cut-off frequency of 5 Hz. Swimming speed (v) was calculated over an average of 15 m (between 5 and 20 m) using the formula: v = d/t, where v is the average swimming speed (m/s), d is the distance covered (m), and t is the time taken (s).

Stroke efficiency was estimated using the formula [7]:

$\eta p = 0.9v \times SF \times k \times 100$,

where ηp is stroke efficiency (%), v is speed (m/s), SF is the stroke rate (Hz), k (cm) is the distance between the shoulder and the tip of the third finger during the forward stroke phase, measured using a tape measure whilst simulating the stroke cycle on land. Arm span was measured whilst the subject was in an upright standing position with arms fully extended and fingers abducted at a 90° angle to the torso. The distance between the tips of the third fingers was measured.

Standardised regression coefficients (b) were examined, and the significance of each was assessed using Student's t-test ($p<0.05$).

Results of the study and discussion. The highest variance was observed in the swimming power metrics, whilst the lowest was found in the arm stroke metrics. Overall, all determinants except one showed a moderate or high significant correlation with competitive performance ($p<0.05$) (Table 1).

The development of a factor model to enhance the performance of young swimmers, based on the improvement of specific kinematic and hydrodynamic characteristics, showed that all factors in the training model have a significant impact on sporting performance, collectively accounting for 69% of the contribution to competitive results.

The mean values fall within the confidence in-

Table 1. Statistical indicators and correlation coefficients (r) between the variables under study and sporting performance

Indicator	x ± SD	σ^2	r	p
100 m swim, s	71,2±8,8	37,5	-	-
Arm stroke length, cm	162,8± 23,6	23,7	0,542	< 0,05
Forearm flexion strength, kg	7,3±0,6	0,9	0,645	< 0,05
Ball velocity, m/s	6,7±0,3	1,6	0,398	< 0,05
Power, W	72,7±4,6	221,8	0,563	< 0,05
25 m swim, m/s	1,4±0,2	0,62	0,817	< 0,05
Stroke efficiency, %	28,8±3,2	16,4	0,481	< 0,05

tervals reported in the scientific literature for swimmers of the corresponding age group and fitness level. Correlation coefficients revealed significant relationships between swimming performance and all selected independent variables, with correlation strengths ranging from moderate to high.

It was established that conducting combined training on land and in the water contributed to an improvement in the results of young swimmers.

In the constructed factor model, the characteristics of ball flight speed during a throw, swimming power, swimming speed and stroke efficiency are predictive factors of swimming performance. Ball flight speed had a positive influence on swimming power, which in turn influenced swimming speed and stroke efficiency.

Using telemetry methods, a high correlation was established between arm span and forearm flexion strength ($r=0.73$; $p \leq 0.05$). Consequently, it was hypothesised that arm span would have a positive and significant effect on the flight speed of the medicine ball during a throw. However, no data were found in the literature regarding the relationship between arm swing and upper limb strength in young swimmers. Therefore, removing the factor relating arm swing to forearm flexion strength improved the fit of the factor model of young swimmers' fitness.

It was hypothesised that the strength and power demonstrated on land are related to the strength and power demonstrated in water. Although the strength-power relationship is not significant (=0.23; $p>0.05$), the force developed during a medicine ball throw explains 91.6% of hydrodynamic power. It was also suggested that greater force is associated with higher generation of propulsive force and output power in water. Total force accounts for 59.3% and 85.1% of the medicine ball's flight speed during an overhead throw and the level of hydrodynamic power, respectively, and is a significant factor in relation to swimming speed ($\beta = 0.61$; $p < 0.05$). Overall, swimmers demonstrating the greatest strength are both efficient (achieving higher swimming speed) and economical (developing greater hydrodynamic power), which enables them to achieve better results in swimming.

Both factors – power and strength on land and in water – had a significant influence on swimming technique. Therefore, the combined development of specific physical qualities and work on swimming technique will enable young swimmers to develop strength and refine the kinematic component of their stroke, and consequently improve their performance.

Conclusions. A factor model of swimming technique efficiency includes variables relating to total force, hydrodynamic power and stroke kinematic efficiency, which account for 68.7% of young swimmers' performance. The level of general strength development has a positive and significant influence on hydrodynamic power in the water and stroke kinematics, which ultimately improves sporting performance. Although anthropometric data were not included in the factor model, they demonstrated a significant contribution to the kinematic determinants that underpin the competitive success of young swimmers.

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Technical, tactical and special physical training for taekwondo practisers

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Abstract

Objective of the study is to analyse and synchronise technical and tactical skills with the specific physical fitness of taekwondo athletes during the preparatory training period.

Methods and structure of the study. The research comprised an analysis of scientific and methodological literature, a pedagogical experiment, and the statistical processing of experimental data. 10 athletes, members of the St Petersburg ITF Taekwondo Junior Team, took part in the Russian ITF Taekwondo Championships (19-23 March 2025 in Sochi). The athletes trained using a specialised methodology, incorporating circuit training. Tasks designed to improve technical and tactical skills were alternated with specialised physical training exercises using the repetition-interval method.

Results and conclusions. To determine the effectiveness of the specialised methodology aimed at synchronising the improvement of technical and tactical skills with the enhancement of taekwondo athletes' specialised physical fitness during the preparatory period, control tests were conducted to assess specialised physical fitness. Objective indicators of the development of specialised endurance confirm the validity of applying a specialised methodology aimed at synchronising the combined effects of improving the level of specialised physical fitness and enhancing the technical and tactical skills of taekwondo athletes.

Keywords: *taekwondo, specialised physical training, training load, endurance.*

Introduction. The issue of synchronising technical and tactical skills with improvements in martial artists' specialised physical fitness is becoming increasingly relevant [1, 6, 7]. A high level of specialised physical fitness is essential for achieving significant sporting results; to this end, we have synchronised it with technical and tactical skills. Virtually all outstanding taekwondo athletes, participants in European and World Cups and Championships, conduct their bouts at a high tempo, combining punches and kicks into combinations and sequences, utilising every situation that arises to execute active manoeuvres [2, 9]. Synchronisation allows for the improvement of technical and tactical skills whilst simultaneously raising the level of the taekwondo athlete's specialised physical fitness during the specialised training period [4, 8].

Objective of the study is to analyse and synchronise technical and tactical skills with the specific physical fitness of taekwondo athletes during the preparatory training period.

Methods and structure of the study. 10 athletes, members of the St Petersburg ITF Taekwondo Junior Team, took part in the Russian ITF Taekwondo Championships (19-23 March 2025 in Sochi). The specialised training period lasted four weeks. All athletes underwent a thorough medical examination and were cleared to take part in training and competition. Training sessions took place six times a week for 2-2.5 hours, depending on the planned workload and objectives. The training programme utilised the repetition-interval method and the circuit training method. Exercises aimed at improving technical and tactical skills were alternated with specific physical conditioning exercises [3, 5]. Table 1 shows the weekly training load.

A specialised methodology designed to coordinate complementary approaches aimed at improving technical and tactical skills and enhancing the level of specific physical fitness among taekwondo athletes was incorporated into the training programme for members of the St Petersburg ITF Taekwondo team in preparation for the Russian Championships.

Cross-country running and sports games were included in the general physical training programme, whilst high-intensity specialised and preparatory exercises were used to improve specific endurance.

To improve a taekwondo athlete's specific endurance, exercises must be performed at a heart rate of 180 bpm and above, as these induce the greatest energy shifts in the body. One of the most effective methods for improving specific endurance in taekwondo athletes is circuit training, and the means of achieving this include: increasing the round duration to 3 minutes or more in sparring, increasing the number of rounds, reducing rest periods between rounds in pre-arranged and free sparring, and training on equipment.

The exercises at each station were performed for three minutes.

Circuit training programme.

First station. Striking a punching bag, alternating in 30-second intervals from 50 to 75% of maximum intensity.

Second station. Jumping rope, alternating the pace in 30-second intervals from moderate to maximum (with double under).

Third station. Striking the bag with the toe, alternating intensity in 30-second intervals from 50 to 75% of maximum intensity.

Fourth station. Alternating forward rolls with a 180-degree turn, simulating technical and tactical movements whilst maintaining balance.

Fifth station. Striking the bag with hands and feet, alternating in 30-second intervals from 50 to 75% of maximum intensity.

Station six. Simulating punches with dumbbells (2–3 kg), alternating in 30-second intervals from 50 to 75% of maximum intensity.

Station 7. Pushing the barbell bar forward from the chest at maximum intensity, alternating in 30-second intervals with the simulation of technical and tactical tasks in attacking and counter-attacking actions.

Table 1. Training load

Days of the week	Direction	Load, min	Direction	Load, min	Load
Monday	SPT	45	STTM	115	Medium
Tuesday	SPT	45	STTM	115	High
Wednesday	GPT	30	STTM	90	Low
Thursday	SPT	45	STTM	115	High
Friday	SPT	45	STTM	115	Medium
Saturday	GPT	30	STTM	90	Low
Sunday	-	0	-	0	Rest

Note: SPT - special physical training, GPT - general physical training

Table 2. Results of baseline tests at the start of the preparatory period

Test subject no.	Test 1 (number of times)	Test 2 (number of times)	Test 3 (number of times)
1	208	72	23
2	207	71	24
3	200	73	25
4	197	70	21
5	205	69	22
6	199	73	23
7	201	68	21
8	203	69	22
9	205	74	24
10	198	73	23
Average	202,3±3,3	71,2±1,8	22,8±1

Table 3. Results of the assessment tests for taekwondo athletes at the end of the specialised training period

Test subject no.	Test 1 (number of times)	Test 2 (number of times)	Test 3 (number of times)
1	215	77	26
2	217	78	27
3	210	79	27
4	208	76	23
5	212	78	24
6	207	75	25
7	211	77	24
8	213	76	25
9	217	80	26
10	205	77	26
Average	211,5±3,3	77,3±1,2	25,3±1,1

Table 4. Results of the assessment tests for taekwondo athletes at the start and end of the pre-competition training period

No.	Test No	Period		Increase	p
		At the beginning	At the end		
1	Test 1 (number of times)	202,3±3,3	211,5±3,3	4,54%	≤0,05
2	Test 2 (number of times)	71,2±1,8	77,3±1,2	8,56%	≤0,05
3	Test 3 (number of bundles)	22,8±1	25,3±1,1	10,96%	≤0,05

Eighth station. Movement and simulation of attacking and counter-attacking actions, delivering strikes with hands and feet, alternating in 30-second intervals from 50 to 75% of maximum intensity.

Results of the study and discussion. Control tests were conducted to assess the effectiveness of a methodology aimed at synchronising the technical-tactical and specialised physical training of taekwondo athletes during the specialised preparation phase.

Control tests to determine the level of specialised physical fitness among taekwondo athletes:

Test 1

– continuous striking of a punching bag with the hands for 1 minute (maximum number of times);

Test 2

– continuous kicking of a punching bag for 1 minute (maximum number of times);

Test 3

– continuous execution of combinations of punches and kicks for 1 minute (maximum number of combinations).

The results of the assessment tests to determine the level of specific physical fitness of taekwondo athletes at the start of the specific training period are presented in Table 2.

Table 3 shows the results of the assessment tests designed to determine the level of physical fitness of taekwondo athletes at the end of the specialised training period.

Table 4 shows the results of the assessment tests designed to determine the level of physical fitness of taekwondo athletes at the start and end of their pre-competition training.

Conclusions. Objective indicators of the development of specific endurance in taekwondo athletes demonstrate the effectiveness of a methodology aimed at synchronising complementary approaches to enhance their specific physical fitness and refine their technical and tactical skills. The athletes have learnt to confidently sustain maximum-intensity effort during training and competition bouts, and to adapt to increases and changes in pace. All members of the St Petersburg ITF Taekwondo national team have significantly improved their level of specialised physical fitness; their speed-strength endurance has increased, and the athletes have become better at adapting to changing match conditions and making quicker decisions to deliver the decisive blow. The results of the 2025 Russian Junior Championships demonstrate the effectiveness of the proposed methodology – the national taekwondo team, comprising all participants in the experiment, took first place in the overall team standings among the country's regions.

Practical recommendations

1. Coaches must monitor the physical condition and well-being of each athlete to prevent overtraining among taekwondo athletes during the specific preparation period.

2. Setting specific objectives and meticulously drawing up a training plan are key to the success of athletes' preparation during the specific training period in taekwondo.

3. Given the high physical and psychological demands of the specific preparation period, it is necessary to relieve athletes' tension through general physical training (GPT) and special physical training (SPT) exercises, which are an effective means of recovery for athletes.

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Criteria for rapid adaptability in judo during the training phase of athletes' preparation

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Abstract

Objective of the study is to identify criteria for rapid trainability in judo athletes during the training phase of their preparation.

Methods and structure of the study. A questionnaire survey was conducted to determine the level of fitness, physical fitness testing was carried out, anthropometric measurements were taken followed by the calculation of physical development indices, and blood group determination was performed. The study was conducted at the Olympic Reserve Sports School in the Vasileostrovsky District of St Petersburg. A total of 34 judo athletes aged between 12 and 14 years, representing all weight categories and with between 3 and 7 years' experience in the sport, were examined.

Results and conclusions. Analysis of the questionnaires revealed the individual timeframes within which judokas achieved a specific level of sporting qualification, enabling them to be divided into two groups: fast learners and slow learners. It was found that the morphological indicators reliably distinguishing fast-training judokas include: low values for the Yarkho-Kaupe weight-height index, the Pigne index and the proportionality index, a normostenic body type, and belonging to blood group III (B). Fast-training judokas outperform slow-training judokas in physical fitness according to the results of two tests: push-ups and forward bends from a standing position on a gymnastics bench.

The data obtained can serve as criteria for the sporting selection of young judokas during the training phase.

Keywords: *judoists, stages of preparation, trainability, training phase, athlete selection.*

Introduction. The development of scientifically sound methods for selecting athletes of different ages and levels of fitness is a pressing issue and requires the close attention of coaches and researchers. A number of studies have been devoted to the issues of athlete selection in combat sports, covering both morphofunctional indicators [3, 5, 8] and the psychophysiological potential of athletes [2, 6]. At the same time, the problem of identifying promising judokas at the early stages of training has not yet been fully resolved.

Objective of the study is to identify criteria for rapid trainability in judo athletes during the training phase of their preparation.

Methods and structure of the study. A questionnaire survey was conducted to determine the level of fitness, physical fitness testing was carried out, anthropometric measurements were taken followed by the calculation of physical development indices, and blood group determination was performed. The study was conducted at the Olympic Reserve Sports School in the Vasileostrovsky District of St Petersburg. A total of 34 judo athletes aged between 12 and 14 years, representing all weight categories and with between 3 and 7 years' experience in the sport, were examined.

Results of the study and discussion. A survey designed to assess the level of trainability among young judokas enabled them to be divided into two groups. The first group comprised fast-training judokas (9 individuals), who took no more than 4 years to achieve the first-level junior sports qualification. The second group consisted of slow-training judokas (11 individuals), who achieved the first-level junior sports qualification after 4-7 years.

As it turned out, in the group of fast-training judokas aged 12-14, significant differences were observed in a number of morphological indicators compared

with slow-training athletes (Table 1). Thus, fast-training judokas are characterised by significantly lower body length, weight-to-height ratio, Pigne's index and proportionality index, relatively short lower limbs and a wide pelvis. This is confirmed by the results of studies on the morphofunctional indicators of martial artists [5, 7, 8].

Based on M.V. Chernorutsky's somatotype classification, it can be concluded that normostenics-characterised by a proportional balance between the body's longitudinal and transverse dimensions-predominate among judokas who adapt quickly to training, whilst athletes who adapt more slowly to training tend to have a more asthenic physique. A study of blood groups in athletes with different levels of trainability revealed a significant predominance of group III (B) among fast-training athletes and group II (A) among slow-training athletes. It appears that the significant number of individuals with blood group III (B) – the phenotype of fast-trained judokas – corresponds to the high speed and coordination capabilities of athletes in this discipline.

When conducting physical fitness tests approved by the Federal Standard for Sports Training at the training stage for the sport of 'judo', significant differences were found in the results of two tests among fast- and slow-training wrestlers: arm flexion and extension in the push-up position and forward bending from a standing position on a gymnastic bench (Table 2). Similar results were obtained in a study of the characteristics of technical and tactical training of student wrestlers at different age stages [1, 4]

Fast training judokas significantly outperformed low training athletes in the results of these tests. As for the indicators in the remaining tests characterising the physical fitness of judokas with different levels of training, it should be noted that there were no significant differences between the groups under study.

It should be noted, however, that in the tests proposed by the Federal Standard for Sports Training in the sport of 'judo', shuttle run is the only test included among those assessing motor coordination. At the same time, the diversity of coordinative types of motor activity requires them to be assessed according to various criteria: the time taken to master a new movement, the time required to alter a combination of movements in accordance with a changed situation, the coordinative complexity of movement sequences, the accuracy and stability of their execution, and the maintenance of stability when balance is disrupted.

All the more so because the differences we observed between fast-training and slow-training judokas show a significant predominance of group III(B) among fast-training athletes, which corresponds to their superior coordination abilities, which evidently ensure their faster trainability in this sport compared to athletes with slow trainability. We therefore believe that, when assessing the physical fitness of 12–14-year-old judokas as they transition to the training phase, it is necessary to include tests such as exercises involving asymmetrical coordination of movements of the arms, legs, head and trunk; tests of balance and vestibular stability; standing long jumps from a starting position with the back and side facing the landing area; forward somersaults.

The absence of significant differences in the results of the 'shuttle run' test between fast-training

Table 1. Comparative assessment of individual typological indicators for judokas in different groups (M+m)

Individual typological indicators	Groups of judokas	
	Fast training (n=9)	Slow training (n=11)
Body length, cm	159,9+2,9	164,5+3,8*
Body weight, kg	49,0+1,5	51,8+1,5
Chest circumference (at rest), cm	83,1+2,9	82,9+4,3
Chest circumference (inhalation), cm	88+2,1	86,8+2,1
Chest circumference (exhalation), cm	80+2,1	79,3+2,1
Chest expansion, cm	8+2,1	7,5+2,1
Body mass index, g/cm	306,4+9,5	314,8+10,2*
Pigne index, u.e.	30,9+0,9	33,4+1,1*
Livi index, %	51,9+1,9	50,3+2,1
Proportionality index, %	74,8+2,2	78,1+2,6*

*Note: n – sample size; M – arithmetic mean; m – standard error of the mean; * – differences between fast-training and slow-training judokas are statistically significant, $p < 0.05$.*

Table 2. Results of physical fitness testing among judokas, M+m

Physical fitness tests	Groups of judokas	
	Fast training (n=9)	Fast training (n=9)
Pull-ups on a 90 cm low bar, number of repetitions	21,4 ± 0,2	19,5 ± 0,3
Push-ups, number of repetitions	51,0 ± 0,5	32,5 ± 0,9*
Forward bend from a standing position on a gym bench, cm	10,3 ± 0,2	4,5 ± 0,4 *
Shuttle run 3 x 10 m, with	7,5 ± 0,2	7,6 ± 0,2
Sit-ups from a supine position (in 30 seconds), number of repetitions	32,7 ± 1,5	27,1 ± 1,3
Standing long jump with a two-foot take-off, cm	203,4 ± 0,6	192,4 ± 0,7

*Note: n – sample size; M – arithmetic mean; m – standard error of the mean; * – differences between fast-training and slow-training judokas are statistically significant, $p < 0.05$.*

and slow-training judokas indicates that using this test alone is insufficient for assessing athletes' coordination abilities. To assess the physical fitness of judoists aged 12-14 when transitioning athletes to the training phase, it is recommended that, in addition to the tests approved by the Federal Standard for Sports Training in the sport of 'judo', the coordination tests mentioned above be included.

Conclusions. The morphological indicators that reliably distinguish fast-training judokas include: low values for the Yarkho-Kaupe weight-to-height index, the Pigne index and the proportionality index; a normostenic body type; and blood group III (B). Among those who train slowly, in most cases there are asthenics with a dolichomorphic body type and belonging to blood group II (A).

Fast-training judokas outperform slow-training ones in physical fitness according to the results of two tests: push-ups and forward bends from a standing position on a gymnastic bench. The data obtained may serve as criteria for the sporting selection of young judokas during the training phase.

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The effect of physical activity on the dynamics of myocardial bioelectrical activity in students

UDC 796.093

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Abstract

Objective of the study is to investigate the effect of the nature of physical activity on the dynamics of myocardial bioelectrical activity in students at an agricultural university.

Methods and structure of the study. A total of 62 students from an agricultural university were examined, from whom two groups were identified based on their levels of physical activity: Group A comprised students who continued to practise selected sports (25 individuals), and Group B comprised students who had stopped practising sport after their third year (41 individuals). The study of myocardial bioelectrical activity in students at an agricultural university was carried out using the results of the standard method for interpreting electrocardiograms. All parameters were recorded three times at each stage of the study: at rest, after a graded physical exercise test, and during the recovery period. A two-stage 'step test' on a 40 cm high step, based on the method of Y.S. Weinbaum, was used as the submaximal graded exercise test. All data obtained from the functional study were analysed using the method of variational statistics.

Results and conclusions. Resting ECG data indicated an improvement in cardiovascular function among students participating in selected sports compared with those who had stopped practising sport. This was reflected in a prolongation of the cardiac cycle by 35.7 beats per minute, and the presence of a high percentage of moderate (68%) and marked (32%) sinus arrhythmia, indicating an increase in cardiac functional reserves among students who engaged in physical exercise throughout their time at university.

Informative indicators for assessing the bioelectrical activity of the students' myocardium under different types of physical activity include: the severity of sinus arrhythmia (ΔRR=0.25–0.50 s), the characteristics of RR intervals, QT intervals and the amplitudes of the P_{II}, R_{II}, T_{II} waves and the total voltage of the R waves in standard electrocardiogram leads.

Keywords: *physical activity, students, bioelectrical activity of the myocardium.*

Introduction. One of the key areas of modern sports science is the study of how the body adapts and improves its physiological functions to achieve optimal performance under various conditions of physical activity.

Numerous works by domestic and foreign authors present the main theoretical approaches to researching adaptation, expanding the range of compensatory capabilities, and increasing the level of functional reserves in students' bodies at different stages of life [3, 15, 16].

Of particular importance is the initial stage of study in the first and second years, which is characterised by a complex period of adaptation for students to the new university environment [10]. One of the conditions for the success of these adaptive changes depends on the organisation of an optimal exercise regime, which contributes to the enhancement of the functional capabilities of the students' major physiological systems [8, 9] .

As students' fitness levels increase, powerful cholinergic reactions develop, one consequence of which is negative chronotropic effects causing a slowing of the heart rate [1, 2]. Due to increased tone in the vagal innervation centres, bradycardia is observed in student athletes. In trained individuals, isotonic cardiac hyperfunction is observed during physical exertion, arising from an increase in cardiac output and the amplitude of heart contractions. Moderate myocardial hypertrophy, combined with some dilation of the heart chambers, is energetically the most economical, as it contributes to increased cardiac efficiency. Such hyperfunction, and therefore hypertrophy, is characterised as 'physiological' [4, 11, 14].

Objective of the study is to investigate the effect of the nature of physical activity on the dynamics of myocardial bioelectrical activity in students at an agricultural university.

Methods and structure of the study. Dynamic studies were conducted among students at the K.A. Timiryazev Russian State Agrarian University – Moscow Agricultural Academy. A total of 62 students were examined, from whom two groups of senior students differing in terms of physical activity were identified: Group A – students who continued to practise selected sports (25 individuals) and Group B – students who had stopped practising sport after their third year (41 individuals).

ECG recordings were made in 12 standard leads (I, II, III – augmented unipolar limb leads aVR, aVL, aVF, unipolar chest leads according to Wilson V_1–V_6).

The study of myocardial bioelectrical activity in students at an agricultural university was conducted using the generally accepted method for interpreting electrocardiograms, including the determination of heart rate, the position of the electrical axis and the electrical position of the heart, the amplitude, shape and direction of the P, Q, R, S and T waves, and the duration of the PQ, QRS and and QT intervals. All parameters were recorded three times at each stage of the study: at rest, after a graded exercise test, and during the recovery period.

A two-stage 'step test' on a 40 cm high step, based on the method of Y.S. Weinbaum, was used as the submaximal graded exercise test. This made it possible not only to assess the adequacy of the responses of the ECG parameters under study following physical exertion, but also to determine the level of the body's physical working capacity during various types of physical activity.

All data obtained from the functional study were analysed using the method of variational statistics, with calculation of the arithmetic mean and the standard deviation. The significance level (P) was determined.

Results of the study and discussion. Analysis of the ECG parameters revealed that, on average, both the interval and amplitude data for the majority of the students examined during the initial period of their university studies were within physiological norms [6, 7].

The electrocardiographic data of the students examined during their fourth year of study are presented in Tables 1 and 2. Studies have shown that senior students in Group A, who continued to engage in

Table 1. Changes in students' ECG interval parameters during their time at university (M±m)

Indicators		Stages of the study	Second year – Stage II (n=66)	Fourth year (n=62)			P IV-A	P IV-B
				Group A	Group B	P A-B		
RR		Rest	0,87±0,01	0,98±0,03	0,81±0,03	0,001	0,001	0,11
		Physical activity	0,53±0,02	0,56±0,03	0,42±0,02	0,001		0,001
		Recovery period	0,71±0,01	0,78±0,02	0,61±0,05	0,003	0,003	0,05
HR		Rest	71,2±1,04	61,2±4,36	74,0±3,52	0,001	0,01	0,001
		Physical activity	118,8±1,83	107,1±3,90	142,8±5,55	0,001	0,06	0,01
		Recovery period	85,6±2,12	76,9±4,07	98,3±4,20	0,32	0,11	0
PQ		Rest	0,15±0,002	0,16±0,006	0,15±0,008	0,32	0,11	0
		Physical activity	0,14±0,005	0,15±0,005	0,15±0,016	0	0,16	0,55
		Recovery period	0,15±0,003	0,16±0,007	0,15±0,005	0,24	0,20	0
QRS		Rest	0,09±0,002	0,09±0,004	0,08±0,006	0,17	0	0,11
		Physical activity	0,09±0,002	0,09±0,006	0,08±0,005	0,24	0	0,11
		Recovery period	0,09±0,004	0,09±0,004	0,08±0,005	0,12	0	0,11
QT	Actual	Rest	0,37±0,005	0,40±0,009	0,38±0,008	0,10	0,006	0,28
		Physical activity	0,31±0,002	0,32±0,010	0,28±0,009	0,006	0,32	0,002
		Recovery period	0,35±0,003	0,35±0,014	0,34±0,010	0,55	0	0,06
	Target	Rest	0,36±0,002	0,39±0,012	0,35±0,007	0,007	0,016	0,016
		Physical activity	0,28±0,003	0,31±0,009	0,25±0,008	0,001	0,003	0,001
		Recovery period	0,33±0,004	0,34±0,007	0,30±0,010	0,003	0,23	0,007
L∞QRS		Rest	71,3±3,58	75,2±5,68	72,3±4,92	0,69	0,55	0,84
		Physical activity	76,6±2,95	77,7±5,61	74,3±5,27	0,69	0,84	0,69
		Recovery period	73,0±2,48	74,2±4,84	73,2±7,06	0,92	0,84	0,92

regular physical exercise either independently or through sports clubs, exhibited statistically significant changes in ECG parameters, indicating an overall improvement in cardiovascular function, compared with students in Group B, who had stopped regular exercise after their third year.

Evidence of improved cardiac function and mobilisation of the heart's functional reserves was provided by a prolongation of the resting heart cycle (RR interval), attributable to vagal tone, and a more appropriate response in heart rate following graded exercise, averaging 107.1 bpm in group A compared with 142.8 bpm in group B. This, together with a more rapid recovery of ECG data, generally indicated an improvement in the quality of the deployment of reserve adaptive mechanisms in senior students who continued to engage in physical exercise. An individual analysis of the degree of sinus arrhythmia showed that in students in Group A, in the majority of cases (68%), the difference in the RR interval (ΔRR) ranged from 0.21 to 0.35 s, corresponding to a moderate degree of sinus arrhythmia. A pronounced degree of sinus arrhythmia (ΔRR = 0.36–0.50 s) was observed in 32% of cases, indicating a rational parasympathetic influence on the activity of the sinus node. No cases of severe sinus arrhythmia (ΔRR ≥ 0.50 s) were noted in group A. However, in Group B, cases of severe arrhythmia were observed (ΔRR = 0.65–0.75 s) in conjunction with repolarisation processes, a reduction in total RR voltage, T_6 syndrome and other changes, indicating the negative impact of limited physical activity during the final period of university study. This was also evidenced by other ECG parameters: mean values of the electrical systole (QT interval), which in students of Group B exceeded normal values both at rest and after physical exertion, particularly during the recovery period (T_{11} by 6–13%).

An analysis of the amplitude parameters of the electrocardiograms of final-year students revealed that in Group A, against the backdrop of increasing fitness levels, positive changes were observed, manifested as an increase in the amplitude of the RII, R and TII waves, alongside a slight decrease in the amplitude of the average PII wave. The changes observed in Group A are associated with the development of physiological myocardial hypertrophy, caused by the continuation of regular physical exercise during university studies [5, 8, 12, 13].

At the same time, in Group B, a significant reduc-

Table 2. Changes in students' ECG amplitude parameters during their time at university (M±m)

Indicators	Stages of the study	Second year – Stage II (n=66)	Fourth year (n=62)			P IV-A	P IV-B
			Group A	Group B	P		
PII	Rest	1,42±0,05	1,36±0,10	2,32±0,15	0,001	0,62	0,001
	Physical activity	2,04±0,10	2,05±0,18	3,42±0,15	0,001	0,92	0,001
	Recovery period	1,65±0,06	1,60±0,13	2,83±0,14	0,001	0,69	0,001
RII	Rest	11,7±0,62	13,5±0,88	9,4±0,84	0,002	0,09	0,03
	Physical activity	13,0±0,44	15,2±0,90	14,1±0,89	0,37	0,03	0,28
	Recovery period	12,2±0,71	14,2±0,72	10,3±0,93	0,002	0,05	0,09
ΣR	Rest	25,3±1,45	28,7±1,75	23,4±1,50	0,03	0,14	0,37
	Physical activity	27,2±1,33	31,3±1,56	26,5±1,79	0,05	0,05	0,76
	Recovery period	26,3±1,39	27,1±1,72	22,2±1,81	0,05	0,69	0,08
SII	Rest	1,07±0,14	1,50±0,53	1,35±0,48	0,84	0,43	0,55
	Physical activity	1,98±0,22	2,04±0,59	1,90±0,67	0,84	0,92	0,92
	Recovery period	1,63±0,17	1,75±0,35	1,62±0,44	0,84	0,76	0,92
TII	Rest	4,44±0,19	5,41±0,38	2,55±0,41	0,001	0,02	0,001
	Physical activity	4,75±0,20	5,84±0,28	3,54±0,30	0,001	0,003	0,001
	Recovery period	4,37±0,22	5,63±0,43	2,07±0,54	0,001	0,012	0,001
TV_2	Rest	3,34±0,27	3,37±0,65	3,03±0,40	0,62	0,92	0,48
	Physical activity	3,53±0,43	3,51±0,51	3,41±0,67	0,92	0,92	0,84
	Recovery period	3,31±0,32	3,39±0,55	3,30±0,49	0,92	0,92	0,92
TV_5	Rest	6,02±0,30	6,20±0,36	4,53±0,50	0,009	0,69	0,012
	Physical activity	5,56±0,36	5,61±0,58	4,03±0,53	0,05	0,92	0,02
	Recovery period	5,47±0,25	5,53±0,63	4,22±0,44	0,10	0,92	0,016

tion in the amplitude of the ECG waves in question was observed, which, in the presence of an enlarged P_{11} wave, indicated an overall deterioration in the bioelectrical activity of the myocardium in these students.

Conclusions. Resting ECG data indicated an overall improvement in cardiovascular function among students in Group A compared with those in Group B. This was reflected in a prolongation of the cardiac cycle by 35.7 beats per minute, a high proportion of cases with moderate (68%) and marked (32%) sinus arrhythmia, which indicated an increase in cardiac functional reserves among students who engaged in physical exercise throughout their time at university.

Thus, informative indicators for assessing the bioelectrical activity of the students' myocardium under different types of physical activity are: the degree of severity of sinus arrhythmia (ΔRR=0.25–0.50 s), the characteristics of RR intervals, QT intervals and the amplitudes of the Pii, Rii, Tii waves, and the total voltage of the R waves in standard electrocardiogram leads.

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The effect of auditory and sensory stimuli – from contemporary music subcultures – on the functional state of young athletes

UDC 61

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Abstract

Objective of the study is to determine the impact of contemporary musical styles (rock, electronic music, rap) on the mental and functional states of young athletes.

Methods and structure of the study. First-year students of the Faculty of Physi-cal Education and Sports at Ulyanovsk Pedagogical University, aged 18-20, participated in the study (40 males and 30 females). Cardiorespiratory parameters were determined: heart rate (HR), respiratory rate (RR), blood pressure (BP), physical fitness level (PCL) according to the Pirogova method (1986), and state anxiety indicators according to the Spielberg-Khanin method (1976), before and after listening to music of the specified genres.

Results and conclusions. Baseline HR values were 63.71 ± 3.42 bpm and 64.23 ± 1.31 bpm for males and females, respectively. Listening to music of each of the specified genres causes an increase in heart rate and blood pressure in all subjects. Rap increases heart rate by an average of 6% and blood pressure by 3%; electronic music – heart rate by 8% and blood pressure by 5%, rock – heart rate by 14% and blood pressure by 9%. Changes in respiratory rate are similar. At rest, it is 13.71±0.57 times/min in young men and 15.77±0.31 times/min in young women. Rap increases respiratory rate by 7%, electronic music by 14%, and rock by 28%. Before listening to music, the UFS is 0.714±0.03 conventional units and is assessed as “above average”. The UFS of young women is 0.712±0.05 conventional units and is assessed as “high”. After listening to music, the functional state of both boys and girls decreases and moves to a lower functional class: "average" for boys, "above average" for girls. Listening to rock music causes the greatest decrease in the functional state level. In boys, the functional state decreases by 16.53% (0.596 ± 0.02 standard units), and in girls, by 22.75% (0.550 ± 0.01 standard units).

The average group level of state anxiety in boys before listening to music is 35.71 ± 1.14 points, assessed as "moderate." After listening to rap, it remains within the "moderate" range, but increases to 38.0 ± 0.86 points (6.4% of the baseline). After listening to electronic music, the average group anxiety score increased to 39.0±1.43 points (a 9.2% increase from the baseline), and after listening to rock music, it increased to 43.14±1.71 points (a 20.8% increase).

Girls had significantly higher baseline anxiety levels than boys, at 43.85±0.77 points, falling somewhere between "moderate" and "high." After lis-tening to rap, the average group anxiety score increased to 45.77±0.69 points (a 4.4% increase), placing the anxiety level at "high." After listening to electronic music, the anxiety level increased to 47.85±0.85 points (a 9.1% increase), and after listening to rock music, it reached 52.92±0.77 points, an increase of 20.7%.

Keywords: *musical subcultures, functional state of the body, cardiorespiratory system, heart rate, blood pressure, respiratory rate, level of physical fitness, psychophysiological state, situational anxiety.*

Introduction. Nowadays, music is one of the most accessible art forms and is extremely popular amongst young people in education. Engaging with music requires little effort, intense concentration or significant financial outlay [2, 4, 9]. The specific nature of music’s impact on human mental and physiological functions has long been of interest to researchers in the ancient world; these studies are particularly relevant today, when people’s lives are overwhelmed by information, noise and stressors [1, 3, 7, 8, 10, 19, 21, 22, 25, 26, 28]. People’s musical preferences have also changed, leading to the formation of various groups and communities of fans of particular styles and genres [1, 5, 6, 11–14].

Today, there are numerous youth music styles, each of which has its own followers aged between

14 and 25, a period when a person's personality is formed [9, 11, 16, 17]. The most interesting of these (rock, electronic music, rap) are those around which stable subcultures have already formed; it is precisely such major trends that shape the spiritual outlook and worldview of the younger generation [5, 6, 23, 24, 27].

Objective of the study is to determine the impact of contemporary musical styles – subcultures – on the physical and mental well-being of young athletes.

Methods and structure of the study. This study was conducted at the Functional Diagnostics Laboratory of the Department of Human Biology and Foundations of Medical Knowledge at Ulyanovsk State University of Education named after I.N. Ulyanov at the start of the first semester of the 2025–2026 academic year. The study involved 70 first-year students from the Faculty of Physi-cal Education and Sport, aged 18-20 (40 males and 30 females).

In accordance with the aim of this study, changes in the parameters of the subjects' functional and mental states under the influence of rock, rap and elec-tronic music were determined. Heart rate (HR), respiratory rate (RR), blood pres-sure (BP) and level of physical fitness [15], and situational anxiety scores using the Spielberger-Hanin method [20], both before and after listening to the speci-fied genres of music for 30 minutes. For each musical genre, the study included 10 repetitions (conducted over 10 days), and the mean values of the studied indicators were determined.

Results of the study and discussion. The results of the study are presented in Table 1. As can be seen, the blood pressure readings for both young men and women prior to listening to music fall within the age-related normal range and are as follows: systolic pressure – 117.71 ± 2.42 mm Hg and 123.15 ± 1.92 mm Hg respectively; diastolic pressure – 75.86 ± 1.72 mm Hg and 80.15 ± 1.23 mm Hg respectively.

Listening to music of each genre (rap, electronic music, rock) causes an in-crease in blood pressure in all subjects. In young men, rap caused an increase in blood pressure on average from 118/80 mm Hg to 122/80 mm Hg; electronic music to 123/82 mm Hg; and rock to 129/86 mm Hg. These musical genres have a similar effect on the blood pressure of young women, raising it from 123/80 mm Hg to 127/84 mm Hg for rap, to 129/85 mm Hg for electronic music, and to 134/89 mm Hg Thus, rap raises blood pressure by approximately 3%, electronic music by 5%, and rock by 9%.

In young men, heart rate after listening to rap rises on average from 64 bpm to 68 bpm, after listening to electronic music to 70 bpm, and after listening to rock to 73 bpm. In young women, the heart rate increases from 64 bpm to 67 bpm after listening to rap, to 68 bpm after electronic music, and to 73 bpm after rock. Thus, rap increases the heart rate by an average of 6%, electronic music by 8%, and rock by 14%.

Listening to these genres of music also increases the respiratory rate. Whilst at rest, the average respiratory rate for young men is 14 breaths per minute, and for young women 16 breaths per minute, after listening to rap the figure rises to 15 and 17 breaths per minute, after listening to electronic music to 16 and 18 breaths per minute, and after listening to rock to 18 and 19 breaths per minute, respectively. In percentage terms, rap increases the respiratory rate by 7%, electronic music by 14%, and rock by 14% after listening to music associated with contemporary youth sub-

Table 1. Cardiorespiratory parameters of the subjects before and after listen-ing to music

Musical genre	Systolic BP, mm Hg		Diastolic BP, mm Hg		HR, bpm		RR, breaths per minute	
	1	2	1	2	1	2	1	2
Young men								
Rap	117,71±2,42	121,71±2,57	75,86±1,72	80,42±1,43	63,71±3,42	68,14±3,57	13,71±0,57	15,29±0,71
Electronic music	117,71±2,42	123,71±2,14	75,86±1,72	82,71±1,14	63,71±3,42	69,57±3,57	13,71±0,57	16,43±0,43
Rock	117,71±2,42	128,88±1,43	75,86±1,72	85,86±0,86	63,71±3,42	73,00±2,86	13,71±0,57	17,57±0,43
Young women								
Rap	123,15±1,92	127,46±1,77	80,15±1,23	84,31±1,15	64,23±1,31	66,84±1,38	15,77±0,31	17,31±0,32
Electronic music	123,15±1,92	128,92±1,77	80,15±1,23	85,46±1,31	64,23±1,31	67,84±1,31	15,77±0,31	17,77±0,15
Rock	123,15±1,92	133,69±1,15	80,15±1,23	88,61±1,15	64,23±1,31	72,46±1,07	15,77±0,31	18,54±0,07

1 – baseline values; 2 – values following exposure to music

Table 2. Levels of physical condition and situational anxiety among partici-pants before and after listening to music from various musical subcultures

Musical genre	PFL, standardised units		Level of situational anxiety, points	
	1	2	1	2
Young men				
Rap	0,714±0,03 above average	0,663±0,04 average	35,71±1,14 moderate	38,0±0,86 moderate
Electronic music		0,653±0,02 average		39,0±1,43 moderate
Rock		0,596±0,02 average		43,14±1,71 moderate
Young women				
Rap	0,712±0,005 high	0,661±0,01 above average	43,85±0,77 moderate	45,77±0,69 high
Electronic music		0,600±0,01 above average		47,85±0,85 high
Rock		0,550±0,01 above average		52,92±0,77 high

1 – baseline values; 2 – values following exposure to music

cultures. Before listening to music, the young men's physical fitness level (PFL) is 0.714±0.03 standard units and is assessed as 'above average'. The PFL for young women is 0.712±0.05 standard units and is classified as 'high'. After listening to music, the PFL for both young men and young women decreases and shifts to a lower functional class: 'average' for young men and 'above average' for young women. After listening to rap, the PFL for young men is 0.663±0.04 standard units (a decrease of 7.14%), and for young women it is 0.661±0.01 standard units (a decrease of 7.16%). After listening to electronic music, the PFL for young men decreased by 8.54% to 0.653±0.02 conventional units, whilst for young women the decrease was 15.73% to 0.600±0.01 conventional units. Listening to rock music causes the greatest decline in functional status. In young men, PFL decreases by 16.53% (0.596 ± 0.02 standard units), and in women by 22.75% (0.550 ± 0.01 standard units). Thus, listening to contemporary youth music genres leads to a deterioration in the cardiorespiratory system and physical condition of the subjects. Rock music has the greatest negative impact compared to electronic music and rap.

Emotional tension is a key component of human adaptive behaviour. Anxiety is the most pronounced emotional reaction that arises when the balance between the human organism and the environment is disrupted. A state of anxiety (situational anxiety) manifests itself through individual emotions such as tension, restlessness and agitation. This is an emotional reaction to a change in familiar environmental conditions, a mismatch between a person's needs and the means to satisfy them, or an inability to cope with the demands of a specific situation. The level of situational anxiety varies depending on whether a person perceives their surroundings as dangerous and threatening or assesses them as friendly and reliable.

The mean group score for situational anxiety (Table 2) among the young men before listening to music was 35.71 ± 1.14 points, which is classified as a 'moderate' level of anxiety. After listening to rap, although it remains within the 'moderate' range, it increased to 38.0 ± 0.86 points (a 6.4% increase from base-line); after listening to electronic music, it rises to 39.0 ± 1.43 points (an increase of 9.2% from the baseline), and after listening to rock music, to 43.14 ± 1.71 points (an increase of 20.8%).

Among young women, the baseline anxiety level is much higher than among young men, standing at 43.85 ± 0.77 points, situated on the borderline between 'moderate' and 'high' levels. After listening to rap, the group average anxiety score increased to 45.77 ± 0.69 points (by 4.4%), with the anxiety level becoming 'high'. After listening to electronic music, the anxiety level rises to 47.85±0.85 points (by 9.1%); after listening to rock music, it reaches 52.92±0.77 points, increasing by 20.7%.

Conclusions. The study thus demonstrated a deterioration in functional status (cardiorespiratory parameters) and an increase in situational anxiety among athletes aged 18–20 under the influence of contemporary youth music genres. Young people appear to be most vulnerable to the negative effects of rock music compared to electronic music and rap. The data obtained may be useful to teachers and staff at educational institutions in the field of physical education and sport when developing mental health recommendations for young people in education, with the aim of preventing anxiety in them; this, in turn, may help to strengthen the psychophysiological health of today's youth.

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Assessment of the morphological profile of young swimmers using bioimpedance analysis of body composition

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Abstract

Objective of the study is to determine the characteristics of body composition and phase angle in young athletes prior to commencing regular swimming training.

Methods and structure of the study. A bioimpedance analysis of the body composition of young athletes aged 7 (a total of 67 participants, comprising 25 girls and 42 boys) with no prior experience of regular swimming training was conducted. The ABC-01 'Medass' device was used to assess body fat mass, body fat percentage, skeletal muscle mass and skeletal muscle percentage, active cellular mass, phase angle and body type.

Results and conclusions. It has been established that in young athletes who are beginning to swim regularly, the key body composition parameters fall within the age-appropriate range. However, boys tend to have a higher proportion of lean body mass and a higher level of active cellular mass, whilst girls have a higher percentage of adipose tissue. Phase angle indices in both groups correspond to low values, reflecting the functional immaturity of cell membranes in children of this age. A predominance of the ectomeso-morphic body type was identified, indicating harmonious physical development and favourable conditions for young athletes to master swimming movements.

Keywords: *: young swimmers, bioimpedance analysis, body composition, initial training, pedagogical monitoring, somatotype.*

Introduction. Modern athlete training is a complex and dynamic process, the effectiveness of which depends largely on the extent to which the individual characteristics of the athletes, as well as their level of functional and physical development (the condition of their bodily systems, optimal body dimensions, and body composition), are taken into account when selecting training methods and techniques. In this regard, in-depth assessment of anthropometric indicators becomes particularly relevant, especially during the initial training phase [1, 2].

Swimming is a sport in which morphological characteristics and body composition have a significant impact on competitive performance. An optimal ratio of fat, muscle and lean body mass contributes to improved hydrodynamic qualities, movement efficiency and the athlete's overall performance capacity. In particular, for swimmers, a specific body composition is regarded as one of the factors determining their performance in competition; therefore, monitoring this indicator is important at all stages of training and is taken into account in the management of the training process [3].

Objective of the study is to determine the characteristics of body composition and phase angle in young athletes prior to commencing regular swimming training.

Methods and structure of the study. The study was conducted at the 'Neftyanik' Sports School in Surgut in 2025. The testing involved 67 young athletes aged 7 (25 girls and 42 boys) who were beginning regular swimming training. Measurements were taken of height, body weight, and chest, waist and hip circumferences. Body composition analysis was carried out using bioimpedance analysis with the Medass ABC-01 multi-frequency analyser.

Results of the study and discussion. An analysis of body composition and phase angle revealed that,

among young swimmers enrolled in first-year beginner training groups and assessed prior to the start of systematic training sessions, the key indicators fell within the age-appropriate range, whilst gender differences and signs of functional immaturity were identified (Table 1).

Boys exhibited higher group-mean values for skeletal muscle mass and active cellular mass, as well as a higher proportion of SMM, indicating a predominance of lean body mass and intensive muscle development. This may be linked to higher levels of physical activity and individual rates of somatic growth. Girls exhibited slightly higher fat mass values whilst maintaining an overall balanced body composition. Such differences correspond to the physiological manifestations of sexual dimorphism and reflect the characteristics of energy metabolism in childhood [1, 2].

The distribution of individual bioimpedance measurements among young swimmers by level showed that in the majority of children, the proportion of fat mass is within the normal range (Fig. 1).

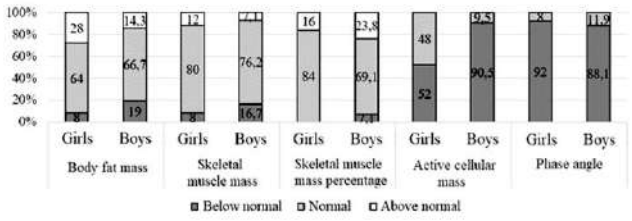

Figure 1. Distribution of individual bioimpedance measurements for young swimmers by performance level (in %)

The higher proportion of boys with low body fat reflects the increased energy expenditure and high levels of physical activity typical of this age group. In contrast, a higher proportion of girls were found to have increased body fat mass, which may be linked to the physiological characteristics of fat metabolism and the early development of hormonal mechanisms regulating energy metabolism [2].

Analysis of SMM indices revealed that the majority of children had values within the age-specific normal range. The greater variability in indicators among boys indicates the influence of somatotropic growth factors and individual rates of physical development. Among girls, the more uniform distribution of SMM values reflects the balance of metabolic processes and the morphological maturation of muscle tissue [2, 4].

The distribution of relative skeletal muscle mass (% SMM) showed reduced values in 7.1% of boys; no such cases were recorded in girls, whilst values exceeding age-specific norms were observed in 23.8% of boys and 16% of girls. % SMM is one of the key criteria for a child's morphofunctional maturity and an indicator of the harmony of physical development [1, 3]. Elevated values indicate the formation of a 'muscular' body type and the development of lean body mass, which is consistent with their naturally higher levels of physical activity and growth rates [3, 4].

ACM characterises the number of metabolically active cells and reflects the level of anabolic processes and energy metabolism in the body. A prevalence of low values in boys may indicate limited cellular activity resources and a possible energy deficit associated with rapid growth rates and high levels of physical activity. In girls, more balanced indicators may indicate the stability of metabolic processes and better adaptation at the initial stage of physical development [1, 3].

In the majority of the children examined, phase angle values were below the age-specific norm [4]. Physiologically low PA values indicate insufficient functional maturity of cell membranes, reduced intracellular hydration and a low level of energy metabolism, which is characteristic of children before the start of systematic training.

Table 1. Bioimpedance analysis results for young swimmers

Indicators	Girls			Boys		
	M±m	Max	Min	M±m	Max	Min
Body fat mass (kg)	4,46±0,47	10	1,3	3,53±0,27	8,2	1,2
Body fat percentage (%)	16,75±1,15	26,3	6,8	13,90±0,80	28,3	5,4
Skeletal muscle mass (SMM) (kg)	7,10±0,31	11,5	4,8	9,14±0,27	13,1	6,3
Skeletal muscle mass percentage (%)	33,98±0,63	46	30	43,00±0,66	51,2	34,8
Active cellular mass (ACM) (kg)	9,01±0,37	14,3	6,5	9,14±0,18	12,6	7,0
Phase angle (PA) (degrees)	4,26±0,09	5,17	3,2	4,26±0,06	5,05	3,32

Regarding the risk of metabolic syndrome, it should be noted that in 29.3% of boys and 69.2% of girls, the values correspond to the 'very low' level, and in 63.4% and 30.8% respectively – 'low'. An increased risk was identified in only 7.3% of boys. These results indicate a favourable state of lipid metabolism and the absence of signs of metabolic dysfunction. The data obtained characterise young swimmers as a metabolically stable group, ready for gradual inclusion in the training process with regular monitoring of body weight and physical performance [1, 2].

Analysis of the somatotype of young swimmers revealed a heterogeneous morphological profile (Fig. 2), with the ectomesomorphic body type predominating in the majority of children.

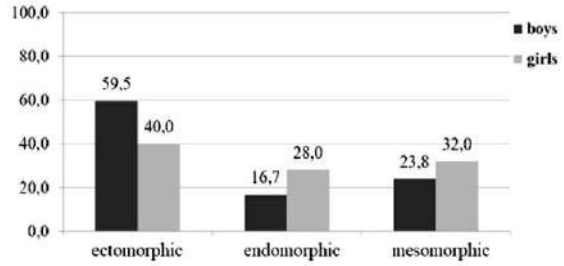

Figure 2. Distribution of somatotypes among young swimmers enrolled in the first year of the introductory training programme (in %)

Boys are more typically characterised by a combination of slenderness and moderately developed musculature, with a low body fat percentage. Girls exhibit a more varied distribution of somatotypes and a slightly higher prevalence of variants with an endomorphic component [1, 2, 3].

Thus, it is appropriate to consider the results obtained in the context of current views on the initial sports training of children, where the primary objective is not selection based on morphological characteristics, but the creation of conditions for harmonious physical development and the formation of a motor foundation. In this regard, the identified characteristics of body composition should be interpreted as the initial morphofunctional background, rather than as a criterion for sporting potential.

From a pedagogical point of view, the identified variability in body composition indicators is of particular interest. It indicates the heterogeneity of beginner training groups in terms of their level of morphofunctional maturity. In the context of standardised programmes, this requires a flexible approach to the intensity of training loads, particularly during the stage of acquiring swimming skills.

Conclusions. It has been established that the physical development of 7-year-old children with no prior experience of regular swimming lessons, who were assessed prior to the start of the training programme, generally corresponds to age-appropriate standards. Body composition is characterised by a harmonious ratio of fat, skeletal muscle and active cellular mass. The obtained indicators reflect the initial morphofunctional status of young swimmers at the stage of enrolment in beginner training groups and can be used as a baseline for subsequent monitoring.

A comprehensive assessment of body composition and somatotypological characteristics can be used as an element of a pedagogical monitoring system aimed at ensuring harmonious physical development, improving the effectiveness of swimming instruction and maintaining the health of young swimmers during the initial sports training phase.

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Cortisol levels in athletes during their adaptation to physical exercise

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Abstract

Objective of the study is to investigate cortisol excretion levels in boys aged 11–15 under conditions of increased physical exertion.

Methods and structure of the study. The study involved ice hockey players aged 11–15 and boys from a control group who were undergoing physical training as part of the general school curriculum. The excretion of bound (Cb) and free (Cf) cortisol in urine was studied. The concentration of Cb was determined by chemiluminescent immunoassay on microparticles using the ARCHITECT i optical system (manufactured in the USA). Free cortisol (Cf) was determined using an enzyme-linked immunosorbent assay (ELISA) with the URINARY 'FREE' CORTISOL ELISA (EIA-2989) kit (manufactured in Germany). A functional test in the form of a graded bicycle ergometer exercise test was used.

Results and conclusions. Increased physical exertion is the dominant factor in the development of glucocorticoid function in the adrenal cortex of boys aged 11–15. High values of Cf and Cb in young ice hockey players, exceeding those of boys in the control group, indicate the stressful impact of physical exertion, particularly in the early stages of the training process. A decrease in Cf at the age of 15 against a background of stable Cb values, observed both at rest and following a controlled physical workload, may indicate the formation of a glucocorticoid reserve during training and an increase in children's resistance to increased physical workload with age.

Keywords: *cortisol, adolescents aged 11–15, hockey, adaptive responses.*

Introduction. Cortisol plays a key role in the mechanism by which short-term adaptive responses transition into the full development of long-term adaptation to physical exertion. In doing so, it not only mobilises the body's plastic functions, creating a pool of free amino acids to support the formation of fats and carbohydrates, but also prevents excessive tissue responses to stress through temporary regulatory suppression of hormone synthesis [3]. Of particular importance when assessing the glucocorticoid function of the adrenal cortex (AC) is the separate study of the levels of free and bound cortisol. The transcortin-glucocorticoid complex has no hormonal activity; it serves to transport glucocorticoids to tissues and acts as a rapidly mobilisable reserve [1]. The effect of physical exercise on AC function in children and adolescents has been studied by a number of researchers; however, in most studies, the activity of regulatory systems is considered merely as an indicator of the child's physical fitness, without taking into account age-related characteristics [5, 6]. At the same time, persistently elevated cortisol levels suppress the biosynthesis and secretion of androgens, leading to delayed growth and puberty in children [2, 4]. Therefore, excessive physical exertion can cause serious endocrine and cardiovascular disorders in young athletes.

Objective of the study is to investigate cortisol excretion levels in boys aged 11–15 under conditions of increased physical exertion.

Methods and structure of the study. The study involved 40 ice hockey players aged 11–15 (sports

class) and 38 boys from the control class who were undergoing physical training as part of the general school curriculum. The excretion of free (Cf) and bound (Cb) cortisol in urine was studied. Cb levels were determined by chemiluminescent immunoassay on microparticles using the ARCHITECT i optical system (manufactured in the USA). Cf was determined using an enzyme-linked immunosorbent assay (ELISA) method with the URINARY 'FREE' CORTISOL ELISA (EIA-2989) kit (manufactured in Germany). To assess the reserve capacity of the AC, a graded exercise test was performed on the 'RITM' VE-05 bicycle ergometer for three minutes at a load of 1.5 W per 1 kg of body weight.

Statistical analysis of the data was performed using methods of variational statistics with the Microsoft Excel Windows 2010 software package. To assess the significance of differences, a t-test based on Student's t-criterion was used.

Results of the study and discussion. It was found that daily Cf excretion in athletes aged 12 to 14 years varies only slightly, ranging from 206.01±8.31 to 242.80±14.10 nmol/day, whilst at the age of 15, a significant decrease of 32.77 nmol/day was observed compared with 14-year-olds ($p<0.05$) (see Table). Such age-related dynamics of cortisol levels are inconsistent with the literature data on the patterns of adrenal cortex function development with age [2, 3] and differ from the indicators for boys in the control group, in whom Cf excretion at 12, 13 and 14 years was 1.6–1.9 times lower than that of the athletes ($p < 0.05$), whilst a significant increase was observed from 13 to 14 and 15 years.

It was further established that the levels of Cf and Cb in young ice hockey players change in opposite directions with age – against a background of a decrease in Cf from 14 to 15 years of age, consistently high values of Cb (ranging from 56.18±2.80 to 60.32±4.06 µg/day) and a significant increase at age 13 ($p<0.05$) (Table 1). This may indicate the formation of a rapidly mobilisable and sufficiently stable reserve of glucocorticoids during the long-term adaptation of children to increased physical exertion. It is also known that a constantly replenished reserve of the hormone may act as a buffer, stabilising the levels of free cortisol under various physiological conditions of the body [1].

In the control group, Cb excretion follows the same pattern as Cf; it remains stable between the ages of 11 and 13 (ranging from 32.45±1.34 to 39.84±1.69 µg/day), increases by the age of 14 ($p<0.05$) and reaches its peak at the age of 15 (Table 1).

Dosed physical exercise causes shifts in cortisol excretion, the nature of which depends on the athletes' age. Thus, in 11-, 12- and 13-year-old ice hockey players, an increase in Cf excretion is observed in response to exercise, which is most pronounced at the age of 11 – 118.70 nmol/h ($p<0.05$), at 12 years of age it amounts to 39.04 nmol/h ($p < 0.05$), and at 13 – only 22.80 nmol/h, which is not statistically significant. However, at the ages of 14 and 15, the response takes on a different character, with a significant decrease in Cf excretion observed, amounting to 41.17 nmol/h ($p < 0.05$) (22.69%) and 37.54 nmol/h ($p < 0.05$) (18.71%) at these respective ages. It is likely that with age, as the fitness of young hockey players improves, their bodies' resistance to muscular exertion as a stressor increases (Figure 1).

Table 1. Excreta levels of free (Cf) and bound (Cb) cortisol in boys aged 11–15 years from the sports and control groups (M±m)

Indicators		Age				
		11	12	13	14	15
Cf, nmol/day	SC	219,89±12,42	221,60±14,02	242,80±14,10	206,01±8,31	*173,24±6,05
		•	•	•	•	
	CC	120,62±4,80	132,96±5,92	130,25±5,02	*169,30±7,37	*200,73±7,00
Cb, µg/day	SC	42,92±1,84	38,45±1,75	*54,00±3,00	60,32±4,06	56,18±2,80
		•	•	•	•	
	CC	33,14±1,81	32,45±1,34	39,84±1,69	*46,30±1,90	*60,86±3,82

Note: SC – sports class, CC – control class;

** – differences are statistically significant compared with the previous age group ($p < 0.05$);*

• – differences are statistically significant between SC and CC ($p < 0.05$).

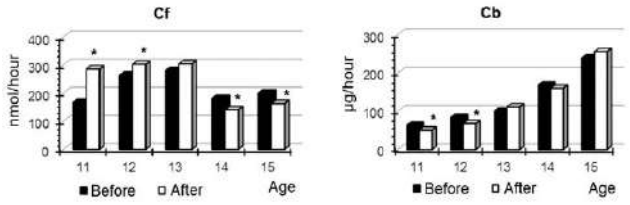

Figure 1 Changes in the excretion of free (Cf) and bound (Cb) cortisol in ice hockey players aged 11–15 in response to a graded exercise test

*Note: Differences are statistically significant compared with rest * – $p < 0.05$*

A different pattern is observed in potassium excretion: unlike free potassium, a graded exercise test causes a statistically significant decrease in potassium excretion in 11- and 12-year-old athletes, amounting to 13.31 μg/h ($p < 0.05$) and 16.25 μg/h ($p < 0.05$), respectively. A decrease in cortisol reserve combined with a sharp increase in Cf may indicate functional stress on the adrenal cortex in young ice hockey players during the adaptation phase to intense muscular activity. With age, Cb excretion stabilises – at 14 and 15 years of age, it is virtually indistinguishable from pre-exercise values – 168.84±10.00 μg/h and 160.45±13.00 μg/h; 240.09±12.00 μg/h and 256.00±18.60 μg/h, whilst at the age of 13 there is a clear tendency towards an increase of 11.29 μg/h (Fig. 1).

Conclusions. Increased physical exertion is the dominant factor in the development of glucocorticoid function in the adrenal cortex of boys aged 11–15. High Cf and Cb levels in young ice hockey players, exceeding those of boys in the control group, indicate the stressful impact of physical exertion, particularly in the early stages of the training process. A decrease in Cf at the age of 15 against a background of stable Cb values, observed both at rest and following a controlled physical workload, may indicate the development of a glucocorticoid reserve during training and an increase in children's resistance to increased physical workload with age.

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Improving the functional capabilities of schoolchildren aged 7–11 with respiratory diseases

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Abstract

Objective of the study is to improve respiratory function in primary school-aged children with respiratory conditions through physical exercise.

Methods and structure of the study. The educational experiment was conducted from 13 January to 16 April 2025 in a specialised therapeutic physical education hall. Children from the experimental group attended the Moscow Centre for Kinesiotherapy three times a week and performed special sets of physical exercises for the respiratory system for 60 minutes. The pupils' overall endurance was assessed using a 6-minute run test; oxygen saturation was measured using the Stange and Genchi tests; and spirometry was used to determine lung capacity.

Results and conclusions. To assess the effectiveness of the experimental method with schoolchildren aged 7–11 years, functional tests and assessment tasks were used, which were conducted before and after the experiment (assessment of overall endurance, oxygen saturation and vital lung capacity). Before the start of the study, the groups were homogeneous, and the indicators showed no statistically significant differences ($p>0.05$). As a result of the study, the indicators in the control group increased, but not significantly ($p>0.05$), whilst in the experimental group, performance in the 6-minute run test improved by 11.4%, in the inspiratory and expiratory breath-holding tests the figures increased by 13.8% and 16.8% respectively, and spirometry data rose by 19.2% ($p<0.05$) .

As a result of the method applied, the results in the experimental group were more than twice as high as those of the children in the control group. Thus, this method has proven its effectiveness. If schoolchildren aged 7–11 with respiratory conditions perform breathing exercises systematically, their functional capacity will improve significantly.

Keywords: *respiratory diseases, physical activity, younger schoolchildren, children, health.*

Introduction. Respiratory diseases are a widespread problem in modern medicine. They have a significant and negative impact on people's quality of life. Infections of the respiratory system carry a serious prognosis, particularly among primary school-aged children. Over recent decades, scientific research has demonstrated that the presence of a stable population of respiratory bacteria in the respiratory tract at an early age is associated with an increased risk to overall health and predicts the frequency of subsequent respiratory infections and the severity of their course in older children [6, 8].

The main causes of respiratory diseases include pathogenic organisms, environmental allergens and unhealthy habits. There are many known diseases of the pulmonary system, such as acute and chronic bronchitis, pneumonia, lung abscess, lung gangrene, bronchiectasis, chronic obstructive pulmonary disease, bronchial asthma, pulmonary emphysema, lung cancer, tuberculosis, pleurisy and pulmonary haemorrhage. Diseases of the respiratory system lead to general weakness, reduced performance, fatigue, increased sweating, prolonged fever, weight loss, enlarged lymph nodes, apathy and low mood [6, 8].

It has been proven that in cases of respiratory diseases, general strengthening and specific breathing exercises should be performed, which improve the functioning of all organs and systems and stimulate the respiratory system, whilst high- and moderate-

intensity physical exercises also stimulate the respiratory system [6, 8].

When performing specific physical exercises, the respiratory muscles are strengthened and the mobility of the diaphragm and chest increases, which helps to reduce congestion in the lungs. Exercises should be selected in such a way that they correspond to clinical data. To improve ventilation in various parts of the lungs, special breathing exercises are performed: for the upper lobes, deep breathing is used with the hands resting on the waist; for the posterior lobes, enhanced diaphragmatic breathing is used. Exercises involving raising the head, spreading the arms out to the sides and upwards, and bending the torso backwards in combination with diaphragmatic breathing help to increase ventilation in the lower lobes. Special breathing exercises increase oxygen consumption and lung ventilation [3–5].

Most techniques for improving breathing are aimed at treating neurotic and other conditions, such as high blood pressure, relieving bronchial spasms and certain other ailments. It is assumed that these methods do not fully enhance the functional capabilities of the child's body, but are primarily aimed at eliminating pathologies. Based on the above, a contradiction is identified between the frequently increasing number of respiratory diseases in children and the shortcomings of modern treatment methods.

Objective of the study is to improve respiratory function in primary school-aged children with respiratory conditions through physical exercise.

Methods and structure of the study. A total of 36 boys and girls aged 7–11 took part in the study. The pupils attended mainstream schools in Moscow. The children participating in the educational experiment had been cleared to take part in physical education lessons by a doctor. All participants were diagnosed with a respiratory condition. The pupils' parents signed an informed consent form for their child's participation in the educational study.

The educational experiment was conducted from 13 January to 16 April 2025 at the Moscow Centre for Kinesiotherapy in a specialised therapeutic physical education hall. All study participants were divided into a control group (CG) and an experimental group (EG) in such a way that, at the start of the study, there were no significant differences between the groups in any of the indicators under investigation.

Children assigned to the control group passed the standardised tests and did not perform any additional special physical exercises. Children assigned to the experimental group additionally attended the kinesitherapy centre after school and performed special exercises for the respiratory system for 60 minutes. Sessions were held three times a week (Monday, Wednesday, Friday from 14:00 to 15:00).

Examples of exercises without equipment (6–8 repetitions):

Starting position (SP). Feet shoulder-width apart, arms hanging down.

1. Spread your arms out to the sides (palms facing up), stretch and take a deep breath, then exhale.

2. Spread your arms out to the sides and breathe in through your nose, then breathe out through your mouth – arms hanging down.

3. Lean to the right; as you breathe out, let your arms slide down your sides, then as you breathe in, return to the starting position, then repeat on the left side.

4. As you exhale, lean forwards, spread your arms out to the sides, then inhale and take a deep breath.

5. Take a maximum breath in through your nose, then exhale in short bursts through your mouth.

6. Inhale through your nose, hold your breath for 8 seconds, then exhale slowly through your mouth.

7. Exhale as fully as possible, then inhale as deeply as possible and hold your breath for 5 seconds.

8. As you inhale, push your stomach out; as you exhale, pull your stomach in.

9. Starting position + sitting on a chair. Turn your torso to the left + inhale, return to the starting position and exhale. Then repeat on the other side.

10. Starting position + lying on your back. Slowly raise your legs to a vertical position. Rest your elbows

Table 1. Comparison of indicators prior to the start of the educational study

Tests	EG (n=24)	CG (n=24)	t; p
6-minute run (m)	716,26±22,35	721,1±22,13	t=0,19; p>0,05
Stange (s)	27,7±0,42	26,31±0,77	t=0,41; p>0,05
Genchi (s)	11,81±0,85	10,73±0,92	t=0,22; p>0,05
Spirometry (ml)	1177,14±31,12	1209,5±30,01	t=1,24; p>0,05

and palms on the floor, supporting your back. Keep the back of your head and neck pressed against the floor.

Examples of exercises with equipment (6–8 repetitions):

1. As you inhale, stand up; as you exhale, squat down – lower yourself onto your knees, keeping the ball in your hands.

2. Starting position + a gymnastic stick on your shoulder blades. Arch your back (pull your shoulders back) and inhale. Lean forwards – exhale.

3. Starting position + ball on the floor. Inhale – raise your arms, exhale – bend forward and pick up the ball. Inhale – stand up straight with your arms raised, exhale and place the ball back on the floor.

4. Starting position + stick on the floor. Inhale – rise up (left foot back, on the ball of the foot), exhale – starting position, then with the right foot.

5. Starting position + stick on the floor. Inhale – lunge forward with the right foot, rise up. Exhale – starting position, then with the left foot.

6. Starting position + stick on the floor. Inhale – raise arms, exhale – pull knee towards stomach using the stick. Exhale – starting position, then repeat exercise with the other knee.

7. Starting position + stick and ball on the floor. Inhale – hold your breath for 6–8 seconds, then exhale slowly and hold your breath again for 6–8 seconds.

8. Starting position + sitting, ball on your knees. Inhale – lift the ball upwards. Exhale – lean forwards.

9. Starting position + sitting, ball held above your head. Inhale – lean to the right. Exhale – return to the starting position, then lean to the left.

10. Starting position + lying on your back, bend your leg at the knee, grasp it with a stick and press it against your chest for 12–15 seconds, then lower your leg. After that, perform the exercise with the other leg.

All schoolchildren who were cleared by a doctor before the start of the educational experiment passed the control standards and functional tests.

1. Measurement of general endurance (6-minute Cooper test). The result is the distance the pupils run in 6 minutes.

2. Measurement of oxygen saturation:

a. On inhalation (Stange test). Breathing is held on the inhale. The duration of breath-holding is calculated using a stopwatch. The test must be performed whilst seated. Result: the arithmetic mean of 3 attempts.

b. On the exhale (Genchi test). The requirements and assessment of the result are the same as in the Stange test.

3. Measurement of vital lung capacity (spirometry). Take a deep breath and exhale as fully as possible, but gradually (over 5–7 seconds), through the mouthpiece of the spirometer. The test is performed three times at intervals of 50–60 seconds. The result is the highest value of the three attempts.

Results of the study and discussion. To assess the effectiveness of the experimental methodology with schoolchildren aged 7–11, functional tests and assessment tasks were administered before and after the experiment. Prior to the start of the study, there were no statistically significant differences in the baseline indicators between the groups, indicating that the sample was homogeneous (Table 1).

Final tests and functional assessments conducted at the conclusion of the educational experiment showed that the results of the children in the experimental group were significantly higher than those of the children in the control group ($p > 0.05$) (Figure 1).

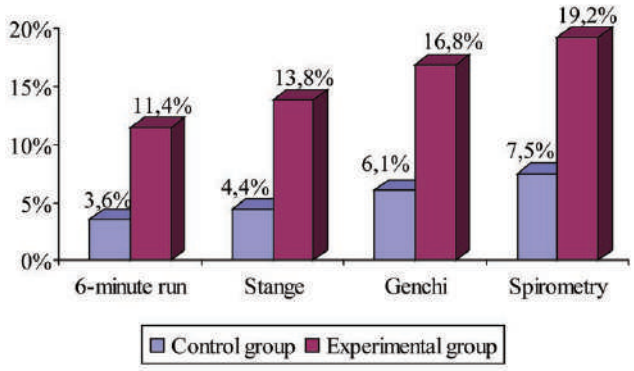

Figure 1. Changes in the indicators for both groups over the study period

The results presented in the figure show that the exercise programme, designed to improve the functional capacity of primary school-aged children with respiratory conditions, has proven to be effective.

A review of the scientific literature reveals a large number of studies devoted to human health and the normal processes of growth and development [1, 2, 7]. A review of the literature has also highlighted the importance of studying respiratory diseases [6, 8]. Particular attention should be paid to school-age children. Currently, there are several breathing techniques [1, 2], but these are designed to address various conditions (such as high blood pressure and neurotic dis-

orders). A detailed analysis of these methods showed that they have an insufficient effect on the functional capabilities of schoolchildren's bodies.

The use of a set of physical exercises aimed at improving respiratory function yielded the following results: in the 6-minute run test, the EG group improved by 11.4%; in the breath-holding test on inhalation and exhalation, the indicators increased by 13.8% and 16.8%, respectively; and in the spirometry test, the data increased by 19.2%. This is more than twice the figures for children in the CG group who did not undertake additional training. Thus, this method has demonstrated its effectiveness and can be used in educational and medical institutions to improve the functioning of the body's systems in primary school-aged children with respiratory diseases.

It is important to follow certain practical recommendations when working with children suffering from respiratory diseases. During sessions, the physical load on the body should be increased gradually by increasing the intensity of the exercises performed. If signs of overt fatigue appear, the intensity of the physical exercises should be reduced. Homework should be set for the independent performance of breathing exercises.

Conclusions. If schoolchildren aged 7–11 with respiratory conditions take part in therapeutic exercise on a regular basis and also perform breathing exercises for at least 60 minutes three times a week, their physical fitness will improve significantly.

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An analysis of prone to deviant behaviour and coping strategies among school-age athletes

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Abstract

Objective of the study is to identify tendencies towards deviant behaviour and coping strategies among student athletes involved in cyclic sports and martial arts.

Methods and structure of the study. An empirical study was conducted involving 136 students (99 males and 37 females) aged 17–19. All respondents were first-year university students in St Petersburg who were actively involved in sporting activities and participating in competitions. Standardised psychodiagnostic methods were used to collect data: the 'Predisposition to Deviant Behaviour' questionnaire and the 'Coping Behaviour in Stressful Situations' method. This empirical study examined the propensity for deviant behaviour and coping strategies among student athletes representing cyclic sports and martial arts.

Results and conclusions. Significant differences were identified between the groups. Martial arts athletes demonstrate more pronounced non-conformity of attitudes and aggression, a moderate risk of addictive behaviour, and reduced volitional control. In turn, representatives of cyclic sports are characterised by conformity, low aggression, and high volitional control. Athletes in cyclic sports more often resort to problem-focused coping and seeking social support, and less frequently use emotion-focused strategies and avoidance. Combat sports athletes tend to choose emotion-focused coping and avoidance strategies, whilst seeking social support less frequently.

Keywords: *deviant behaviour, coping strategies, athletes, student age, analysis.*

Introduction. In the context of today's sociocultural reality, the issue of deviant behaviour has become particularly pressing, manifesting itself in various social groups, including among students involved in sporting activities. [1, 6, 9]. On the one hand, physical education and sport are traditionally regarded as an effective tool for preventing deviant behaviour, contributing to the formation of socially acceptable behavioural models. On the other hand, the increased demands of training and participating in sporting competitions can create conditions for the development of attitudes that permit the violation of generally accepted norms of behaviour in the pursuit of success [3, 4, 5].

Studying the propensity for deviant behaviour and the predominant coping strategies among students will help to determine which methods of coping with stress contribute to students' successful adaptation and which, conversely, provoke maladaptive forms of behaviour [7, 8, 10].

Objective of the study is to identify tendencies towards deviant behaviour and coping strategies among student athletes involved in cyclic sports and martial arts.

Methods and structure of the study. The study involved 136 student athletes (99 male and 37 female) aged 17–19. All participants were first-year students from various faculties at universities in St Petersburg, actively involved in competitive sports in cycling disciplines (62 students) and martial arts (74 students).

Research methods: 1) the 'Propensity for Deviant Behaviour' (PDB) questionnaire (A.N. Orel, K.V.

Sugonyaev), designed to assess an individual's predisposition to various forms of deviant behaviour. Key measured parameters: the scale of attitude towards socially desirable responses (service scale); propensity to violate norms and rules, predisposition to addictive behaviour, tendencies towards self-harming and self-destructive behaviour, propensity towards aggression and violence, level of volitional control over emotional reactions, propensity towards delinquent behaviour.

2) The 'Coping Behaviour in Stressful Situations' (CISS) methodology (N. Endler, J. Parker; adapted by T.L. Kryukova) identifies dominant strategies for coping with stress and includes the following types of strategies: problem-oriented (aimed at actively resolving the problematic situation); emotion-oriented (focused on experiencing and expressing emotions caused by stress); avoidance strategies (manifested in denial or evasion of the problem); distraction strategies (involving shifting attention to other activities); strategies for seeking social support (involving seeking help from close and significant others) [2].

Results of the study and discussion. An analysis of predisposition to various forms of deviant behaviour, conducted using the PDB methodology, revealed significant differences between participants in cyclic sports (Group 1) and combat sports (Group 2).

Social desirability bias. Both groups of students demonstrated similar scores on the social desirability scale: 88.2% of respondents showed an average degree of willingness to present themselves in a favourable light, reflecting a natural need to appear 'normal' in the eyes of society. A high tendency to provide socially desirable answers was demonstrated by 11.7% of students.

Non-conformity and aggression. In the martial arts group, the proportion of students with non-conformist attitudes is significantly higher: high scores on the scale of tendency to violate norms and rules are found in 8.8% of martial artists and 5.9% of athletes in cyclic sports, on the scale of propensity for aggression and violence – high scores were found in 11.8% of martial artists and 2.9% of athletes in cyclic sports.

It is evident that high scores for non-conformist attitudes and a tendency towards aggression are linked to the specific nature of combat sports, which require autonomy in decision-making under conditions of acute stress, a readiness for confrontation and the demonstration of strength, and the development of competitive aggression as a means of victory. Among martial arts students, 32.1% scored low on the scale of transgressing norms and rules, and 18.8% showed a low level of propensity for aggression.

In the group of cyclic sports, 52.9% of students showed low scores on the scale of transgressing norms and rules, and 58.8% showed a low level of propensity for aggression. It is evident that adherence to a plan and monotonous work towards a result, characteristic of cyclic sports, are more likely to foster conformist attitudes.

Addictive patterns and self-regulation. Combat sports athletes demonstrate a higher risk of addictive behaviour (8.2% with high scores compared to 3.5% among athletes in cyclic sports), greater emotional lability (5.9% with high scores on the self-harm behaviour scale compared to 2.9%), and reduced volitional control (29.4% with low levels compared to 17.6%), due to the need for instant reactions in combat, where reflection is secondary. Combat sports athletes more frequently demonstrate moderate signs of delinquent tendencies (in 57.3% of respondents).

In cyclic sports, a moderate tendency towards escapism is more frequently observed (66.2% of athletes with moderately elevated addiction scores), likely manifested through intense physical exertion as a means of 'switching off' from problems. The identified moderate scores on the addiction (60.3% of respondents) and delinquency (32.6%) scales indicate a moderate tendency to seek alternative ways of regulating emotional states and an orientation towards hedonistic values (the pursuit of pleasure and novel sensations). This does not imply the presence of delinquent patterns, but signals the need for preventive measures in conditions of heightened stress. High levels of volitional control were identified in 36.1% of athletes in cyclic sports.

The average scores on the scale of volitional control of emotional reactions among the majority of martial arts students (66.1%) ensure sufficient emotional resilience to everyday stressors and volitional control, but do not rule out the risk of emotional burnout, particularly during prolonged stress: 18.3% of martial arts students demonstrate high scores on the emotional reaction control scale.

A comparative analysis using the Mann-Whitney

U-test revealed statistically significant differences in the choice of coping strategies between student athletes in cyclic sports (Group 1) and martial arts (group 2).

Problem-focused coping is the dominant mechanism in group 1: students focus on analysing the situation, planning actions and seeking constructive solutions. The mean scores for coping choice in Group 1 were M=28.4 (SD=3.2), which is statistically significantly higher than in Group 2 (M=19.7, SD=4.1; U=112.5, p=0.007). Clearly, the identified differences are linked to the characteristics of the training process in cyclic sports, where success depends directly on discipline, long-term planning and the sequence of training loads.

The coping strategy of seeking social support also occupies a significant place in the structure of coping behaviour among members of Group 1. The mean score on this scale is M=24.8 (SD=2.9), which is significantly higher than the scores for Group 2 (M=16.3, SD=3.7; U=134.2, p=0.009). This strategy contributes to greater emotional stability and enables the identification of rational solutions in stressful situations. The infrequent use of the strategy of seeking social support among martial arts students is likely due to the values of autonomy and self-sufficiency cultivated in the martial arts environment, where athletes must make decisions independently during combat and take responsibility for them.

In Group 1, the identified low level of emotion-focused strategies and avoidance coping indicates a low level of impulsive reactions, a tendency to overcome difficulties through purposeful actions rather than by avoiding them. On the emotionally oriented coping scale, Group 1 scored M=12.1 (SD=2.4) – significantly lower than Group 2 (M=21.5, SD=3.3; U=98.7, p=0.003). Scores for avoidance strategies were also minimal: M=8.3 (SD=1.8) versus M=17.9 (SD=2.6) in Group 2 (U=87.4, p=0.001).

In Group 2 (martial arts athletes), the prevalence of emotion-focused coping and avoidance strategies in stressful situations (avoiding the problem through denial, daydreaming or distraction) indicates that martial arts athletes tend to focus on regulating their own emotions (suppression, reaction, emotional release) rather than on solving the problem. This may be linked to the high emotional intensity of competitive activity and the need to rapidly release emotional tension. In situations of acute stress, this may provide short-term relief, but in the long term it reduces adaptability and increases the risk of maladaptive behaviour.

Using Pearson's correlation analysis, statistically significant correlations were identified between deviant behaviour and the coping strategies employed by student-athletes in the overall study sample.

The study revealed a negative correlation (at $p \leq 0.05$) between social desirability and maladaptive coping ($r = 0.295$ for emotion-focused coping and $r = 0.300$ for avoidance). The stronger the desire to appear 'correct' in the eyes of others, the less frequently students resort to emotional reactions and avoidance of problems. This confirms the protective role of social desirability as a factor that restrains impulsive and unconstructive reactions.

It was found that the higher a student's propensity for any form of deviant behaviour, the greater the likelihood of choosing emotion-focused coping ($r = 0.342$, at $p \leq 0.05$).

A negative correlation was found between a tendency towards addictive behaviour and the use of problem-oriented coping ($r = -0.272$, $p \leq 0.05$): the higher the tendency towards addictive behaviour, the lower the tendency to use problem-oriented coping strategies.

A strong positive correlation was found between avoidance-oriented coping and all scales of the PDB questionnaire (except for the first service scale): the higher the tendency towards any type of deviant behaviour, the greater the likelihood of choosing an avoidance-oriented coping strategy.

Conclusions. Most students demonstrate a moderate tendency towards deviant behaviour.

The study's findings confirm that the type of sporting activity has a significant influence on the development of behavioural attitudes and stress-coping strategies. The specific nature of training and competition shapes consistent patterns of behaviour: in cyclic sports, adaptive, rational strategies (analysis, planning, reliance on support) become established, whilst in combat sports, emotionally charged and avoidance tactics are more frequently used, reflecting the need for rapid emotional release and independence in decision-making.

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Developing students' social and communication skills through gaming sports

UDC 796.015.132

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Abstract

Objective of the study is to identify the educational potential of team sports in developing the social and communication skills of university students and to experimentally demonstrate the effectiveness of their use in the university educational process.

Methods and structure of the study. The study was conducted over two semesters at the university's sports facilities and involved 68 first-, second- and third-year students. The students were divided into an experimental and a control group of 34 students each, who were identical in terms of physical fitness and lack of regular experience in team sports, ensuring their initial homogeneity. The experimental group followed a specially designed programme based on the systematic use of five-a-side football, volleyball and basketball, with the structure of the sessions aimed at developing skills in teamwork, rapid information exchange and coordination of actions in dynamic game situations. Sessions took place twice a week and combined training and game-based activities.

Results and conclusions. Analysis of the data revealed the dynamics of the development of students' social and communication skills under the influence of systematic participation in team sports. The results of the study showed that the systematic use of five-a-side football, volleyball and basketball has a marked positive effect on the development of students' social and communication skills. During the experiment, participants in the experimental group demonstrated significant improvements across all key indicators, including communicative tolerance, the level of group inclusion and the effectiveness of team interaction.

Keywords: *team sports, students, teamwork, interpersonal communication, education, soft skills.*

Introduction. The modern higher education system requires students to possess well-developed social and communication skills – the ability to work in a team, interact within a group, make decisions under pressure, and take responsibility for the outcome. However, research shows that many students experience difficulties in interpersonal communication, which manifests itself in reduced communicative activity, a lack of constructive behavioural models, and difficulties in collaborative work. This makes the search for effective pedagogical tools that enable the development of these qualities in natural and emotionally rich environments particularly relevant [2, 4, 5].

The most effective means of developing social and communication skills are team sports – five-a-side football, football, volleyball and basketball. Team sports place high demands on participants: the need to analyse situations quickly, coordinate actions, take partners' interests into account, take responsibility and maintain emotional stability [1, 3, 6, 7]. Such a dynamic environment for interaction creates natural conditions for the development of communication and social skills, which distinguishes sports games from formal training sessions.

In global educational practice, team sports have long been used to develop soft skills; however, in Russian higher education, such approaches have been implemented to a limited extent, which underscores the significance of this research. Given the growing demands on graduates – the ability to work in a team, communicate and make decisions under conditions of uncertainty – team sports can be regarded as a promising tool for developing socially

significant qualities in students. Their potential requires further scientific analysis, experimental testing and wider implementation in university physical education practice.

Objective of the study is to identify the educational potential of team sports in developing the social and communication skills of university students and to experimentally demonstrate the effectiveness of their use in the university educational process.

Methods and structure of the study. The study was conducted over two semesters at the university's sports facilities and involved 68 first- to third-year students, divided into an experimental group and a control group of 34 students each. The groups were identical in terms of physical fitness and lack of regular experience in team sports, which ensured their initial homogeneity. The experimental group followed a specially designed programme based on the systematic use of five-a-side football, volleyball and basketball, with the structure of the sessions aimed at developing skills in teamwork, rapid information exchange and coordination of actions in dynamic game situations. Sessions took place twice a week and combined training and game-based activities.

The control group followed a traditional physical education programme, comprising general physical training without a specific focus on games. To assess changes in social and communication skills, questionnaires, pedagogical observation, sociometry, expert assessment and self-assessment methods were used. Measurements were taken at the beginning and end of the experiment, which made it possible to identify changes both within and between the groups, and thereby determine the influence of team sports on the development of students' communication skills.

Results of the study and discussion. Analysis of the data obtained revealed the development of students' social and communication skills under the influence of regular participation in team sports. At the initial stage, the experimental and control groups demonstrated comparable indicators, as confirmed by similar values for the overall level of social and communication skills (58.3±1.4 and 57.6±1.5 points, respectively, p=0.68), communicative tolerance (112.5±2.8 and 114.1±2.6 points, p=0.54) and the group inclusion index (0.48±0.03 and 0.46±0.03, p=0.61). This indicates the initial homogeneity of the sample and creates appropriate conditions for analysing the impact of the game programme (Table 1).

Upon completion of the educational experiment, a marked increase in the overall score for social and communication skills was observed in the experimental group. Its value increased from 58.3±1.4 to 72.5±1.3 points ($p<0.05$), reflecting a qualitative improvement in the students' readiness to engage in interaction, take responsibility when solving group tasks, and demonstrate initiative and flexibility in communication. The control group also demonstrated a slight improvement from 57.6±1.5 to 61.4±1.4 points ($p<0.05$); however, the extent of the changes was significantly less pronounced. The final inter-

Table 1. Trends in students' social and communication indicators

Indicator	Group	Before the experiment	After the experiment	p, after the experiment
		M ± m		
Comprehensive indicator of social and communication skills, points	EG	58,3 ± 1,4	72,5 ± 1,3	< 0,05
	p	< 0,05		
	CG	57,6 ± 1,5	61,4 ± 1,4	
	p	< 0,05		
Communicative tolerance, points	EG	112,5 ± 2,8	97,3 ± 2,6	< 0,05
	p	< 0,05		
	CG	114,1 ± 2,6	109,8 ± 2,7	
	p	≥ 0,05		
Sociometric index of group inclusion, standard units	EG	0,48 ± 0,03	0,63 ± 0,03	< 0,05
	p	< 0,05		
	CG	0,46 ± 0,03	0,50 ± 0,04	
	p	≥ 0,05		
Expert assessment of teamwork, points	EG	2,9 ± 0,1	4,1 ± 0,1	< 0,05
	p	< 0,05		
	CG	2,8 ± 0,1	3,2 ± 0,1	
	p	≥ 0,05		

group comparison confirms the advantage of the game-based methodology. Thus, the difference in the level of skill development reached statistical significance ($p<0.05$), indicating a direct influence of sports games on the intensity of the development of social and communicative qualities.

An important indicator was the dynamics of communicative tolerance. In the experimental group, a decrease in the indicator was observed from 112.5±2.8 to 97.3±2.6 points ($p<0.05$), which signifies an increase in tolerance towards partners' individual characteristics, a reduction in the number of conflictual reactions, and a strengthening of the desire for compromise. In the control group, the changes were trend-like (from 114.1±2.6 to 109.8±2.7 points), but did not reach statistical significance ($p\geq0.05$). An intergroup comparison of the final scores revealed a noticeable advantage for the experimental participants ($p<0.05$). In essence, this is explained by the nature of team sports, which regularly place students in situations of micro-conflicts and necessitate rapid coordination of actions. The format of team interaction in five-a-side football, volleyball and basketball encourages the habit of quickly defusing tension, supporting teammates and maintaining a business-like tone in communication.

Positive changes also affected the sociometric structure of the student groups. The group inclusion index among participants in the experimental programme rose from 0.48±0.03 to 0.63±0.03 ($p<0.05$), indicating an increase in their social status within the group and an expansion of their interpersonal relationships. In the control group, the improvement was minimal and statistically insignificant (0.46±0.03 to 0.50±0.04; $p\geq0.05$). The final differences between the groups also reached the level of significance ($p<0.05$). This result confirms that game-based activities not only develop individual communication skills but also alter the very system of intra-group relations, making it more integrated and emotionally healthy.

Expert assessment of team interaction reinforced the overall picture; thus, the teachers observing the process noted a significant increase in coordination, mutual support and the effectiveness of role distribution among students in the experimental group. The average score increased from 2.9±0.1 to 4.1±0.1 points ($p<0.05$), whereas in the control group it rose only from 2.8±0.1 to 3.2±0.1 points ($p\geq0.05$). The significant superiority of the final scores in the experimental group ($p<0.05$) demonstrates that systematic team-based game activities foster sustainable models of productive interaction, in which each group member takes on an active role and participates in the joint resolution of game-related and organisational tasks.

Overall, the study's results confirm the high effectiveness of team sports as a means of developing social and communication skills among students. The observed dynamics indicate that mini-football, volleyball and basketball, with their high level of emotional intensity and requirement for constant interaction, create natural conditions for the development of communication skills, joint decision-making, mutual responsibility, developed empathy and the ability to work under pressure. At the same time, the influence of team sports extends beyond physical training, becoming part of students' overall personal development and contributing to their professional and social adaptation.

Conclusions. The results of the study showed that the systematic use of five-a-side football, volleyball and basketball has a marked positive effect on the development of students' social and communication skills. During the experiment, participants in the experimental group demonstrated significant improvements across all key indicators, including communicative tolerance, levels of group inclusion and the effectiveness of team interaction. The results of the experiment suggest that team sports can be considered an effective tool for developing soft skills within a university educational environment. Their inclusion in the teaching process helps to strengthen interpersonal relationships, enhance the cohesion of student groups and create conditions for more successful social and professional adaptation among students.

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The use of integrated activities in physical education classes

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Keywords: *interdisciplinary integration, meta-disciplinary universal learning activities, integrated assignments, practice-oriented case studies.*

Introduction. Under the Federal State Educational Standards (FSES), school education is aimed not only at physical development but also at fostering cross-curricular, universal learning skills – the ability to apply knowledge in various situations. Fifth grade is an important transitional stage when the foundations of independence and logical thinking are laid [1]. At this age, the role of group activities increases, making basketball an effective teaching tool. Game-based activities contribute to the development of communicative, regulatory, and cognitive skills.

Modern educational requirements call for the development of cross-curricular concepts. In this regard, the 'Basketball' module can serve as a foundation for implementing integrated tasks that combine physical education content with other disciplines and expand its educational potential.

Objective of the study is to theoretically justify and experimentally verify the effectiveness of using integrated tasks in the subject of 'Physical Culture' during integrated lessons in fifth grade as a means of fostering meta-disciplinary universal learning activities.

Methods and structure of the study. The experiment was conducted at Secondary School No. 47 in Perm (January-March 2026) with two groups participating: the experimental group (EG, n=25) and the control group (CG, n=25). The experimental group was given integrated assignments, while the control group followed the traditional curriculum.

The study was designed in accordance with the requirements of the Federal State Educational Standards and was based on interdisciplinary interaction among academic disciplines. The experimental teaching process was planned in collaboration with teachers of Russian, mathematics, and English, during which 'points of contact' in the content of the academic disciplines were identified, allowing for the integration of the 'Basketball' module's content with other subjects.

On this basis, integrated tasks (practice-oriented case studies) were developed to facilitate the transfer of knowledge across disciplines. Interaction was implemented through the following teaching methods: 'from theory to practice' (applying mathematical knowledge to analyze performance in physical education classes), 'comprehending theory' (working with instructions and terminology – Russian language classes), and 'understanding through communication' (use of English sports vocabulary during exercises).

The development of meta-disciplinary universal learning activities was assessed through testing. The results showed that the integration of academic disciplines based on the 'Basketball' module and the application of the developed methodological techniques contribute to the development of meta-disciplinary universal learning activities and also increase students' awareness of their motor activities.

Results of the study and discussion. The initial level of development of meta-disciplinary universal learning activities in the control and experimental groups was comparable, amounting to 2.32 ± 0.4 points in the CG and 2.2 ± 0.43 points in the EG (on a five-point scale). At the end of the experiment, the average score in the control group increased to 2.8 ± 0.32 points, while in the experimental group it reached 3.76 ± 0.48 points. The significance of the differences was assessed using the Mann–Whitney U test and was $p < 0.01$.

Conclusions. The integration of the 'Physical Culture' course (the 'Basketball' module) with the subjects 'Russian Language,' 'Mathematics,' and 'English' in the elementary school curriculum promotes the development of meta-disciplinary universal learning activities among students. This approach ensures a more interconnected mastery of the curriculum. As a result, students become more aware of their learning activities, and the connection between theoretical knowledge and practical experience is strengthened.

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Indicators of students' readiness for physical exercise

UDC 796

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Abstract

Objective of the study is to identify effective aspects of physical education for university students, taking into account their level of readiness for physical activity.

Methods and structure of the study. Research was conducted at Plekhanov Russian University of Economics, comprising: a review of the literature; a survey of first-year students (healthy students (n=390) and students with health issues (n=390)); and predictive modelling of students' physical education.

Results and conclusions. The experiment involved students from health groups I and II (the general medical group, GMG) and health group III (the special medical group, SMG). Priority forms of physical activity at school (team sports, gymnastics, athletics and ski training), as first-level predictors, were taken into account in the predictive modelling of students' physical education (PE): the introduction of priority types of sports games at school and physical education (PE) lessons, as well as sports clubs, including those for SMG students (taking into account their state of health). Factors increasing and decreasing students' physical activity as second-level predictors determine the prognostic significance for the modernisation of PE: professional development of specialists in priority types of sports games at school and corresponding types of phygital sports; the application of digital technologies in the physical education and sports process, including with SMG students; the introduction of soft and neuroscientific sports activities into lessons. The identified predictors of students' readiness for physical activity formed the basis for predictive modelling of PE, extrapolating positive experiences of participation in clubs for priority sports to achieve a cumulative effect in improving young people's health.

Keywords: *students, fitness levels, physical activity, health status, specialist medical group, general medical group.*

Introduction. Against the backdrop of contemporary challenges, there has been a decline in students' health, partly due to a shift in their priorities regarding physical activity. Outside of study hours, students fall into two groups: the first group engages in no physical activity; the second prefers physical activity whilst self-isolating, using information technology [3].

In order to engage students in regular physical education and sporting activities, it is necessary to identify predictors of physical activity among students during their school years, so as to extrapolate positive experiences of using physical education resources into the university environment and achieve a cumulative effect in promoting young people's health.

Objective of the study is to identify effective aspects of physical education for university students, taking into account their level of readiness for physical activity.

Methods and structure of the study. Research was conducted at Plekhanov Russian University of Economics, comprising: a review of the literature; a survey of first-year students (healthy students (n=390) and students with health issues (n=390)); and predictive modelling of students' physical education.

Results of the study and discussion. As an independent variable, a predictor has prognostic significance, representing a characteristic of an individual that determines the prediction of other characteristics of that individual [1]. Experts view physical readiness as a personal construct based on physical abilities and needs (interests) [6]. A student's readiness for physical activity is defined as a personal construct based on predictors at school.

The choice of types of physical activity for students must be determined taking into account health and socio-psychological characteristics (interpersonal interaction strategies) [5]. In support of the author's position that the introduction of sports games into physical education for young people contributes to the transformation of their spiritual and moral development, we note that for students with specific health conditions, it is advisable to introduce adapted forms of sports games, which will also contribute to the development of teamwork skills [3].

The study involved students from health groups I and II (GMG) and health group III (SMG), for whom a gentle exercise regime is required. School pupils' attendance at PE lessons serves as a predictor of their attendance at university (Fig. 1).

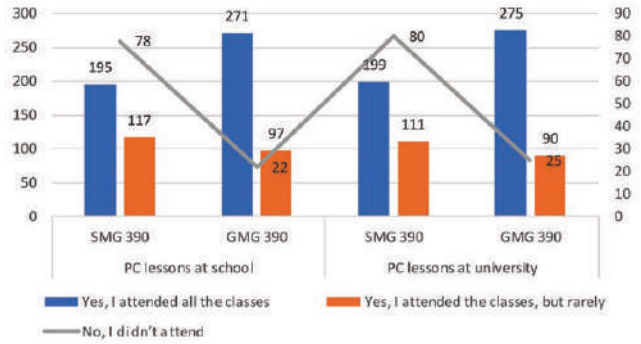

Figure 1. Attendance at physical culture classes at school/university

The combined figure (those who rarely attend PC lessons and those who do not attend at all) is as follows: SMG school pupils – 195, SMG students – 191, GMG school pupils – 119, GMG students – 115. This group of students (GMG, SMG) represents a cohort for whom specific conditions must be created in accordance with their characteristics (predictors) to forecast their engagement in PE classes at university.

Predictors of attendance at school sports classes do not correspond to the predictive value of attendance at similar classes at university. An analysis of GMG respondents' attendance at sports clubs at school/university showed: 156/101 attended sports clubs, attended rarely – 108/88, and 126/201 did not attend at all, which may be due to the strict selection process for university sports clubs to participate in competitions and determines the establishment of sports and fitness clubs, taking into account students' predictors for sports at school (Fig. 2).

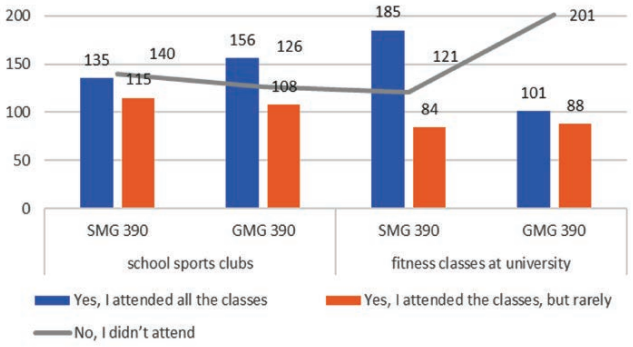

Figure 2. Attendance at classes (sport/fitness)

An analysis of SMG respondents' participation in sports clubs also confirms that school-level predictors have no predictive value for university-level predictors. Thus, at school, respondents participated in sports clubs (135 – regularly, 115 – rarely and 140 – not at all), which indicates their interest in sport and the conditions provided, where SMG students could practise their favourite sport whilst taking their health into account.

SMG students choose wellness activities (185 – regularly, 84 – rarely and 121 – not at all), which is due, on the one hand, to the lack of sports clubs for students with health conditions that take their health into account; on the other hand, by the variety of recreational clubs and the desire to engage in physical activity, even without taking into account their school-related preferences for specific sports.

The current situation can be explained by the fact that the inconsistent regulatory requirements regarding the admission of students with health conditions to sports activities and participation in competitions create difficulties for teachers and coaches in engaging this category of students in sporting activities at the university.

Predictors of GMG/SMG respondents' participation in school sports were identified: 207/178 pupils preferred team sports, 99/82 – gymnastics, 48/68 – athletics and 36/62 – cross-country skiing (Fig. 3).

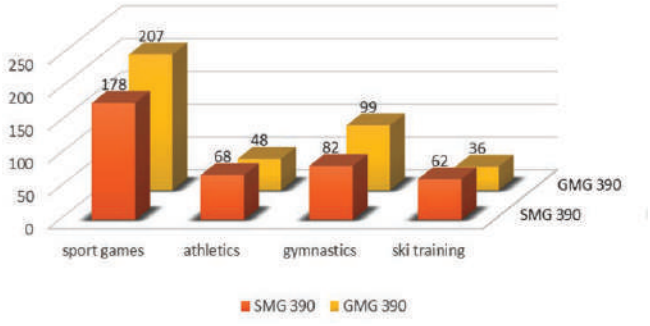

Figure 3. Priority sports at school (PC lessons/clubs)

In order to replicate the positive experience of sports activities in priority sports and achieve a cumulative effect in improving students' health, these predictors must be incorporated into PE.

Factors increasing physical activity among GMG/SMG students: gyms (180/157); specialists (107/82); social interaction (68/85); soft activities (35/66). Factors reducing physical activity: a heavy workload and exams (94/84 and 86/104); lack of sleep (43/89) and extra work (35/80) (Fig. 4).

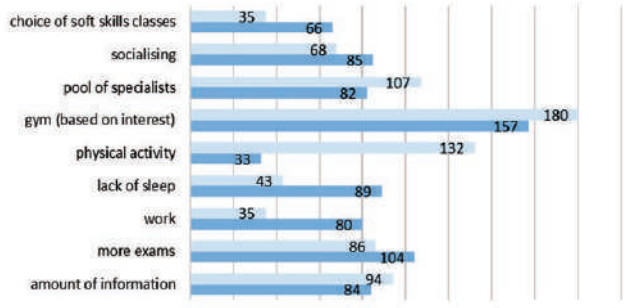

Figure 4. Factors influencing students' physical activity

We propose that priority types of physical activity at school serve as first-level predictors for the modernisation of PE in the first year of study; factors influencing increases and decreases in students' physical activity serve as second-level predictors, which provide predictive value for the modernisation of PE in subsequent years of study.

Based on the first-level predictors, we will conduct predictive modelling of PE in the first year of study (content and organisation):

- introducing priority types of sports games from school into PC lessons, including for students with special educational needs, taking into account their health status (elements or adapted types of sports games with simplified rules);

- organisation of sports and fitness clubs to promote mass participation in sport (intra-university competitions) in the school's priority sports for GMG students who have not made the university's main teams, and for SMG students, taking into account their health.

Based on second-level predictors, we will conduct predictive modelling of physical education for subsequent courses of study:

- introduction of the school's priority sports to enhance student interaction based on team interests through the development of behavioural strategies (cooperation and compromise) [3];

- professional development for specialists in the priority types of sports games at the university and corresponding types of phygital sports; the application of digital technologies in the physical education and sports process, including with SMG students, to improve the quality of education and increase the number of students participating in the university's sporting life [2];

- introducing soft and neuroscientific sports activities (neurogymnastics, neuroscience sports) into PC classes to help students recover from academic and work-related stress, optimise cognitive and intellectual abilities, and improve their psychological and emotional well-being [4].

Conclusions. The identified predictors of students' readiness (at the first and second levels) for physical activity facilitated the predictive modelling of students' physical education, by extrapolating positive experiences of participation in sports clubs for priority sports to achieve a cumulative effect in improving the health of young students.

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Physical education classes at university as a factor in the development of students' speed and strength abilities

UDC 796.012.1

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Abstract

Objective of the study is to investigate the effect of incorporating additional exercises into students' training programme on the development of speed-strength abilities.

Methods and structure of the study. The experiment involved 100 students from Don State Technical University aged between 17 and 22. The initial level of speed-strength exercises was assessed for the control and experimental groups of students. The following tests were used for this purpose: 100-metre sprint, long jump (from a standing start and from a running start), standing long jump, and shuttle run.

Results and conclusions. Based on the theoretical and methodological research of other authors, a programme has been developed to improve students' speed-strength abilities, which includes hopping from foot to foot along a gymnastics bench, jumping over an obstacle on both feet, skipping, jumping on the spot whilst throwing a weight from the chest, and shuttle runs. The results of applying this programme showed positive progress in the experimental group across all test exercises: from 2.9% to 7.5% over three months.

Keywords: *speed and strength abilities, students, passing fitness tests, additional exercises.*

Introduction. Of all physical abilities, speed-strength qualities are of particular importance – a set of characteristics that includes the ability to rapidly generate force, maintain high power output during short bursts of effort, and demonstrate high speed and coordination when performing dynamic movements. For students, regardless of their future career path, the development of speed-strength abilities enhances adaptability, stress resistance and overall physical fitness, which in the long term has a positive impact on health and productivity [3, 4]. The methodology for developing speed-strength abilities, as a scientific and practical issue, brings together research in the fields of theory and methodology of physical education, sports training, exercise physiology, biomechanics and occupational psychology. Domestic and international literature presents a variety of approaches to developing these qualities: from classic strength training programmes using heavy weights to specialised methods involving plyometrics, sprinting routines, power training and techniques for improving intermuscular coordination. However, when transferring sports methodologies to the context of mass or optional physical education for students, a number of methodological, organisational and ethical issues arise: optimising training loads to account for initial fitness levels and health status, ensuring safety, adapting exercises to the material and technical conditions of universities, and taking into account the academic timetable and the psychophysiological characteristics of students [1, 2].

The training and development of speed-strength abilities is most effectively carried out between the ages of 10 and 17. The older a person becomes, the more difficult it is for physical abilities, including speed-strength qualities, to form and develop. The development of this quality is necessary and beneficial at all age stages, including the age group of the average student (17–22 years).

Objective of the study is to investigate the effect of incorporating additional exercises into students' training programme on the development of speed-strength abilities.

Methods and structure of the study. The experiment involved 100 students from DSTU aged between 17 and 22. The students were divided into two groups: an experimental group and a control group, each comprising 50 people. The control group took part in the standard physical education programme. The experimental group followed a programme with an additional set of exercises designed to develop speed-strength qualities.

There are quite a few exercises that reflect a person's level of speed-strength abilities. In physical education classes at school, and subsequently at higher education institutions, the standing two-foot long jump is most commonly used. In addition, push-ups, throwing distance and other exercises may be tested.

In general, exercises for speed-strength qualities can be broadly divided into three main and one additional category. These are presented with examples below (Table 1):

Based on the data presented above, a study was designed and conducted on the development of students' speed-strength abilities within the framework of physical education classes at the university.

The study comprised the following stages:

1. Dividing the students into a control group and an experimental group.

2. Conducting speed-strength ability tests for both groups.

3. Conducting specialised sessions in the experimental group to develop speed-strength exercises.

4. Analysis of the results obtained.

5. Formulation of the study's conclusions.

Thus, the test session involved measuring speed-strength performance in the following exercises: long jump (from a run-up / standing), high jump, shuttle run, and 100-metre sprint.

A specific programme was then developed, which was performed only by the experimental group (Table 2). The control group followed a standard physical education programme.

The exercises had their own specific techniques, but generally lasted for one minute. There was a 30-second break between sets. Each physical training session consisted of five sets, lasting approximately 30 minutes.

The programme was carried out in the experimental group over a period of three months. A total of 10 sessions were held, in each of which around 30 minutes was devoted to developing the students' speed-strength abilities.

The next stage of the methodology was the evaluation of results. To this end, a comparison was made of the results of the experimental and control groups before and after.

Results of the study and discussion. Following three months of experimental sessions, the following comparative results were obtained (Table 3):

Table 3 shows the difference in performance be-

Table 1. Exercise groups for speed and strength

Category	Description
1. Overcoming resistance greater than the target value	The speed of the exercise decreases
	The display of strength increases
2. Overcoming resistance less than the target value	The speed of the exercise increases
	Strength decreases
3. Overcoming resistance equal to the target value	Virtually maximum exercise speed
4. Instantly overcoming an impact load	Maximum power output during the exercise over a short period
	These are also referred to as explosive exercises, i n line with the characteristics of this category

Table 2. A programme of exercises designed to develop speed and strength skills

Exercise	Features of performing the exercise
Hopping from foot to foot along a gymnastics bench	Variations in execution
Jumping over an obstacle on both feet	The obstacle course is approximately 10 cones lined up in a row
Jumping rope	Execution varies depending on the students' abilities
Jumping on the spot whilst throwing a weight from the chest	At least 10 repetitions in a row
Shuttle run	The length of the 'course' for the shuttle run is 10 metres

Table 3. Comparison of mean values for the experimental and control groups before and after the experimental sessions

Exercise	Control group		Experimental group	
	Before	After	Before	After
100-metre sprint, s	16,4	16,7	16,5	15,9
Running long jump, cm	321	324	320	331
Standing long jump, cm	169	170	167	172
Running high jump, cm	98	98	98	104
Shuttle run, s	9,1	8,9	9,3	8,6

Table 4. Comparison of results

Exercise	Control group	Experimental group
	Difference, %	Difference, %
100-metre sprint, s	+ 1,8% (negative trend)	- 3,6% (positive trend)
Running long jump, cm	+ 0,9% (positive trend)	+ 3,4% (positive trend)
Standing long jump, cm	+ 0,59% (positive trend)	+ 2,9% (positive trend)
Running high jump, cm	0% (lack of trend)	+ 6,12% (positive trend)
Shuttle run, s	- 2,19% (positive trend)	- 7,5% (positive trend)

tween the two groups before and after the three-month study. For the various types of jumps, a positive result is an increase in performance measured in centimetres, meaning that the students jumped further or higher. For the 100-metre sprint and the shuttle run, a positive result is a reduction in the time taken to complete the run.

Thus, in the experimental group, all five indicators from the speed-strength exercise tests showed positive trends. The results for the control group are not quite as clearly positive. In one instance, a negative trend was observed – the students' 100-metre sprint times were 0.3 seconds slower (a 1.8% decrease). Furthermore, there was no change in the standing long jump – the result remained at 98 cm. In the case of the experimental group, the overall effect was significantly greater than that of the control group. This indicates the success of the selected exercises and the implementation of the programme for the development of speed-strength skills.

Conclusions. Based on the theoretical and methodological research of other authors, a programme has been developed to improve students' speed-strength abilities, which includes hopping from foot to foot along a gymnastics bench, jumping over an obstacle on both feet, skipping, jumping on the spot whilst throwing a weight from the chest, and shuttle runs.

The results of applying this programme showed positive progress in the experimental group across all test exercises: from 2.9% to 7.5% over three months.

Thus, the high effectiveness of the developed exercise programme for developing speed-strength abilities in students was confirmed.

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Physical fitness of students of universities of the Siberian region in comparative context with the standards of the all-russian physical skills GTO

UDC 796

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Abstract

Objective of the study The aim of the study is to conduct a theoretical and statistical analysis of the physical fitness of students in the Siberian region, comparing it with the standards of the GTO Physical Fitness Test (Level VII), to identify trends and to develop corrective scientific and methodological measures.

Methods and structure of the study. The study was conducted between 2024 and 2025. First- and second-year students took part in the study from: Siberian Federal University, Krasnoyarsk (SFU); Krasnoyarsk State Medical University named after Prof. V.F. Voino-Yasenetsky, Ministry of Health of Russia (KSMU); Siberian State University of Science and Technology named after Academician M.F. Reshetnev, Krasnoyarsk (SSUST); and Krasnoyarsk State Agrarian University (KSAU). The total sample size was 1,450 students. Over a two-year period, follow-up testing of physical fitness indicators was conducted among male and female students: 100 m run (male and female students), 3000 m run (male students), 2000 m run (females) sit-ups in one minute (females) and pull-ups on a high bar (males). The results of the fitness tests yielded over 4,500 physical fitness indicators. This statistical data was analysed using mathematical statistics and compiled into tables. Furthermore, an analysis of the physical fitness indicators was carried out against the standards of the GTO Physical Culture and Sports System – Level VII, on the basis of which the main conclusions were formulated.

Results and conclusions. The analytical study revealed a low level of physical fitness among university students in the Krasnoyarsk Krai, whose results do not meet the GTO standards. Female students' physical fitness indicators are higher than those of male students; in the 100-metre sprint, their results correspond to the GTO bronze badge, and in the one-minute sit-up test, to the silver badge. At the same time, for male students, the GTO bronze badge is achieved only in the 100-metre sprint. To address the aforementioned identified issues in the physical education of university students, the following innovative organisational and methodological measures are proposed to improve the content and focus of the current physical education system for students: to restructure the targeted content of the physical education curriculum for students at the university, specifically to prepare them to meet the GTO physical fitness standards; to design a sport-specific approach to physical education that enables students to develop the skills and abilities required for selected sports (Specialist Diploma + competitive athlete); to implement a comprehensive approach to students' physical education aimed at encouraging students to engage actively in physical education and sport and at improving the physical fitness of future specialists.

Keywords: *students, universities, the Siberian region, GTO physical fitness standards, comparative analysis, physical fitness.*

Introduction. The primary aim of physical education for university students is to improve their physical fitness. Upon completing their university studies, students should not only receive a degree as future professionals, but also have attained the necessary level of physical fitness to enable them to work productively and actively in their future careers.

However, as practice shows, upon completion of their university studies, only 7% of male students have a high or good level of physical fitness, 30% have an average level, and 63% have a low level; among female students, 8.5% have a high or good level of physical fitness, 24% have an average level, and 67.5% have a low level. These statistical indicators highlight the

need to improve the curriculum content and, more broadly, the overall focus of physical education for students at the country's universities.

Objective of the study The aim of the study is to conduct a theoretical and statistical analysis of the physical fitness of students in the Siberian region, comparing it with the standards of the GTO Physical Fitness Test (Level VII), to identify trends and to develop corrective scientific and methodological measures.

Methods and structure of the study. The study was conducted between 2024 and 2025. First- and second-year students took part in the study from: Siberian Federal University, Krasnoyarsk (SFU); Krasnoyarsk State Medical University named after Prof. V.F. Voino-Yasenetsky, Ministry of Health of Russia (KSMU); Siberian State University of Science and Technology named after Academician M.F. Reshetnev, Krasnoyarsk (SSUST); and Krasnoyarsk State Agrarian University (KSAU). The total sample size was 1,450 students. Over a two-year period, follow-up testing of physical fitness indicators was conducted among male and female students: 100 m run (male and female students), 3000 m run (male students), 2000 m run (females) sit-ups in one minute (females) and pull-ups on a high bar (males). The results of the fitness tests yielded over 4,500 physical fitness indicators. This statistical data was analysed using mathematical statistics and compiled into tables. Furthermore, an analysis of the physical fitness indicators was carried out against the standards of the GTO Physical Culture and Sports System – Level VII, on the basis of which the main conclusions were formulated.

Results of the study and discussion. Upon completion of the analytical and statistical work, a dataset comprising 4,350 results was compiled from first- and second-year students (young men and women). The following basic physical qualities were tested: general endurance (3,000 m run for young men and 2,000 m run for young women); speed (100 m run for both male and female students); and strength indicators (pull-ups on a high bar for male students and sit-ups per minute in the supine position for female students). The statistical data collected were analysed using methods of mathematical statistics ($\bar{X} \pm \sigma$), and the results obtained regarding the students' physical fitness were compared with the standards of the GTO (State Physical Culture and Sports Programme) – Level VII. The resulting data were presented in Tables 1 and 2.

The results of the physical fitness tests for female students, presented in Table 1, show that, overall, the level of physical fitness among female students at universities in the Krasnoyarsk Krai is virtually identical. They meet the GTO standards in the 100-metre sprint and the sit-up test.

An analysis of the physical fitness of university male students in the Krasnoyarsk Krai shows that only in the 100-metre sprint do the results come close to the GTO standards (bronze badge).

Table 1. Physical fitness indicators for female university students in the Krasnoyarsk Krai

University	N	Test exercises					
		100-metre sprint, m/s	GTO Badge	2000 m run, min/sec	GTO Badge	Sit-ups in 1 minute	GTO Badge
SFU	200	17,9±0,8	B	14.30±1.12	–	36,9±7,1	S
KSMU	200	18,1±0,6	B	15.35±1.20	–	37,1±3,8	S
SSUST	200	18,1±1,3	B	14.26±1.17	–	36,9±4,9	S
KSAU	200	18,3±1,4	B	15.07±1.10	–	29,1±3,9	–

Table 2. Physical fitness indicators for male students at universities in the Krasnoyarsk Krai

University	N	Test exercises					
		100-metre sprint, m/s	GTO Badge	2000 m run, min/sec	GTO Badge	Sit-ups in 1 minute	GTO Badge
SFU	200	14,9±1,1	B	14.58±1.36	–	6,5±1,7	–
KSMU	50	15,4±1,3	B	15.53±1.7	–	4,3±1,9	–
SSUST	200	15,1±1,2	B	15.48±1.5	–	7,1±1,9	–
KSAU	200	15,3±1,1	B	15.20±2.04	–	7,8±2,9	–

Conclusions. The analysis carried out revealed a low level of physical fitness among university students in the Krasnoyarsk Krai, whose results do not meet the GTO standards. Female students' physical fitness indicators are higher than those of male students; in the 100-metre sprint, their results correspond to the GTO bronze badge, and in the one-minute sit-up test, to the silver badge. At the same time, male students only achieve the GTO bronze badge in the 100-metre sprint. To address the aforementioned issues in students' physical education at the university, the following innovative organisational and methodological measures are proposed to improve the content and focus of the current physical education system for students: to restructure the educational content of the physical education process for students at the university, specifically to prepare them to meet the GTO standards; to design a sport-specific approach to physical education that enables students to develop the skills and abilities required for selected sports (Specialist Diploma + competitive athlete); to implement a comprehensive approach to students' physical education aimed at encouraging students to engage actively in physical education and sport and at improving the physical fitness of future specialists.

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Adaptive physical education based on a functional-digital approach and football tools for children with intellectual disabilities

UDC 796.035

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Abstract

Objective of the study is to provide a theoretical justification for applying the functional-digital (phygital) approach in the process of adaptive physical education, with an emphasis on creating individualized and motivating conditions for the development of motor and cognitive skills in children with intellectual disabilities and autism spectrum disorder (ASD).

Methodology and organization of the study. The study is grounded in the analysis of scientific and methodological literature and regulatory documents, the description of modern digital and interactive technologies (VR, AR, MR) in adaptive physical education, as well as a structured examination of algorithms within digital platforms that implement the principles of adaptability, individualization, visualization, and progress monitoring for children with intellectual disabilities and autism spectrum disorder.

Results and conclusions. The implementation of the functional-digital approach in the process of adaptive physical education contributes to the formation of a controlled, personalized, and predictable learning environment for children with intellectual disabilities and autism spectrum disorders. The use of digital technologies such as VR, AR, and MR makes it possible not only to individualize the workload and exercise complexity but also to provide visual support and instant feedback, which enhances motivation, engagement, and the frequency of motor action repetitions.

The analysis demonstrates that the use of the functional-digital approach ensures the comprehensive development of physical qualities, cognitive and social skills, contributes to the prevention of secondary disabilities, and provides conditions for safe, gradual, and motivating acquisition of new motor abilities. The digital environment becomes an effective tool for supporting a child along an individual developmental trajectory and facilitating social integration. Overall, the phygital approach in adaptive physical education confirms its high effectiveness and promise for working with children with ID and ASD.

Keywords: *adaptive physical culture, phygital approach, intellectual disabilities, autism spectrum disorder, children, social adaptation.*

Introduction. Modern society places increased demands on the social adaptation and independence of individuals with developmental disabilities. Intellectual developmental disabilities and ASD are accompanied by difficulties in cognitive, communicative, sensorimotor, and behavioral domains, which limit physical activity, participation in sociocultural life, and overall quality of life. Under these circumstances, adaptive physical education (APE) promotes not only motor and cognitive development but also purposefully ensures the formation of functional skills necessary for daily living and social integration.

The digital component enables objective analysis of motor activity, cognitive and behavioral indicators, timely program adjustments, and the construction of individual personal development trajectories for children with disabilities.

The combination of real and virtual tasks promotes the development of coordination, attention, executive functions, emotional regulation, and social communication in a predictable, gentle, and manageable format that meets the needs of children with ASD. The institutional prerequisites and regulatory framework for the introduction of phygital sports have already been established; these documents include Strategy

2030 (Decree of the Government of the Russian Federation No. 3081-r) and the approved federal standard for sports training in the discipline of 'phygital sport (functional-digital sport)' (Order of the Ministry of Sports of the Russian Federation No. 628 dated 02.07.2024), which opens up opportunities for scaling the approach within the system of adaptive physical education and adaptive sports at sports schools and educational institutions.

To date, a considerable body of scientific and methodological material has been accumulated that substantiates the effectiveness and importance of physical activity for children with disabilities [3, 4].

Objective of the study is to provide a theoretical justification for applying the functional-digital (phygital) approach in the process of adaptive physical education, with an emphasis on creating individualized and motivating conditions for the development of motor and cognitive skills in children with intellectual disabilities and autism spectrum disorder (ASD).

Methods and structure of the study. The study is grounded in the analysis of scientific and methodological literature and regulatory documents, the description of modern digital and interactive technologies (VR, AR, MR) in adaptive physical education, as well as a structured examination of algorithms within digital platforms that implement the principles of adaptability, individualization, visualization, and progress monitoring for children with intellectual disabilities and autism spectrum disorder.

Results of the study and discussion. Overcoming sensorimotor deficits, manifested in the inconsistency between brain signals and motor responses, and developing proprioception – the sense of body position in space – are among the primary objectives of adaptive physical education for children with intellectual disabilities and ASD.

Traditional methods of adaptive physical culture for children with intellectual disabilities (ID) and autism spectrum disorders (ASD) fail to increase motivation for participation, as these children are characterized by rapid satiation, difficulties in comprehending verbal instructions, and limited transfer of skills to everyday life [1, 2, 4].

Today's children, including those with intellectual developmental disabilities, can be described as a 'digital generation' that absorbs information more effectively through digital channels.

Digital technologies first entered adaptive physical culture in the form of biofeedback systems (fitness trackers, smart watches, and smart rings), which were designed to collect real-time information about the body's condition [2].

The functional-digital approach helps to resolve this contradiction by transforming abstract instructor demands ('smoothly bend your arm,' 'shift your body weight') into specific, interactive visual-kinesthetic tasks. In this way, the digital environment serves as a universal translator, where body movement directly affects the visual output. For example, the task of developing coordination is accomplished not through verbal instructions but through the need to physically stop a virtual object projected onto the floor in real time with one's foot, which creates a direct and comprehensible cause-and-effect link between the action and the visible result for the child, bypassing the stage of verbal processing.

A crucial aspect is the ability of the phygital environment to provide visual structuring of space and activity (visual scaffolding) in the face of motor planning and spatial orientation difficulties characteristic of children with ASD. This is compensated through the creation of digital movement "frameworks," while interactive projections, augmented reality (AR), and motion capture systems provide clear visual markers: movement trajectories, activation zones, and points of force application, enabling the child to follow a visual plan rather than an abstract instruction, thereby reducing anxiety and the cognitive load associated with independent movement planning. This visual predictability of the environment is a critical factor in reducing sensory overload, as it focuses attention on the relevant stimulus (a trigger, signal, or information directly related to the current task, goal, or behavioral context), minimizing the influence of destabilizing external factors (noise, movement of other people).

The functional-digital approach helps to improve social skills, develop new competencies, and is effective in promoting inclusion and enabling the participation of individuals with disabilities.

A key principle in organizing effective instructional impact is the concept of the zone of proximal development (hereinafter ZPD), introduced by L.S. Vygotsky. According to this approach, a child's development occurs through solving tasks that they cannot accomplish independently but can master with the help of an adult or a more competent peer. The digital environment based on phygital technologies offers unique opportunities for precise and individualized implementation of this principle in the adaptive physical

education of children with autism spectrum disorders (ASD) and intellectual disabilities (ID).

First and foremost, the digital platform acts as an automated and non-judgmental 'experienced mentor.' It possesses the ability for adaptive dosing of workload and task complexity in real time. The algorithms underlying interactive simulators continuously analyze the user's performance; thus, if a child demonstrates consistent failure, the system does not register a defeat but automatically simplifies the task: it enlarges the virtual target, slows the pace of object appearance, and reduces the amplitude of the required movement. Conversely, consistently successful performance leads to a gradual increase in difficulty, allowing the child to remain within their ZPD, where each subsequent action requires a slight degree of effort, ensuring continuous forward progress and preventing the emergence of frustration and negative emotional states associated with chronic failure.

The most important mechanism of support within the ZPD is the system's provision of timely hints and 'assistance.' Unlike socially colored correction from a teacher, which may be perceived as a negative evaluation, the game simulator provides help instrumentally and neutrally. For example, when a child has difficulty performing a movement, the system can visually highlight the trajectory of an arm or leg movement, mark the target object, or demonstrate a model performance in a simplified animation. This function creates conditions for positive reinforcement: the child does not receive a negative assessment for an error but instead receives a resource for self-correction, which strengthens their self-confidence and sustains intrinsic motivation.

The use of the functional-digital approach transforms rehabilitation from an intuitive process into an evidence-based, measurable, and personalized one, significantly increasing the effectiveness of working with children with intellectual disabilities and ASD.

Conclusions. The integration of digital technologies into the process of adaptive physical education opens fundamentally new opportunities for unlocking the potential of individuals with ASD and ID by creating a controlled, personalized, and predictable environment aimed at developing physical abilities and cognitive skills. The phygital environment does not serve as a trigger for children with autism spectrum disorder; on the contrary, it becomes a means of managing the primary condition and preventing secondary disabilities.

The application of the functional-digital approach in APE for children with intellectual developmental disabilities and ASD represents a promising research endeavor that combines purposeful practical skills training with the capabilities of digital technologies. This approach enhances diagnostic accuracy, learning individualization, children's motivation, and the effectiveness of sports rehabilitation activities, contributing to the improvement of quality of life and the social adaptation and integration of children with ID and ASD.

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Developing swimming skills in adults using applied swimming techniques

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UDC 797.2

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Keywords: *swimming, swimming lessons, adults, fear of water, motor skills, practical swimming techniques.*

Introduction. The ability to swim is essential for ensuring safety in the water. Swimming promotes good health and helps develop endurance and coordination. Traditional swimming instruction methods, designed for a long-term mastery of basic swimming skills, do not always meet the needs of adult learners seeking quick and high-quality results. The fast pace of life and lack of free time call for intensifying the process of teaching adults to swim.

The application of the applied swimming method involves integrating elements of swimming techniques from various styles into a unified training structure, which allows for more effective adaptation of the methodology to the individual psychophysical characteristics of the participants and accelerates the process of adaptation to the aquatic environment [1].

Objective of the study is to experimentally demonstrate the effectiveness of the applied swimming method as a means of accelerating the development of basic technical skills in adult learners.

Methods and structure of the study. The study included women aged 20-44 (n=33) who studied the applied swimming method at the XFit 'Zhemchuzhina' and 'Record' pools (Perm) in 2025. The experimental group EG-1 (n=19) included participants with a fear of water and functional changes in the musculoskeletal system; EG-2 (n=14) included participants without a fear of water but with no swimming experience.

The process of mastering the applied swimming technique was implemented through the sequential study of basic elements, comprising the following stages: 1. Development of breathing skills: practicing the "inhalation-exhalation" cycle with the face submerged in water; 2. Improving leg technique: performing breaststroke and backstroke leg movements under various conditions: using a floating support, in a non-supported position, while holding one's breath, and in coordination with the breathing rhythm (inhaling and exhaling into the water); 3. Improving arm technique: performing stroke movements using the front crawl, back crawl, and breaststroke in similar variable conditions: with a floating support, in a non-supported position, while holding one's breath, and in coordination with the breathing cycle.

The following classification of applied swimming techniques was used in the study: 1) Breaststroke (brass arms, crawl legs) – mixed limb movements: arm strokes are performed in accordance with the breaststroke technique, while alternating leg movements follow the elements of the crawl; 2) Back crawl with arms fixed at the hips, performing alternating arm strokes from a starting position in which the upper limbs are positioned along the torso; 3) Back crawl with a roll onto the back – performing a cycle of movements followed by a roll onto the back to inhale.

When teaching applied swimming techniques, the subjects' preferences were taken into account: swimming without goggles or avoiding contact between the face and water; the desire to master a specific swimming technique or its technical element. Thanks to this, it was possible to reduce the training time to 10 sessions, as the subjects performed what they were best at and what corresponded to their swimming needs.

Results of the study and discussion. Following 10 sessions, for subjects in the EG-1 group, who mastered the 'breaststroke arms-freestyle legs' technique, the time to cover a 25-meter distance was 66 ± 2.8 seconds (number of errors 2.1 ± 0.3), and the Cooper test result was 166 ± 8.3 meters; 'front crawl with roll to back' – 25 m – 57.5 ± 2.1 sec (1.8 ± 0.3 errors) and 220 ± 9.3 m in the Cooper test; 'backstroke with arms fixed at the hips' – results shown: 62.8 ± 1.5 sec (1.6 ± 0.2 errors) and 175 ± 7.9 m, respectively; in EG-2, the number of errors in the 50-meter swimming technique was 2.2 ± 0.2, and the result in the Cooper test was 137.0 ± 7.02 m.

Conclusions. The results of the experiment confirmed the effectiveness of applied methods for teaching swimming to adult learners. In EG-1, the use of an individually differentiated approach in teaching adults ensured the development of swimming skills and psychological confidence. In EG-2, statistically significant positive changes were observed after the sessions in both endurance levels (Cooper test) and swimming technique quality.

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Correction of musculoskeletal disorders in students of special medical health group ‘a’ through swimming and water-based muscle strengthening exercises

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Abstract

Musculoskeletal disorders in students are considered one of the most common forms of functional deviations in young age. The majority of students exhibit various forms of posture disorders, including scoliotic posture, increased physiological spinal curvatures, asymmetry of the shoulder girdle and pelvis. Students of special medical group ‘A’ represent a contingent with functional deviations that do not impede physical education classes but require adaptation of the content and intensity of the load. The main objectives of physical education for this group are the correction of identified deviations, restoration of the functional state of the musculoskeletal system (MSS), and the formation of stable self-control skills.

Objective of the study is to scientifically substantiate and experimentally verify the effectiveness of a comprehensive program for correcting functional musculoskeletal disorders in students of special medical health group ‘A,’ based on the combined use of swimming and exercises aimed at strengthening the muscular corset, within the process of physical education in a higher educational institution.

Methods and structure of the study. The study was conducted at DSTU from September to December during physical education classes for students of special medical group ‘A.’

Results and conclusions. The research results confirm the advisability of a comprehensive approach to organizing classes for students of special medical health group ‘A,’ wherein swimming and muscle-strengthening exercises are considered not as auxiliary, but as fundamental components of correctional and health-improving work.

Keywords: *students of special medical group, strengthening of the muscular corset, swimming.*

Introduction. The modern stage of higher education development is characterized by a steady decline in the level of physical activity among students against a backdrop of increasing academic, informational, and psycho-emotional load. The predominance of static postures, prolonged work at a computer, use of mobile devices, and insufficient motor compensation lead to the formation of functional musculoskeletal disorders (MSD) already at a young age. According to domestic and foreign authors, 60 to 85% of students have various deviations in posture, muscle tone, and spinal mobility, which is considered a serious medical and social problem of the modern student population [1,5].

A particular risk group consists of students assigned to special medical group "A" based on their health status. This category of learners is characterized by the presence of functional deviations in various body systems, including the musculoskeletal system, while maintaining the ability for systematic physical education classes provided there is strict dosage and individualization of the load [2]. In students of special medical group (SMG) ‘A,’ MSD typically have a complex nature and manifest as posture disorders, muscle imbalance, reduced endurance of the trunk stabilizer muscles, and functional pain syndromes.

From the perspective of adapted and therapeutic physical culture, a key task in working with students of special medical group ‘A’ is not only preventing the progression of identified deviations but also targeted correction of functional MSD, formation of a rational motor stereotype, and increasing the level of postural stability.

In this context, means of physical rehabilitation combining high effectiveness and safety attract particular at-

tention from researchers. One such means is swimming and aquatic exercises, which possess pronounced therapeutic and preventive potential. The physical properties of the aquatic environment – buoyancy, hydrostatic pressure, and resistance – create unique conditions for unloading the spine, activating trunk muscles, and forming symmetrical movement patterns. For example, the authors' study focused on the use of a set of competitive swimming exercises within supplementary education programs for schoolchildren. The developed methodology included the consistent use of general developmental and specialized exercises to master swimming technique, which contributed to strengthening the core muscles [4].

Furthermore, modern scientific literature emphasizes the key role of the muscular corset in ensuring spinal stability and maintaining correct posture. Insufficient functional capacity of the deep stabilizing muscles is considered one of the leading factors in the formation of MSD and pain syndromes.

Swimming is widely used in the system of physical rehabilitation for individuals with MSD. Authors note that the aquatic environment reduces compressive load on the spine, promotes relaxation of overstrained muscles, and simultaneously activates deep trunk stabilizers.

Domestic studies also confirm the advisability of using swimming in the system for correcting MSD. They note that regular swimming sessions contribute to improved posture, increased spinal mobility, and normalization of muscle tone in individuals with functional disorders.

Platonov (2013) emphasizes that combining various forms of motor activity allows for influencing different levels of movement regulation, ensuring more stable adaptive changes. Thus, programs incorporating swimming and water-based exercises for strengthening the muscular corset appear to be the most promising for correcting MSD in students of special medical group 'A' [3].

Objective of the study is to scientifically substantiate and experimentally verify the effectiveness of a comprehensive program for correcting functional musculoskeletal disorders in students of special medical health group 'A,' based on the combined use of swimming and exercises aimed at strengthening the muscular corset, within the process of physical education in a higher educational institution.

Methods and structure of the study. The study was conducted at DSTU from September to December during physical education classes for students of special medical group 'A.' The experiment comprises three interconnected stages:

1. Diagnostic stage – initial examination of students, selection of research participants, formation of control and experimental groups, conducting baseline diagnostics of musculoskeletal system (MSS) state indicators.

2. Formative stage – implementation of the experimental MSD correction program in the experimental group and conducting traditional classes according to the adapted physical culture program in the control group.

3. Control stage – repeated diagnostics of the studied indicators and comparative analysis of the obtained results.

60 students aged 17-20 were randomly assigned to control and experimental groups of thirty individuals each, comparable in gender, age, and nature of musculoskeletal disorders.

Inclusion criteria for the study: 1. Belonging to special medical health group 'A'; 2. Presence of functional musculoskeletal disorders (posture disorders, muscle imbalance, reduced endurance of trunk muscles); 3. Absence of contraindications to swimming.

The experimental program was developed considering the principles of adapted physical culture: individualization, gradual progression, accessibility, and systematicity. The program combines swimming sessions and the traditional adapted physical culture program provided by the university curriculum.

Structure of sessions for the experimental group:

Sessions are held 2 times per week and include: 1–2 sessions in the pool; 1–2 sessions on land. The duration of one session is 45–60 minutes.

Sessions in the pool include preparatory, main, and concluding parts. Primary focus is on swimming styles that ensure symmetrical muscle work and minimal axial load on the spine (backstroke, adapted front crawl). Elements of aquatic gymnastics and breathing exercises are used.

The control group follows the traditional adapted physical culture program provided by the university curriculum, without targeted use of swimming.

Results of the study and discussion. To comprehensively characterize the functional state of the MSS, the following diagnostic methods were used:

1. Assessment of spinal mobility. Spinal mobility was determined using functional tests (forward, backward, and lateral bends) with measurement of movement amplitude using a centimeter scale. These methods are widely used in the practice of physical therapy and adapted physical culture and possess sufficient informativeness.

2. Assessment of pain syndrome. The intensity of pain sensations in the spinal region was determined using a Visual Analogue Scale (VAS), which allows for quantitative assessment of the subjects' subjective sensations.

Table 1. Spinal Mobility Indicators (cm, M±m)

Indicator	Group	Before Experiment	After Experiment
Forward Bend	Experimental	6,8 ± 0,4	10,9 ± 0,5
Forward Bend	Control	6,9 ± 0,5	7,8 ± 0,4
Backward Bend	Experimental	3,8 ± 0,3	6,1 ± 0,4
Backward Bend	Control	3,5 ± 0,3	4,2 ± 0,3
Lateral Bend	Experimental	10,5 ± 0,6	14,7 ± 0,6
Lateral Bend	Control	10,7 ± 0,5	11,6 ± 0,5

Table 2. Pain Syndrome Indicators on the VAS Scale (points, M±m)

Group	Before Experiment	After Experiment
Experimental	4,6 ± 0,3	2,0 ± 0,2
Control	4,5 ± 0,4	3,8 ± 0,3

The research results reflect the dynamics of functional state indicators of the musculoskeletal system in students of special medical health group 'A' during the pedagogical experiment. Data analysis was conducted separately for the control and experimental groups with subsequent comparison of intergroup differences.

At the diagnostic stage, no statistically significant differences between the control and experimental groups on the main studied indicators were revealed ($p > 0.05$), which indicates their initial homogeneity and correct sample formation.

Upon completion of the formative stage, pronounced positive changes were recorded in the experimental group, while in the control group the dynamics were less pronounced or unstable.

1. Changes in spinal mobility (Table 1). The study of spinal mobility revealed positive dynamics in the amplitude of movements in the sagittal and frontal planes among students of the experimental group. The most pronounced changes were recorded during forward and lateral bends, indicating improved elasticity of the muscular-ligamentous apparatus and reduction of muscle tension.

In the control group, the increase in spinal mobility indicators was minimal and in some cases within the margin of measurement error.

2. Dynamics of pain syndrome (Table 2). Analysis of the subjective assessment of pain sensations in the spinal region showed a significant reduction in pain intensity among students of the experimental group. According to the VAS scale, the average pain syndrome values decreased more than twofold.

In the control group, a trend towards reduced pain sensations was also noted; however, these changes were not stable and were less pronounced.

Conclusions. A comprehensive analysis of all studied indicators indicates the high effectiveness of the experimental program based on the combination of swimming and the traditional adapted physical culture program provided by the university curriculum.

The obtained results confirm the advisability of implementing the developed program into the physical education system for students of special medical health group 'A' and indicate the expediency of the combined use of exercises in the aquatic environment and on land. Aquatic therapy programs combined with land-based exercises lead to a more pronounced improvement in postural control compared to the isolated use of individual means.

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The concept of using physical culture as a driving force for the modernisation of the legislative sector

UDC 796.062

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Abstract

Objective of the study is to develop a model for the organisation of physical education and sport in which infrastructural, symbolic, activity-based and legal components are united by the common goal of fostering civic identity, a sense of place and a readiness to defend the homeland.

Methods and structure of the study. Review of the scientific literature, comparative analysis, modelling.

Results and conclusions. It has been shown that the existing legal framework only partially reflects the educational, developmental and integrative potential of physical education, which creates a systemic obstacle to the implementation of a comprehensive state policy in this area. Furthermore, the physical spaces of physical culture – school stadiums, street workout areas, fitness and health centres, and recreational zones – continue to be viewed either as 'sports facilities' (technical units) or as 'leisure venues' (service points). They are not conceptualised as territories of meaning. Yet it is precisely here—in movement, in physical and sporting activities, in overcoming challenges, and in joint effort—that fundamental patriotic attitudes are formed: a sense of home, a readiness to defend, a habit of caring for the territory, and identification with the place.

Keywords: *physical culture, model, organisation, legislative framework, patriotic education.*

Introduction. The current legislative framework for the physical education and sport sector, whilst being thoroughly developed in terms of standards, safety and the organisation of competitions, fails to capture the patriotic potential of the spaces themselves. The concepts of 'patriotic education' and 'physical culture' appear side by side in official documents, but are not ontologically linked. The law regulates the process but not the environment; it stipulates events but not the landscape.

This gives rise to objective contradictions: infrastructure capable of serving the national idea operates as a neutral territory. Its educational potential is either not utilised at all, or is realised spontaneously, without reliance on legal mechanisms or fundamental support.

Thus, the relevance of this study is determined by the need to overcome the departmental and conceptual disconnect between the strategy of patriotic education and sectoral legislation on physical culture, by proposing a concept of the space of physical culture and sport as a connecting link and a driver of legal modernisation.

Objective of the study is to develop a model for the organisation of physical education and sport in which infrastructural, symbolic, activity-based and legal components are united by the common goal of fostering civic identity, a sense of place and a readiness to defend the homeland.

Methods and structure of the study. Review of the scientific literature, comparative analysis, modelling.

Results of the study and discussion. An analysis of Federal Law No. 329 'On Physical Culture and Sport in the Russian Federation' has revealed a fundamental contradiction between the declared priority of

Table 1. Structure of the patriotic landscape model

Level	Component	Content
1	Infrastructure and environment	Physical characteristics: accessibility, aesthetics, symbolism, integration with the historical and cultural context of the location
2	Activity and practice	Usage scenarios: competitions, rituals, joint training sessions, events marking significant dates
3	Social and communication	Formation of local communities, intergenerational transfer of experience, mentoring
4	Regulatory and legal	Legislative enshrinement of the space's status as 'educational', criteria for effectiveness, design requirements

patriotic education as a national strategy and the lack of substantive provisions in sectoral legislation, which fails to recognise the patriotic potential of the physical culture and sport sector.

In this regard, the following key problems have been identified:

1. Conceptual uncertainty is manifested by the absence in the conceptual framework of Federal Law No. 329 of categories linking the sphere of physical culture and sport with the educational effect; – the concepts of 'patriotism', 'developmental sphere', 'educational environment' and 'socially oriented infrastructure' are not operationalised and have not been incorporated into the legal framework of the physical culture and sport sector.

2. Institutional fragmentation exists, as patriotic education is assigned to departmental structures (coordination councils, programmes) but is not 'woven into the fabric' of everyday physical education activities.

The physical spaces of physical culture belong administratively to one sector, whilst the objectives of patriotic education belong to another. There is no legal bridge between them.

3. Sports facilities and physical culture and health complexes are classified according to technical parameters (capacity, area, compliance with standards). There are no criteria for assessing the educational capacity of physical education and sports spaces, nor their symbolic and identity-forming potential.

4. A regulatory and methodological gap can be identified. There are no standards for the design of physical education spaces that take into account the objectives of patriotic education. There are no requirements regarding the content of the environment (visual codes, memorial integrations, event scenarios). There are no methodologies for measuring the patriotic effect of physical education and sport activities in a specific physical space.

An analysis of Federal Law No. 329, as amended on 24 June 2023, revealed that the conceptual framework lacks the categories necessary to legitimise the concept of a patriotic landscape. The text of the law does not even mention patriotic education. The category has not been introduced into the sector's conceptual framework. The educational environment is absent as a legal category. The concept of the space of physical culture is not mentioned in either a value-based or a technical sense. The law operates with the concepts of 'sports facilities', 'venues for events' and 'physical culture and sports organisations', which indicates an object-based rather than a spatial approach. The patriotic potential of a facility is not provided for as a criterion for assessment or design.

To develop a conceptual model of the patriotic landscape, its essence must be clearly defined.

A patriotic landscape is an integrative model for the organisation of physical culture and sport, in which infrastructural, symbolic, activity-based and legal components are united by the common goal of fostering civic identity, territorial attachment and a readiness to defend the homeland (Table 1, Fig. 1).

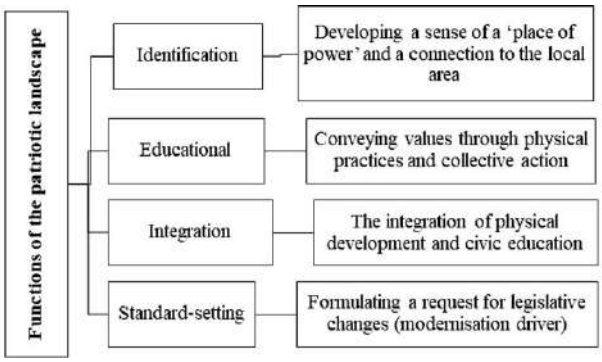

Figure 1. Functions of the patriotic landscape

The following system is proposed as a framework for assessing the patriotic potential of the physical education and sport sector (Fig. 2).

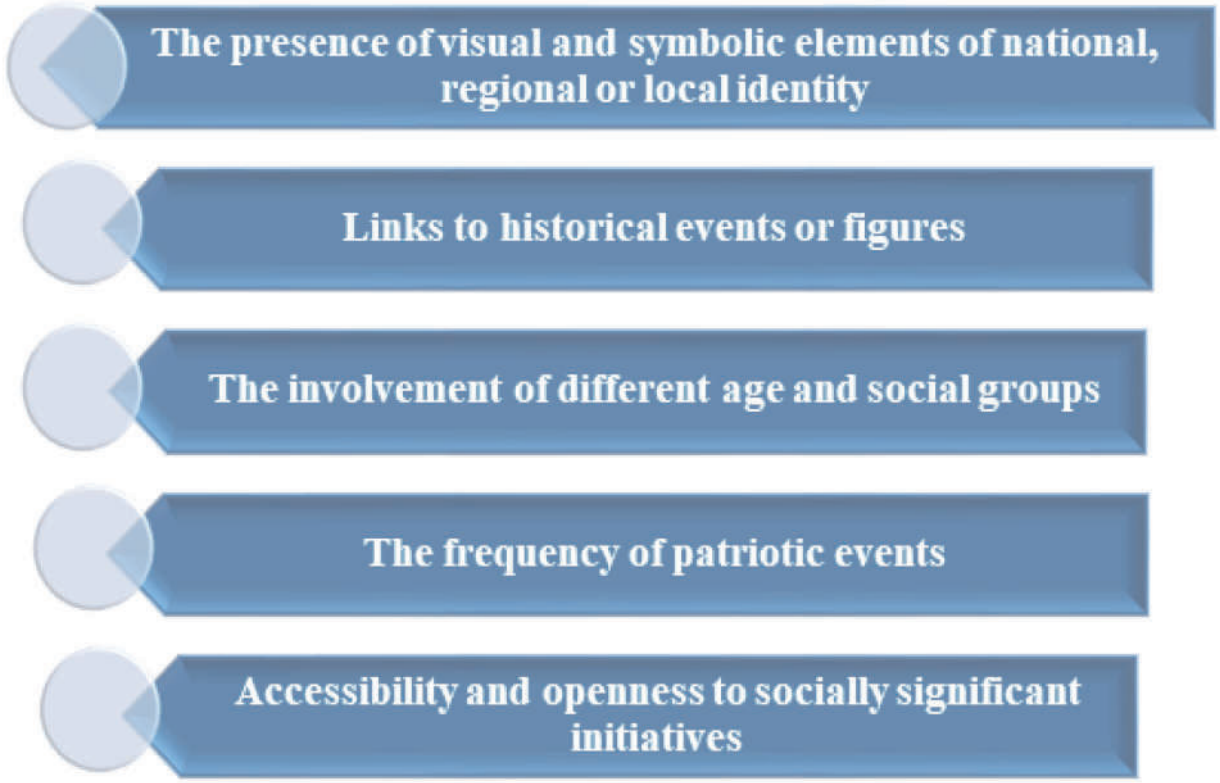

Figure 2. Criteria for assessing the patriotic potential of the physical education and sport sector

An analysis of Federal Law No. 329, as amended on 24 June 2023, has revealed that the conceptual framework lacks the categories necessary to legitimise the concept of a patriotic landscape. The text of the law does not even contain a mention of patriotic education. The category has not been introduced into the sector's conceptual framework. The educational environment is absent as a legal definition. The category of physical culture space is not mentioned in either a value-based or technical sense. The law operates with the concepts of 'sports facilities', 'venues for events' and 'physical culture and sports organisations', which indicates an object-based rather than a spatial approach. The patriotic potential of a facility is not provided for as a criterion for assessment or design.

An analysis of the fundamental principles of legislation on physical culture and sport shows that Article 3 lists the fundamental principles, among which the principle of patriotic orientation, the educational function, and the value-oriented development of the sector are absent. The physical culture sector is declared to be neutral and service-oriented, rather than educational.

An analysis of the entities involved in physical culture and sport within the federal law revealed that the list of entities is extensive but not value-oriented. The entities are listed by sector, not differentiated by their objectives. There is no categorisation of entities performing educational and patriotic functions. 'Citizens' are present as 'participants', but not as bearers of patriotic agency.

An analysis of the powers listed in current legislation has shown that the powers of all levels of government include the development of elite sport, the development of mass sport, the construction and renovation of sports facilities, ensuring accessibility, and the training of a sports reserve. The current law on physical culture does not formulate a single power through the category of 'upbringing'. The development of physical culture and sport is an end in itself, but is not linked to the achievement of national goals extending beyond the sector itself. Facilities are built, but are not assessed for their contribution to the formation of the citizen.

An analysis of the articles relating to infrastructure development shows that the law defines sports facilities as 'facilities... intended for the holding of physical

education and sporting events'. The definition is technocratic and functional. A sports facility is a 'venue for events'. It is not regarded as a space for socialisation, a territory of identity, an environment for upbringing, or a symbolic resource of the territory. There is no classification of facilities according to their socio-educational potential.

The only reference to educational themes is found in Article 34, 'Educational Activities in the Field of Physical Culture and Sport', but exclusively in the context of educational organisations implementing programmes in the field of physical culture and sport. The educational function is confined within the education system and is not extended to sports facilities, street spaces, recreational areas, school grounds, etc. Outside educational organisations, physical education and sport cease to carry an educational burden – such is the logic of the current law.

Conclusions. The analysis reveals a fundamental conceptual gap. Federal legislation on physical education and sport does not provide a legal basis for classifying the sphere of physical education as a vehicle for patriotic education. The sector exists normatively within the paradigm of 'providing services' and 'organising events', but is not conceptualised as a space for the formation of civic identity. The legislative framework for the sphere of physical culture was not originally designed to address patriotic objectives or to realise the educational potential of physical culture. Conceptual modernisation is required, driven by the proposed model of a 'patriotic landscape'.

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Developing physical fitness through the principle of ‘repetition without repetition’

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Abstract

Objective of the study is to substantiate ‘repetition without repetition’ as a principle for developing physical fitness.
Methods and structure of the study. The study involved a review of the scientific and methodological literature, systematic analysis, deduction and induction, and content analysis. The research was conducted between 2024 and 2025.
Results and conclusions. It has been established that the principle of ‘repetition without repetition’ refers to the repeated execution of movements to solve a motor task during the development of physical fitness. The latter is based on motor abilities.

Keywords: *physical training, skill development, repetition without repetition, review.*

Introduction. Physical fitness is a key component of a person’s ability to achieve a planned outcome; this outcome determines the means and methods used to develop that person’s physical fitness.

Physical fitness for various human activities is comprised of motor abilities; their qualitative basis and distinctive characteristics are determined by physical qualities, whilst motor skills and abilities represent the form in which these qualities are manifested [3]. Motor abilities are developed through various types of activity, taking into account the principles governing the development of motor skills, habits and physical qualities. Clearly, there must be an organic interconnection and interaction between physical qualities and motor skills and habits.

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Methods and structure of the study. The study involved a review of the scientific and methodological literature, systematic analysis, deduction and induction, and content analysis. The research was conducted between 2024 and 2025.

Results of the study and discussion. Motor abilities should be regarded as a systemic entity constituting a unified whole. They consist of physical qualities as their substance, and motor skills and abilities, which represent the form in which these qualities are manifested. Two questions arise: What are the patterns governing the development of motor abilities as a holistic entity? How should one be guided by the laws governing the development of physical qualities and the formation of motor skills and abilities? Understanding the essence of motor abilities, questions regarding their development and formation must be considered from the perspective of synergetics. The validity of our position is based on the fact that the principle of ‘repetition without repetition’ is underpinned by the laws of self-organisation [3].

Before discussing this principle in greater detail, let us turn to the provisions of the theory and methodology of physical education concerning motor abilities. Physical exercises are characterised by form and content. The content and form of physical exercises are organically interrelated. The content of a physical exercise plays a leading role in relation to

its form. Therefore, to achieve success in a physical exercise, its content must be altered, which will influence the development of physical qualities. And this can lead to an increase in the body's functional capabilities. However, form and content are inseparable as parts of a whole – motor abilities. Therefore, to develop physical qualities, one must repeatedly perform physical exercises, applying motor skills and abilities. It is precisely this that will ensure both the development of physical qualities and the refinement of the motor skills and abilities themselves, as the form in which the former are manifested. Developing physical qualities impart a qualitative distinctiveness to motor abilities. Thus, the development and refinement of physical qualities, motor skills and abilities in their holistic unity – within the system of motor abilities – cannot be isolated and developed separately [4]. It can be said that a change in the nature of motor abilities will, accordingly, affect motor skills and techniques. Physical recreation, aimed at overcoming fatigue and restoring working capacity, plays an important role in this process [9, 10].

Thus, according to L.P. Matveev [4], an increase in the speed and endurance of movements affects their amplitude and the ratio of the supported and unsupported phases of the exercise. Imperfect motor skills and techniques hinder the optimal expression of a person's functional capabilities, and thus their development. This leads to an increase in unnecessary energy expenditure, which, in turn, results in a reduction in the level of physical development. It has been established that a highly developed form of motor abilities facilitates the best utilisation of physical potential. For example, at the same skiing speed, a person with a more refined technique expends 10–20% less energy than a person whose technique is less refined.

However, some authors hold opposing views. They believe that when developing motor abilities in athletes, physical qualities must first be developed, followed by the formation of the sport's technique [4, 7]. It is impossible to develop physical qualities in isolation, as they are inextricably linked and interdependent with motor skills and abilities. The development of one leads to a corresponding change in the other. A clear example of this is preparation for the GTO fitness test – the 'gold' level requires the comprehensive development of a range of physical qualities, abilities and skills [6].

Therefore, it is necessary to seek out methods for their development. The principle of 'repetition without repetition' proposed by N.A. Bernstein [1] can serve as the basis for the development and implementation of such a methodology in physical education and sport.

What is the value of the principle of 'repetition without repetition' for addressing issues in physical education and sport? To answer this question, let us consider a number of propositions characterising this principle.

1. The principle of 'repetition without repetition' is based on the laws of synergetics [3], which determine the interactions, interrelationships and correlations between physical qualities, motor abilities and skills that develop within the framework of holistic motor abilities. Therefore, interdisciplinary research into the issues of physical education and sport should be undertaken to develop and substantiate the synergetic foundations of physical education and sports training.

2. By applying the principle of 'repetition without repetition', the process of developing motor abilities can be described. When a movement is performed repeatedly, it is not copied each time; rather, various methods of solving the motor task under changing conditions are developed and implemented. In this context, what is crucial is not the number of repetitions, but the level of mastery achieved in motor abilities, which constitute developed physical qualities, and the form of their manifestation is the acquired motor skills and abilities.

3. The essence of repeated movement execution in the development of motor abilities lies in gradually progressing towards the goal by identifying optimal movements associated with solving the pedagogical task. When an exercise is correctly performed repeatedly, the process of solving this task occurs through the modification and refinement of each successive repetition. Without taking these principles into account, physical exercise turns into a process of 'mechanical rote learning' [2].

4. During repeated performance of an exercise, the brain sends a specific 'command' to the muscles and receives signals from proprioceptors regarding the results of their functioning. Based on the signals received, the brain sends new 'commands' to the muscles, aimed at correcting the execution of the exercise. Thus, there is a direct and reciprocal connection between the brain and the peripheral nervous system, which facilitates the process of movement construction. The same goal can be achieved in many ways (pathways), and all of them are effective [8]. It is char-

acteristic that, alongside the construction of movement, the development of physical qualities within the motor skills system occurs simultaneously [5].

5. The acquisition of a motor skill is not the result of accumulating experience through the repeated execution of the same stereotypical commands, but rather the training of a person to perform the skill in a new way with each repetition, i.e. taking into account the need for appropriate adaptation to solve the motor task according to the principle of 'repetition without repetition' [8].

6. When implementing the principle of 'repetition without repetition', each successive movement is performed under slightly different conditions. Therefore, to achieve the same result, it is necessary to develop a person's ability to solve a motor task, to cultivate their skill in quickly finding a solution under the changing conditions of the exercise being performed, guiding them towards achieving the desired result. At the same time, it is important to ensure that the result achieved in the movements corresponds to the set goal [8]. Movements are regulated by sensations (I.M. Sechenov), but the reverse is equally true: sensations, as both an image and a regulator, are constructed through movement.

Conclusions. 1. The principle of 'repetition without repetition' is implemented through the repeated performance of motor actions aimed at developing motor skills and abilities, which are manifestations of physical qualities. Motor skills and abilities are interrelated and interact within the system of motor abilities. The result of solving a motor task when applying the principle of 'repetition without repetition' is the development of a person's physical fitness, which is required by the activity they are performing. 2. The principle of 'repetition without repetition' is implemented through repeated actions involving, as it were, the same movements. In reality, a motor task is being solved to develop the motor abilities that constitute physical fitness. Subsequently, the result of each repetition is systematically assessed, with the technique of performing the actions being compared each time against a standard and followed by an analysis of any deviations. Taking into account the data from the assessment of physical fitness and the comparison of motor technique, corrections are made to these deviations until the intended result, corresponding to the set goal, is achieved.

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Improving the strength capabilities of qualified female weightlifters in the preparatory period of the annual training cycle

UDC 796

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Abstract

Objective of the study To develop practical recommendations for improving strength abilities, taking into account the nutrition and endocrine system performance of qualified female weightlifters.

Methods and structure of the study. We conducted a pedagogical experiment involving six female weightlifting masters of sport and three amateur athletes. The study was conducted at the Batyr Sports Complex in Kazan. We studied performance in competitive events (snatch and clean and jerk) and results in control exercises for explosive strength.

Results and conclusions. While studying the hormonal levels of female weightlifters during the preparatory period, we identified two types of hormonal imbalances: low triiodothyronine levels and high thyroxine levels. We developed a retracting microcycle for low triiodothyronine levels and high thyroxine levels. Improving strength abilities requires not only a well-designed training plan and high motivation, but also maintaining normal levels of endocrine hormones.

Keywords: *strength abilities, explosive power, qualified female weightlifters, preparatory period, hormonal background, nutritional features.*

Introduction. The contemporary development of international sport is characterized by a steady trend toward expanding gender equality, manifested in the active inclusion of women in sports previously associated primarily with male participation, particularly martial arts and weightlifting. In this regard, studying the place and role of women in sport, which historically developed as a space for predominantly male self-realization, is particularly relevant. At the same time, a modern scientific approach requires abandoning value judgments about women's "natural" inability to demonstrate results comparable to those of men, as the level of athletic achievement is determined by a complex of biological, psychophysiological, methodological, and social factors [7, 8].

The relevance of research into improving the strength capabilities of qualified female weightlifters is driven by the rapid growth of athletic achievements in women's weightlifting and the need for a scientifically sound training process that takes into account the physiological characteristics of the female body. In modern high-performance sport, traditional methods borrowed from men's weightlifting are often ineffective or lead to overtraining [6, 9]. At the 2025 World Weightlifting Championships in Førde, Norway, the highest total score for women in the snatch and clean and jerk was 283 kg.

The high level of competitive results in women's weightlifting (the 2021 women's world record is 335 kg based on total points) requires the search for new theoretical, methodological, and methodological approaches to improving the effectiveness of the educational and training process, especially in the preparation of athletes for national teams.

The preparatory period is the foundation of the annual cycle, as it is during this stage that the morphofunctional prerequisites for achieving maximum strength performance in competition are established. The need to find the optimal balance between volume and intensity of training, as well as the specific selection of exercises for developing explosive strength and absolute muscle strength in women, remains one of the most pressing issues in sports education.

Research by L.G. Shakhlina indicates the need to consider the ovarian-menstrual cycle (OMC) when planning strength training during the preparatory period, while irrational intensity distribution without regard to hormonal levels reduces training effectiveness [5]. V.N. Platonov established in his research that qualified female weightlifters reach the limit of their adaptive capabilities, which requires the implementation of innovative muscle contraction regimens and load variability to overcome the «strength plateau» [4].

Improving strength abilities is impossible without understanding the biomechanical characteristics of competitive exercises, as it is crucial to maintain a balance between developing overall strength and maintaining movement structure during the preparatory period [3]. It is becoming clear that the rate of improvement in athletic performance will depend on the growth dynamics of maximum strength and explosive power of the major muscle groups involved in the work, ensuring the effective performance of competitive exercises [1, 2].

Purpose of the study: to develop practical recommendations for improving explosive strength, taking into account the nutrition and endocrine system performance of qualified female weightlifters.

Methods and structure of the study. We conducted a pedagogical experiment involving six female weightlifting masters of sport and three amateur athletes. The study was conducted at the Batyr Sports Complex in Kazan. We studied the performance in competitive exercises (snatch, clean and jerk) and the results in control exercises for explosive strength.

Results of the study and discussion. Hormonal levels are a key factor influencing the development of explosive power in skilled female weightlifters. While studying the hormonal levels of female weightlifters during the preparatory period, we identified two types of hormonal imbalances: low triiodothyronine levels (Table 1) and high thyroxine levels (Table 2). With normal thyroxine (T4) and thyroid-stimulating hormone (TSH) levels, but low triiodothyronine (T3) levels, athletes experience rapid fatigue, persistent weakness, inattention, absent-mindedness, sleep disturbances, limb cramps, and swelling.

The athletes from Table 2 have a high level of the T4 hormone; with elevated values of this hormone, athletes experience irritability, fatigue, tachycardia, and weight loss.

For comparison, three amateur-level female athletes were invited to join the experimental group. The weightlifters also underwent testing, and their levels

Table 1 – T3 hormone levels in female weightlifters

Units of measurement	T3	T4	TSH
	pmol/L	pmol/L	μIU/ml
Norms	2.63-5.7	9-19.05	0.35-4.94
Sportswomen			
No. 1	2.22 / below normal	12:55	2.5800
No. 2	2.01 / below normal	13.65	2.5500
No. 3	2.77 / below normal	16.80	2.3200

Table 2 – T4 hormone levels in female weightlifters

Units of measurement	T3	T4	TSH
	pmol/L	pmol/L	μIU/ml
Norms	2.63-5.7	9-19.05	0.35-4.94
Sportswomen			
No. 1	4.38	19.12 / above normal	2.5900
No. 2	4.80	21.08 / above normal	3.4200
No. 3	4.55	19.15 / above normal	3.6600

Table 3 – Levels of T3, T4 and TSH hormones in female athletes who are not qualified in weightlifting

Units of measurement	T3	T4	TSH
	pmol/L	pmol/L	μIU/ml
Norms	2.63-5.7	9-19.05	0.35-4.94
Sportswomen			
No. 1	3.11/ norm	12.15/ normal	2.1600
No. 2	4.30/ normal	14.08/ normal	3.5700
No. 3	5.10/ norm	17.01/ normal	3.8000

were normal for all three endocrine hormones: T3, T4, and TSH (Table 3).

Based on the results of the three tables, we see the following: qualified female athletes have endocrine system disorders and are more susceptible to the risk of developing various diseases due to hormonal imbalances than unqualified athletes who have stable hormonal levels.

After analyzing the athletes' training plan and nutrition diary, we concluded that while the training plan was well-designed, there were nutritional deficiencies. Further discussion with the athletes revealed the cause of the endocrine hormonal imbalance: a desire to lower their weight class. After analyzing the weightlifters' results, we recommend reducing their workout loads to 50-60% of their maximum possible weight and alternating training and rest days while under observation by a sports medicine specialist.

An example of the content of a retracting microcycle with low levels of the hormone triiodothyronine.

% - indicated from the maximum possible weight taken

A, B – circuit training

1 workout:

Warm-up: 10 minutes of running, 3 sets of abdominal crunches (p) x 15 times, 3 sets of hyperextension (p) x 15 times

Barbell snatch - 20% - 10 times, 25% - 8 times, 30% - 5 times, 40% - 5 times, 50% - 5 reps x 5 times, 40% - 6 times, 30% - 3 reps x 8 times

Barbell push – 20% - 10 times, 30% - 2p x 8 times, 40% - 5 times

A) squat push-up – lying push-up – squat push-up – jump – 15 times

B) 24kg kettlebell swings – 15 times

B) Press – 15 times

D) Hyperextension with weight – 10 times

D) Squats with a 30 kg barbell – 10 times (5 rounds, 3 minutes rest between rounds)

5. Stretching

6. Treadmill 20 minutes, speed 10

Training:

Warm-up: 10 minutes of running, 3 crunches x 15 reps, 3 hyperextensions x 15 reps

Squats with a barbell 20% - 10 times, 30% - 8 times, 40% - 6 times, 50% - 5 reps x 5 times, 60% - 3 reps x 1 time

Bench press 20% - 10 times, 30% - 8 times, 35% - 6 times, 40% - 5 reps x 5 times, 50% - 3 reps x 1 time, 55% - 1 time, 50% - 3 times, 40% - 3 reps x 4 times, 35% - 6 times, 30% - 10 times

Stretching

Exercise bike 20 minutes

3rd workout:

1. Warm-up: 10 minutes of running, 3 sets of crunches x 15 reps, 3 sets of hyperextensions x 15 reps

2. Barbell push - 20% - 10 times, 25% - 8 times, 30% - 5 times, 40% - 5 times, 50% - 5 reps x 5 times, 40% - 6 times, 30% - 2 times x 5 reps

3. Barbell Snatch 40% - 5 reps x 5 times

4. A) Barbell squats 30% - 8 times

B) Bench press 30% - 10 times

B) 16kg kettlebell swings – 15 times (4 rounds, 2 minutes rest between rounds.)

5. Stretching

6. Treadmill 20 minutes, speed 10.

An example of the content of a retracting microcycle with a high level of the thyroxine hormone.

training

Warm-up: cardio 10 minutes, press 3p x 15 times, hyperextension 3p x 15 times

Squats with a barbell 20% - 12 times, 30% - 10 times, 40% - 8 times, 55% - 5 reps x 5 times, 60% - 3 reps x 1 time, 55% - 2 reps x 3 times, 40% - 6 times, 30% - 8 times, 20% - 10 times

Bench press 20% - 10 times, 30% - 8 times, 35% - 6 times, 40% - 5 reps x 5 times, 50% - 3 reps x 1 time, 60% - 2 reps x 1 time

Stretching

Exercise bike 20 minutes

training

Warm-up: cardio 10 minutes, press 3p x 15 times, hyperextension 3p x 15 times

Barbell snatch - 20%-10 times, 25%-8 times, 30%-5 times, 40%-5 times, 50%-5 times x 5 times, 40%-6 times, 30%-8 times x 3 times

3. Barbell push – 20% - 10 times, 30% - 8 times x 2 reps, 40% - 5 times x 7 reps

4. A) Squat push-up – lying push-up – squat push-up – jump – 15 times

B) 24kg kettlebell swings – 15 times

B) Press – 15 times

D) Hyperextension with weight – 10 times

D) Squats with a 25 kg barbell – 10 times

3 rounds, rest between rounds 1 minute

5. Stretching

6. Treadmill 20 minutes, speed 10

training

Warm-up: cardio 10 minutes, press 3p x 15 times, hyperextension 3p x 15 times

Barbell snatch - 20%-10 times, 25%-8 times, 30%-5 times, 40%-5 times, 50%-5 times x 5

Barbell Jerk - 20% - 10 times, 30% - 8 times, 35% - 6 times, 40% - 5 reps x 5 times, 50% - 3 reps x 1 time, 55% - 1 time

Stretching

Treadmill 30 minutes, speed 9.

We also developed nutritional recommendations that take into account the specific functions of the endocrine system. To stabilize endocrine hormones, it is also recommended to adhere to a calorie maintenance plan calculated individually for each weightlifter. It is also important to remember the ratio of proteins, fats, and carbohydrates. The optimal values during the maintenance phase are: protein – 1.7-1.8 grams per 1 kg of body weight, fat – 1 gram per 1 kg of body weight. Carbohydrates during the maintenance phase are calculated as the remaining calorie intake using the formula: daily calorie intake (kcal) – kcal (protein) – kcal (fat), and divide the result by 4 kcal (the calorie content of 1 gram of carbohydrate).

For two months, qualified female weightlifters underwent treatment with an endocrinologist and sports nutritionist, followed a balanced diet, and minimized training loads. The athletes' endocrine hormone levels after two months (Table 4) demonstrate the effectiveness of this comprehensive approach to improving explosive strength.

Thus, the results of our experiment allow us to recommend that qualified female weightlifters adhere to a balanced diet and monitor their endocrine hormones.

A test to assess the maximum strength of qualified female weightlifters (Table 5) was conducted to examine how changes in hormonal levels affect the strength performance of female athletes.

After recovery, the athletes' performance in the competitive snatch and clean and jerk exercises increased by at least 5,5% (Table 6).

Thus, we see a direct link between improvements in strength, increased strength performance, and hormonal levels in qualified weightlifters. Based on these results, we can conclude the following: the lower the endocrine hormone levels, the less effective the improvement in strength in qualified weightlifters.

Testing of speed-strength abilities was also carried out before and after restoration of endocrine system hormones (Table 7).

The study results demonstrate the positive impact of normal hormonal levels on the speed-strength performance of qualified female weightlifters. While performing the complex before hormonal levels were re-

Table 4 – Endocrine hormone levels of qualified female weightlifters after two months of training

Units of measurement	T3	T4	TSH
	pmol/L	pmol/L	μIU/ml
Norms	2.63-5.7	9-19.05	0.35-4.94
Sportswomen			
No. 1	2.90/norm	12:55	2.1600
No. 2	3.15/norm	13.65	3.5700
No. 3	5.10/norm	16.80	3.8000
No. 4	4.38	10.11/norm	2.1500
No. 5	4.80	13.18/norm	3.7800
No. 6	4.55	18.05/norm	2.6500

Table 5 – Indicators of development of strength abilities of female weightlifters before restoration of endocrine system hormones

Athlete	Dash (max)	Thrust (max)	In/to
No. 1	70	60	48
No. 2	50	80	48
No. 3	85	90	53
No. 4	60	100	63
No. 5	75	80	63
No. 6	95	80	75

stored, the athletes experienced cramps, dizziness, limb weakness, absent-mindedness, and inattention. After recovery (Table 7), the athletes, in addition to successfully completing the tests, were in good physical condition, productive, and motivated.

Thus, we can draw the following conclusion: to improve strength abilities, not only a well-designed training plan and high motivation are necessary, but also maintaining normal levels of endocrine hormones.

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Table 6 – Indicators of development of strength abilities of female athletes after restoration of endocrine system hormones

Athlete	Dash (max)	Thrust (max)	In/to	Xcp±σ	Increase, %
No. 1	75	65	48	70,0±7,07	7,2
No. 2	60	85	48	72,5±17,7	10,4
No. 3	90	95	53	92,5±3,5	5,5
No. 4	65	110	63	87,5±31,8	8,6
No. 5	80	85	63	82,5±3,5	6,1
No. 6	100	85	75	92,5±10,6	5,5

Table 7 – Performance of female athletes after hormonal restoration endocrine system

Name of the test	Sportswomen (before/after)						Xcp±σ	Growth, %
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6		
1. Bending and unbending arms in a lying position for 30 seconds, number of times	31/ 38	29/ 33	30/36	22/28	23/29	26/32	32.6± 3.8	17.9
2. Squat push-up – lying push-up – squat push-up – jump in 30 seconds, number of reps	18/ 23	20/23	20/24	17/21	16/20	13/16	21.2± 3.8	18.2
3. Long jump from a standing position, see	210/ 230	221/ 233	230/ 237	207/ 211	218/ 225	207/ 215	225.2± 10.3	4.3
4. Barbell snatch, 50% of maximum weight, for 30 seconds, reps	3/5	3/4	5/8	5/8	3/5	2/4	5.7± 1.9	38.3

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