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CONTENT

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AUDIO STIMULATION ATHLETES WITH VISUAL IMPAIRMENTS IN RUNNING

Andrii Yefremenko

Svyatoslav Koval

Viktor Pavlenko

Tetiana Shutieieva

Yaroslav Kraynik

Svetlana Pyatisotskaya

Kharkiv State Academy of Physical Culture,

Kharkiv, Ukraine

Purpose: revealed differences in the running characteristics of athletes with visual impairment without and with audio stimulation.

Material and methods: test №1: running for 4 minutes with a gradual increase in pace; test №2: running for 4 minutes in the tempo of the metronome (140; 150; 160; 170 bpm).

Results: Comparison of test results №1 and №2 in the group of young men revealed the reliability of differences ($p<0,05$) for: the first and fourth minutes of running; average running speed in the second minute. Comparison of the results of tests №1 and №2 in the group of girls revealed the reliability of differences ($p<0,05$) for: the distance of running in the first minute; average running speed in the first and second minutes.

Conclusions: similar physiological reactions were recorded in boys and girls on exercise, which increases in steps, regardless of the method of stimulation. At the same time, there are certain differences in the strategy of movement, depending on the method of stimulation. This confirms the complex effect of the imposed rhythm

on the performance of cyclic locomotion. We expected significant differences between running characteristics with and without auditory stimulation. However, a large number of reliable differences between the results, including for boys and girls, were not found. At this stage, we are inclined to think that the selected metronome frequencies are convenient for running with a load that rises stepwise.

Keywords: metronome, rhythm, tempo, athletics.

Introduction

The human body is able to perceive and respond to stimulation of the main senses from the outside [8]. An individual is able to arbitrarily choose a specific (with varying degree of awareness) rhythm of motor activity. Obviously, to effectively solve a specific motor task, the rhythm will be different. For example, cyclic locomotion (walking, running, etc.), which are everyday and simple for a healthy person. They have important practical significance for movement, development and control of preparedness and rehabilitation. We can say that the rhythmic performance of cyclic locomotion indicates their quality (economy and efficiency). Thus, in the area of bimanual coordination isolate rhythmic-auditory stimulation, which can stabilize internal coordination creating an effect called «anchoring». When a particular point in a cycle of movement (for example, placing a foot on a support) is synchronized with a metronome, an effect called anchoring may occur [2, 7], which showed a more stable connection between the characteristics of the musculoskeletal system and the respiratory system during cyclic movements through locomotor respiratory coupling. Rhythmic motor actions can be combined with external acoustic stimuli (metronomes and music). This phenomenon is known as sensorimotor synchronization [16]. At the same time, concentration on an external stimulus distracts from internal experiences (uncertainty, fatigue, laziness). Showed an increase in time to fatigue due to the use of sound stimuli during exercise. It is assumed that this is due to the parallel processing of external and internal signals. That is, the main attention when performing physical work is transferred to external stimuli in an attempt to reduce the perception of signals about the tension of the

musculoskeletal system and cardio-respiratory system. Also, this may be due to an increased level of relaxation as a result of an exact expectation of the upcoming movement. Perhaps there is a certain «rhythmic pattern» as the most effective strategy for solving a motor problem. The frequency of cyclic locomotion in recreational runners between 130 and 200 steps per minute (spm) [10]. Perhaps we should speak only about the individual rhythm of movement. Auditory or visual stimulation is most commonly used in physical exercise.

Thus, the **purpose of the current study** was to revealed differences in the running characteristics of athletes with visual impairment without and with audio stimulation.

Material and Methods of research

Object: athletes with visual impairments (category T13) (boys n=6 and girls n=5). *Ethical Statement.* The study was approved by the Ethics Committee of the Kharkiv State Academy of Physical Culture and all subsequent procedures were consistent with the Helsinki Declaration. To determine the athlete's classification, a Diagnosis Certificate signed by the attending physician was used. This was sufficient evidence of visual impairment. Athletes have given written consent to assign a classification.

Test №1. Groups of athletes with visual impairments (girls or boys) at the command «Go!» Performed a run for 1 min. in a free rhythm, which the test person had to independently raise every minute (only 4 m). The benchmark was the average heart rate (HR) and the average running speed (V № … min; m/s), which was reported to the test person at the end of each minute. Each subsequent minute, it was recommended to run at an elevated rhythm based on perceived running speed and physiological sensations. Running was performed on a platform with a ground covering, on a plot of 20 m with bright markings every meter, which was limited by cones. When the athlete reached the cone, the coach gave the command to turn and continue to run the other way. At the end of 1, 2, 3 minutes, HR (bpm) was recorded, the distance covered (Dist. after № … min; m) and Rating of Perceived Exertion (RPE after № … min; score) by Borg «6-20» (from 6 («Easy») to 20 («maximum

effort»). After this, the test person returned to one of the cones for the start of the next minute of the run (a total of 15±5 s were used to record and report the indicators). As soon as all the test participants were ready, a signal was given to start running. At the end of 4 minutes or in case of refusal to continue, HR and Dist. were recorded after 1-4 min. Indicator changes were reported to test person only to select running speed.

Two hours later, the test person proceeded to perform a second test.

Test №2. Groups of athletes (groups of 5 people) at the command «Go!» Performed a run for 1 min. (4 min in total) to the rhythm of the metronome, which rises every minute (140, 150, 160, 170 bpm). Running was performed on the same platform as in test № 1. The digital metronome signal was fed through a portable audio system. At the end of 1, 2, 3 minutes record HR, Dist. after № …. min and RPE. At the end of each minute, the test person returned to one of the cones to start the next minute of the run (a total of 15 ± 5 s were used to record the indicators). As soon as all the test participants were ready, the signal was given to start running the race at a given rhythm. Recorded HR and Dist. after 1-4 min: at the end 4 m; in case of refusal to continue running; in case of apparent inconsistency with a given rhythm of running (>10 SPM).

Statistical analysis was performed using the software package Statistica 10 (USA). The analysis of compliance of sample data with the normal distribution law was performed using the Kolmogorov-Smirnov test. Parametric and non-parametric methods of analysis were used to describe, assess interconnections, and differences in results: descriptive statistics; Pearson correlation coefficient; Mann-Whitney U-test; Student's t-test paired samples. For all analyzes, the level of statistical significance was set at $p<0,05$.

Results of the research

All participants were able to complete the test №1 and №2. The measured running characteristics and heart rate had a different approximation to the normal distribution law. Based on the results of the Kolmogorov-Smirnov test, an appropriate statistical criterion was chosen to compare the results. The kinematic characteristics

and physiological responses recorded during the run without audio stimulation are presented in Table 1.

Table 1

Results of the research

Type of measurement	male		female	
	M±SD			
	rhythm	no rhythm	rhythm	no rhythm
HR start	105,00±12,73	97,46±16,33	102,86±8,10	100,29±11,39
HR №1 min	131,46±18,35	129,81±19,60	151,86±17,60	149,29±20,04
HR №2 min	155,69±16,53	154,62±17,00	165,86±15,36	164,57±19,65
HR №3 min	166,00±12,47	169,15±16,19	171,36±17,28	170,86±19,86
HR №4 min	173,42±13,06	176,46±13,35	173,71±20,14	177,43±13,00
Dist. after №1 min	118,43±16,54*	108,62±17,43*	91,98±5,43*	102,46±15,10*
Dist. after №2 min	129,17±31,08	136,28±30,97	95,63±8,30	101,09±15,59
Dist. after №3 min	142,70±24,40	144,66±24,38	142,07±17,22	147,53±8,24
Dist. after №4 min	136,15±16,89*	148,44±5,26*	121,37±12,94	129,95±23,31
V №1 min	1,97±0,27	1,81±0,29	1,53±0,09*	1,71±0,26*
V №2 min	2,15±0,52*	2,27±0,52*	1,60±0,14*	1,68±0,0,26*
V №3 min	2,38±0,41	2,41±0,41	2,37±0,29	2,46±0,14
V №4 min	2,27±0,28	2,47±0,09	2,02±0,21	2,17±0,39
RPE after №1 min	9,54±1,50	9,35±1,35	9,07±3,69	9,00±1,66
RPE after №2 min	9,81±1,33	10,12±2,03	10,93±1,27	10,14±2,21
RPE after №3 min	13,62±2,04	13,42±1,60	14,93±1,69	14,36±1,15
RPE after №4 min	15,92±1,09	16,38±0,98	15,64±0,74	16,36±1,08

*Significant differences with the auditory stimulation and without auditory stimulation <0,05

The coefficient of variation of heart rate in the group of young men during 4 minutes of running decreased (CV = 13,96; 10,62; 7,51; 7,53), and in the group of girls it changed in a wave-like manner (CV = 11,59; 9,26 ; 10,09; 11,59). The group variation of the running distance in the group of young men decreased in the third and fourth minutes, and increased in the second minute of the test (CV = 13,97; 24,07;

17,10; 10,66), while in the group of girls it increased (CV = 5,90; 8,67; 12,12; 12,40). The average running speed had a similar dynamics, as well as the running distance of the subjects of both groups. The coefficient of variation for RPE decreased (CV male: 15,76; 13,53; 14,99; 6,86; CV female: 40,67; 11,61; 11,29; 4,76).

The coefficient of variation of heart rate in the groups decreased (CV male: 15.10; 10.99; 9.57; 7.57; 7.39; CV female: 13.42; 11.94; 11.62; 7.32). Group variation of distance running in test groups dynamically changed (CV male: 16,05; 22,72; 16,85; 3,54; CV female: 14,74; 15,42; 5,58; 17,93). The average running speed of the test person of both groups had a similar dynamics, as well as the distance of the run. The coefficient of variation for RPE decreased (CV male: 14,50; 20,03; 11,95; 6,00; CV female: 18,49; 21,83; 8,02; 6,61).

Comparison of test results №1 between groups revealed the reliability of differences ($p < 0,05$) for: heart rate in the first minute of the race; running distance in the second and fourth minutes.

Comparison of the results of test №2 between the groups revealed the reliability of differences ($p < 0.05$) for: heart rate in the first minute of the race; running distance in the first, second and fourth minutes; average run speed in the third minute.

Calculation of the correlation relationship between similar running characteristics performed with and without audio stimulation. In the group of young men revealed a significant correlation for: heart rate at the first (r=0,79), the second (r=0,96), the third (r=0,80) and the fourth (r=0,41) minutes of running; distance running at the second (r=0,84) and the third (r=0,88) minutes. In the group of girls, a significant correlation was found for: heart rate at the first (r=0,56), second (r=0,59) and third (r=0,77) minutes of running; running distance in the fourth (r=0,58) minute. For all other indicators, no significant correlations were found.

Conclusions / Discussion

In our study, a metronome was used as an auditory stimulation. When choosing rhythms for running, we were guided by data from previous studies. J. Edworthy & H. Waring (2006) suggested 200 or 70 bpm music for running [5]. C. Karageorghis et

al. (2012) investigated walking at a pace of 80, 120 and 140 bpm [10]. F. Styns et al. (2007) argue that people can synchronize with musical tempos in the range 50-190 bpm [18]. We chose a range of rhythms: the transition from fast walking to running (140 bpm) to comfortable and effective running cadence (170 bpm). They also took as a basis the assertions that the transition from walking to running in humans usually occurs at a speed of about 2,1 m/s [11,9,20], which corresponds to the average speed of movement recorded in our study.

We found contradictory reductions in the frequency of the step due to lagging, which is consistent with the recorded changes in other studies [3, 4].

The heart rate increased every subsequent minute in test №1 and №2 for sportsmen with visual impairment of both groups. The difference in the physiological response was only an increase in the variation in the group of girls at the last minute of the run with audio stimulation. Obviously, both versions of the test did not cause difficulties for sportsmen with visual impairment. Most of the sportsmen with visual impairment managed to gradually dose the load and achieve high heart rate. A decrease in the length of the distance in the fourth minute in the subjects of both groups indicates the exhaustive nature of the tests. The increase in the distance of running in the group of young men in the fourth minute of running without audio stimulation can be explained by a motivational factor and greater endurance, unlike girls. However, this contradicts the assumption that the rhythm, which is synchronized with the pace of the individual's work, may contribute to an increase in endurance when performing exercises. The absence of significant differences in the dynamics of the physiological response indicates a similar task of testing to follow the rhythm or gradually independently increase the speed of running. The test person of both sexes demonstrated the ability to mobilize in the process of solving a motor task regardless of the method of stimulation. This confirms the ability of trained individuals to evaluate and dose the amount of exercise. The selected frequency can serve as an exhaustive exertion stimulus for the contingent represented.

No significant differences were found for the test groups between test №1 and №2 in terms of RPE. The coefficient of variation was reduced for two tests in both

groups. This confirms the ability of trained individuals to qualitatively evaluate and dose perceived loads when solving a motor task, regardless of the method of stimulation [6]. Thus, both tests were quite tedious for the subjects of both groups, as indicated by high RPE scores at the end of the test and a decrease in the intro group variation of the score. Our data contradicts the fact that dissociation caused by focusing on the auditory stimulus can change the perception of effort, allowing runners to work more intensively longer [6]. Perhaps with a different character of stimulation (motivational music) we would have recorded other results.

The results of the study confirm the previously stated data by different authors on the effect of the tempo of music on the performance of cyclic exercises. The adjustment of the pace of the run relative to the cadence of the subjects created optimal conditions for sensorimotor synchronization as a whole. This is consistent with the findings of the research of M. Roerdink et al. (2011) for cyclic locomotion.

Similar physiological reactions were recorded in boys and girls on exercise, which increases in steps, regardless of the method of stimulation. At the same time, there are certain differences in the strategy of movement, depending on the method of stimulation. This confirms the complex effect of the imposed rhythm on the performance of cyclic locomotion. We expected significant differences between running characteristics with and without auditory stimulation. However, a large number of reliable differences between the results, including for boys and girls, were not found. This may be due to the visual features of the subjects, as well as indicate the inconsistency of the data, which requires in-depth research. At this stage, we are inclined to think that the selected metronome frequencies are convenient for running with a load that rises stepwise.

Thanks. The study was performed in accordance with the plan of scientific work of the Kharkiv State Academy of Physical Culture.

Conflict of interest. The authors declare the absence of any conflicts of interest.

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Information about the Authors

Andrii Yefremenko: PhD (Physical Education and Sport), Associate Professor; Kharkiv State Academy of Physical Culture: Klochkivskastreet 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000-0003-0924-0281

E-mail: ukrnac@ukr.net

Svyatoslav Koval: PhD (Physical Education and Sport), Associate Professor; Kharkiv State Academy of Physical Culture: Klochkivskastreet 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000-0001-7140-6276

E-mail: Koval.S.S.79@gmail.ru

Viktor Pavlenko: PhD (Pedagogical Science), Associate Professor; Kharkiv State Academy of Physical Culture: Klochkivskastreet 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000-0003-0888-2485

E-mail: pavlenko102@ukr.net

Tetiana Shutieieva: Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000-0002-0217-9505

E-mail: polyna71@mail.ru

Yaroslav Kraynik: Kharkiv State Academy of Physical Culture: Klochkivskastreet 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000-0003-1567-8570

E-mail: yaroslavkr2014@gmail.com

Svetlana Pyatisotskaya: PhD (Physical Education and Sport), Associate Professor; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000-0002-2246-1444

E-mail: skharchenko@rambler.ru

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ERGOMETRIC AND PHYSIOLOGICAL CHARACTERISTICS OF SPECIAL PHYSICAL FITNESS OF ATHLETES IN SPORTS WITH ENDURANCE

Andrii Diachenko

Yurii Shkrebtii

Ye Chenging

National University of Ukraine on Physical Education and Sports,
Kyiv, Ukraine

Purpose: to determine the individual parameters of the training work modes on the rowing ergometer for the development of specific components of the functional support of athletes in sports with the manifestation of endurance.

Material and methods: the study involved 25 kayakers, members of the Shandong Province, Jiangxi (China) teams. The Dansprint rowing ergometer (Denmark) was used to measure the ergometric power in real time. Oxygen consumption (VO_2), CO_2 emission level (VCO_2), pulmonary ventilation (VE) were determined for each respiratory cycle using an Oxycon (Jaeger) mobile gas analyzer.

Results: indicators of ergometric power, recorded in accordance with the level of response of the cardiorespiratory system in the process of modelling the components of the functional support of the special kayaker's performance. On this basis the modes of training means, and also the program of their target use in system of special functional training of rowers are developed.

Conclusions: the effectiveness of the program of special functional training of rowers is proved. The result is an increase in the ergometric power and response of the cardiorespiratory system when modelling the components of the functional

support of the special performance of rowers - fast kinetics, steady state and fatigue compensation.

Keywords: functional training, special physical fitness, ergometry, ergometric power, cardiorespiratory system.

Introduction

Modern scientific and methodological foundations for the development of the functional capabilities of athletes are aimed at the formation of an integral structure of the functional support of the special performance of athletes [1]. A characteristic feature of this process is the allocation of the main components of competitive activity, providing fast kinetics, a steady state and compensation for fatigue during overcoming the competitive distance [2].

In the presence of a wide range of ergometric and physiological characteristics of functional readiness, attention is drawn to the reactive properties of the cardiorespiratory system (CRS), which have a significant impact on the level and structure of the functional support of the special working capacity of athletes [3]. The response of pulmonary ventilation to a change in partial pressure ($VE \bullet PaCO_2$-1), the release of CO_2 ($VE \bullet VCO_2$-1), consumption of O_2 ($VE \bullet VO_2$-1) in different periods of competitive activity affects the structure of the functional support of special working capacity, increases the possibilities realization of the existing functional potential of athletes, in particular the power and capacity of energy reactions [4].

At the same time, there was an understanding that the implementation of the results of control and assessment of functional capabilities into practice requires the accuracy of measuring the reaction, as well as high accuracy of modeling physical loads in accordance with the quantitative and qualitative individual characteristics of the athletes' reaction to competitive loads [7]. In the presence of a wide range of means and methods for monitoring the assessment and interpretation of its results, data related to the modeling of individual parameters of training work, based on the analysis of the reaction of the system of functional support of competitive activity, are presented extremely insufficiently. This is largely due to the lack of

methodological approaches to the conversion of test loads in training, the complexity of the transfer of load parameters, at which the required levels of reaction are achieved in real training work.

As a tool for the implementation of such an approach, methodological approaches have been proposed that allow the use of ergometers as a means of individualizing the parameters of training work in accordance with the level of reaction of the cardiorespiratory system and energy supply [12]. Particular successes in this direction were achieved when modeling the conditions for the realization of the power and capacity of aerobic and anaerobic energy supply [8]. The issues of modeling the parameters of competitive activity, taking into account the dynamics of the functional support of special working capacity, remain largely open. It is obvious that in the presence of common approaches to the organization of control, the choice of indicators, the uniqueness of the structure of special functional readiness requires a special analysis for almost every kind of sport and type of competition [13]. This is especially important for cyclic sports, where differences in the duration and intensity of overcoming the competitive distance form the differences in the functional support of the initial segment, middle and second half of the distance [9]. They are especially expressive on the example of rowing in kayaks, where the differences in the structure of the functional support of special working capacity associated with the duration of the distance (200 m, 500 m, 1000 m), the type of competition (kayak and canoe), qualifications and article of athletes [2].

An important component of the control, assessment and interpretation of indicators of functional capabilities and special working capacity is to determine the quantitative and qualitative characteristics of the integral structure of the functional support of special working capacity, where an increase in the effectiveness of each component affects the general condition of athletes, in particular, the effectiveness of competitive activity in model or natural conditions of its implementation. [11]. In the presence of a significant amount of data on the power and capacity of aerobic and anaerobic energy supply, quantitative and qualitative characteristics of the body's reactive properties, which reflect the ability of athletes to quickly, adequately and

fully respond to training and competitive loads, the scientific literature is insufficiently covered. The reactive properties of CRS form the parameters of training loads, which are modeled in accordance with the level of reaction and energy supply of work

On the example of rowing sports, the conditions for registering the parameters of training work are shown in accordance with the indicators of competitive activity of athletes, in particular, the conversion of test loads in training [3]. The conversion tool was the use of special rowing ergometers of the latest generation, which make it possible to reproduce individual ergometric parameters of working capacity while maintaining the kinematic and dynamic structure of rowing locomotions, as well as parameters of ergometric power of work, at which a certain level of functional support of special working capacity was achieved [8].

In this regard, the **purpose of the work** was formulated - to determine the individual parameters of the training work regimes on the rowing ergometer for the development of specific components of the functional support of athletes in sports with a display of endurance.

Material and Methods of research

Material. The study involved 25 qualified rowers in kayaks, members of the combined teams of Shandong and Jianshi provinces (PRC). The age of the athletes is 23,1 ± 2,0 years. Rowing experience 10,2 ± 1,5 years.

Methods. Ergometry. A rowing machine Dansprint (Denmark) was used to measure the ergometric indicators of the power of work in real time.

Gas exchange measurements. Oxygen consumption (VO_2), CO_2 removal (VCO_2), pulmonary ventilation (VE) were determined using a mobile gas analyzer Oxycon (Jaeger).

The experimental part of the study was carried out by specialists from the laboratory for monitoring sports training in water sports of the General Administration of Sports of China (Nanchang, Jianshi Province, China) with the participation of specialists from the National University of Physical Education and Sports of Ukraine (Kiev, Ukraine).

Statistical analysis. A statistical package (SPSS 10.0) was used to evaluate and analyze the data obtained. Descriptive statistics offered to determine the arithmetic mean - $\bar{x}$, standard deviation - S, maximum (max) and minimum (min) indices, 25% and 75% indices.

Results of the research

The test was attended by rowers on kayaks of a homogeneous group (according to the indications of aerobic power, VO_2 max – 5,4 ± 0,3 $l \cdot min^{-1}$), anaerobic capacity (La test 30s – 10,2±1,9 $mmol \cdot l^{-1}$) and anaerobic capacity (La test 120 s - La test 30 s – 10,2±1,9 $mmol \cdot l^{-1}$).

In the process of testing, test loads were simulated, which ensured the implementation of the components of the functional support of the special working capacity of rowers at a distance of 1000 m - fast kinetics, steady state and fatigue compensation. Individual indicators of ergometric power, cardiorespiratory system (CRS) and energy supply of work were recorded. Physiological characteristics of work are presented in table 1.

Table 1

Physiological characteristics of the special working capacity of qualified kayak rowers (n=25)

Test	Components of functional support of competitive activity	Indicators	Measurement conditions
Test 30 s	Rapid kinetics of the initial part of the competitive distance	$V_E \cdot PaCO_2^{-1}$ $V_E \cdot VCO_2^{-1}$	The highest value of the indicator
Test 120 s	Steady state	$V_E \cdot VO_2^{-1}$ $V_E \cdot VCO_2^{-1}$	The period of stability of the reaction within 30 s
Critical power load (CPL): test 90 s	Fatigue compensation	$V_E \cdot VO_2^{-1}$ (тест 120) / $V_E \cdot VO_2^{-1}$ (НКП) *100% $V_E \cdot VCO_2^{-1}$ (тест 120) / $V_E \cdot VCO_2^{-1}$ (НКП) *100%	The CPL was performed one minute after the step test according to the protocol for determining VO_2 max

Table 2 shows the indices of special working capacity and physiological reactions characterizing the specific manifestations of the reactive properties of CRS

at different segments of a distance of 1000 m in rowing in kayaks before and after the execution of the experiment program. The experiment included a program of training sessions aimed at increasing the reactive properties of CRS in a competitive distance. The modes of training work simulated the conditions for testing rowers. The training sessions included work segments of 30 s, 120 s and 90 s. The parameters of work in the segments of 30 s and 120 s corresponded to the individual indicators of ergometric power of work and above, recorded during the initial testing. The ergometric parameters of work in the 90-s sections were carried out in accordance with the testing parameters, and the number of sections was regulated by the ability to maintain the specified work parameters (work to failure). Rest intervals increased after each segment was performed. The program was completed over 8 weeks (48 training sessions, six times a week). The focus of the classes is presented in table 2.

Table 2

Program of training sessions aimed at developing the components of the functional support of the special working capacity of qualified rowers

Weeks	Parameters of work on a segment		
	Working time on a segment with a duration of 30 s; recovery time 30 s, +15 s after each segment (Mode A)	Working time on a segment lasting 120 s; recovery time 180 s, + 30 s after each segment (Mode B)	Working time on a segment with a duration of 90 s; recovery time 60 s, +60 s after each segment (mode C)
	Number of training session per week		
1	A – 3 training session	B – 2	C – 1
2	A – 3	B – 2	C – 1
3	A – 2	B – 2	C – 2
4	A – 2	B – 2	C – 2
5	A – 1	B – 2	C – 3
6	A – 1	B – 1	C – 4
7	A – 2	B – 2	C – 2
8	A – 2	B – 2	C – 2

Table 3 shows the results of testing athletes before and after the implementation of the training program aimed at developing the components of the functional support of the special working capacity of kayak rowers specializing at a distance of 1000 m.

Table 3

Ergometric and physiological characteristics of the reaction of the cardiorespiratory system of qualified rowers (n=25)

Test	Indicators	Before the program					After the program				
		Statistics									
		$\bar{x}\pm S$	min	max	25%	75%	$\bar{x}\pm S$	min	max	25%	75%
Test 30 s	$\bar{W}$, W	369,9± 19,0*	335	515	345	390	422,9± 15,0*	379	540	406	438
	$V_E \cdot PaCO_2^{-1}$, c. u.	3,5± 0,9	1,8	5,0	2,6	4,3	3,7± 0,5	2,5	5,1	3,0	4,0
	$V_E \cdot VCO_2^{-1}$, c. u.	30,0± 4,0	23,1	39,3	26,4	32,4	33,0± 3,0	25,1	41,0	28,1	35,1
Test 120 s	$\bar{W}$	250,7± 11,8*	229	295	238	264	287,9± 10,0*	257	324	288	298
	$V_E \cdot VO_2^{-1}$, y. o.	29,6± 3,9	20,7	35,9	23,8	35,8	34,9± 4,1	21,9	38,0	24,0	36,9
	$V_E \cdot VCO_2^{-}$, c. u.[1]	33,6± 3,2	26,2	39,0	30,0	36,9	36,6± 3,0	29,2	41,0	23,1	39,9
Critical power load (CPL): test 90 s	$\bar{W}$	235,5± 11,5*	218	282	224	248	265,0± 9,2*	235	300	243	274
	$V_E \cdot VO_2^{-1}$ test 120 / $V_E \cdot VO_2^{-1}$ CPL *100%, %	8,6± 5,3	2,4	15,8	5,3	14,3	9,3± 3,3	5,4	15,8	5,8	13,0
	$V_E \cdot VCO_2^{-1}$ test 120 / $V_E \cdot VCO_2^{-1}$ CPL *100%, %	7,6± 4,3	2,4	12,6	4,0	10,3	12,6± 2,3	5,4	21,6	10,2	17,3

As a result of the implementation of the program of special functional training, the rowers' indicators of ergometric power of work increased ($p < 0.05$). An increase in the ergometric power of work was accompanied by an increase in the reaction of the CRS in all athletes in all parameters. This is most clearly seen in the specific indicators of pulmonary ventilation and the release of carbon dioxide when performing the "90 s test". An increase in the response of pulmonary ventilation against the background of the development of fatigue indicates an increase in the response of respiratory compensation of metabolic acidosis ($V_E \cdot VCO_2^{-1}{}_{test\ 120}$ / $V_E \cdot VCO_2^{-1}{}_{CPL}$*100% і $V_E \cdot VO_2^{-1}{}_{test\ 120}$ / $V_E \cdot VO_2^{-1}{}_{CPL}$ *100%) in 22 rowers. An

increase in the response of pulmonary ventilation to the release of CO_2 is accompanied by an increase or maintenance of the level (95-97% VO_2 max) of the maximum consumption of O_2. To the experiment, this type of reaction was observed only in 11 athletes.

Conclusions / Discussion

The analysis showed that each component of the CRS response is a condition for the formation of an integral structure of the functional support of special performance. An increase in rapid kinetics is an incentive to achieve and maintain a stable state, an increase in the reaction of compensation for metabolic acidosis, including during the period of active development of fatigue.

The given data confirm the well-known ideas about the criteria of the athletes' functional readiness. Changes in athletes' working capacity under the influence of intense physical training are accompanied by an increase in the reaction of the cardiorespiratory system and energy supply of work. Optimization of the reactive properties of athletes in accordance with the structure of the functional support of special working capacity in the special literature is considered as an informative criterion for a favorable adaptation of the body to intense physical activity. This phenomenon is confirmed by the example of the application of the program of special physical training of rowers, implemented on the basis of measuring ergometric parameters of work in accordance with the level of rapid kinetics, steady state, fatigue compensation [1, 2, 9].

An increase in the level of special working capacity of athletes in the process of modeling the initial segment, middle and second half of the distance was accompanied by an increase in the reaction of the cardiorespiratory system to the development of hypoxia, hypercapnia, accumulation of products of anaerobic metabolism.

The most expressive during the work of the "critical" load power (modeling the second half of the distance during the development of fatigue - load of the "critical" power "test 90 s") is the increase in special performance ($\bar{w}$) CPL – by 11,3%), increased reaction of CRS ($VE \bullet VCO_2$-1test 120 / $VE \bullet VCO_2$-1 CPL*100% – by

39,7%), maintaining the stability of consumption O2 (VE • VO_2-1test 120 / VE•VO_2-CPL * 100% – by 7,5%).

Strengthening the compensation of fatigue is a condition for the effective development of functional capabilities in sports with the manifestation of endurance [6]. The given data, as well as the data presented in the special literature, indicate that the mechanisms of fatigue compensation are considered as a composite integral structure of functional readiness [5]. Its manifestations depend on the effectiveness of the initial part of the reaction, a steady state, which provide not only high performance of athletes at specific segments of the distance, but also a high degree of efficiency of transient processes of anaerobic-aerobic energy supply, hypoxia - hypercapnia - a high degree of accumulation of anaerobic metabolism [14, 15, 16].

The given data form new possibilities for improving special physical training in sports with the manifestation of endurance, taking into account the specific characteristics of the competitive activity of athletes.

Prospect of further research is the determination of the quantitative and qualitative characteristics of the functional support of competitive activity in the natural conditions of training athletes in sports with manifestations of endurance.

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Information about the Authors

Andrii Diachenko: Doctor of Physical Education, Professor; National University of Physical Education and Sport of Ukraine: 03150, Kyiv, st. Physical Education, 1.
ORCID: https://orcid.org/0000-0001-9781-3152
E-mail: adnk2007@ukr.net

Yurii Shkrebtii: Doctor of Physical Education, Professor; National University of Physical Education and Sport of Ukraine: 03150, Kyiv, st. Physical Education, 1.
ORCID: https://orcid.org/0000-0001-7092-9841
E-mail: shkrebtiyum@ukr.net

Ye Chenging: postgraduate; National University of Physical Education and Sport of Ukraine: 03150, Kyiv, st. Physical Education, 1.
ORCID: https://orcid.org/0000-0002-3058-3943
E-mail: adnk2007@ukr.net

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IMPROVING THE METHODOLOGY OF DEVELOPMENT OF STRENGTH QUALITIES OF 15-16-YEAR-OLD JUDOKAS

Yuriy Tropin

Natalia Boychenko

Julia Kovalenko

Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

Purpose: to improve the methodology of developing strength qualities of 15-16-year-old judoists with the use of dynamic exercises.

Material and methods: analysis of scientific and methodological information, Internet sources and generalization of best practices, pedagogical testing; timing; pedagogical experiment, methods of mathematical statistics. 20 judokas, aged 15-16 years, took part in the pedagogical experiment. Athletes were divided into two groups: control and experimental with 10 judokas in each. The pedagogical experiment lasted three months (September - November 2020).

Results: based on the analysis of scientific and methodological information and generalization of best practices, it was found that the level of development of strength qualities largely determines the tactical and technical training of a judoka, the style, and nature of the competitive fight. The control group was engaged in the training program for Children's and Youth Sports School, and the judoists of the experimental group used a set of dynamic exercises in the training process. The exercises were distributed in such a way as to ensure the alternation of the load, mainly for the muscles of the legs, arms, back, abdomen, and general impact. At the beginning of the experiment, the control indicators of strength qualities did not reveal

significant differences between the control and experimental groups (p>0,05, the value of t ranges from 0.32 to 1.01).

Conclusions: during the experiment it was found that the use of sets of dynamic exercises in the training process has a positive effect on the judokas` strength preparedness. This is evidenced by the results obtained at the end of the experiment, so the judoists of the experimental group have significantly higher indices of strength preparedness in almost all tests (p <0.05, the value of t ranges from 2.10 to 2.34). In the test "Uchi-komi in 30 s" the result is also better in judoists of the experimental group, but it is statistically insignificant (t = 1.07; p> 0.05), this is since this exercise is specific to judo.

Keywords: judo, training process, qualified athletes, strength qualities, dynamic exercises.

Introduction

Judo is one of the four most popular sports in the world, along with Sambo, Greco-Roman, and Freestyle Wrestling. International Judo Federation (IJF) includes 198 national federations. In total, about 28 million people in the world practice Judo. In recent years, it is characterized by several trends: the increased intensity of motor actions on the tatami, increased its contact, increased the speed of technical and tactical techniques. Thus, the training of judokas began to be subject to new requirements that must be considered when planning a program to improve their skills. The high level of modern sport requires significant requirements for functional and strength preparedness, and knowledge of these basics will help not only the coach but also the athlete himself in achieving high sports results [3, 7, 9]. The coach-teacher must take care of the harmonious development of each athlete, and it is possible only through general strength training and many other vital motor qualities by all possible means of physical culture and sports [6, 12, 13].

The main task of special strength training in Judo classes is the development of those qualities that a judoka needs for successful training matches. Thus, the means of educating the special strength qualities of a judoka should be considered

exercises that contribute to the formation and improvement of skills in performing the elements of the fight or the whole techniques that a judoka performs alone or with a partner; educational and competitive fights of different orientation; moving games with elements of confrontation, etc. [3, 4, 10].

The level of development of strength qualities largely determines the tactical and technical training of a judoka, the style, and nature of the competitive fight. Thus, the ability to selectively detect significant muscular effort allows judokas to successfully perform combinations of techniques, timely use of countermeasures, which, as an indicator, increases the reliability of technical and tactical actions. The athlete in such conditions has confidence in his abilities, the fight becomes offensive and technically versatile [2, 8, 14].

Connection of work with scientific programs, plans, and themes. The study was conducted under the research topic of the Kharkiv State Academy of Physical Culture "Scientific and Methodological Foundations of Using the Information Technology in the Training of Specialists in the Field of Physical Culture and Sports" (state registration number 0113U001207).

Purpose of the study is to improve the methodology of developing strength qualities of 15-16-year-old judoists with the use of dynamic exercises.

Material and Methods of research

The following methods were used to solve the tasks of the research: analysis of scientific and methodological information, Internet sources and generalization of best practices, pedagogical testing; timing; pedagogical experiment, methods of mathematical statistics.

The level of strength training was determined by the following tests: 100-metres race (s); push-ups in 20 s (number of times); pull-ups on horizontal bar in 20 s (number of times); abdominal crunches in 20 s (number of times); standing long jumps (cm); pull-ups on horizontal bar (number of times); the maximum number of push-ups (number of times); squats with a partner of equal weight (number of times); hanging leg lifts on the stall bars (number of times); bent arm hang (s); static

uchikomi (without separating the partner's legs from the tatami) in 30 s (number of times).

The pedagogical experiment was conducted in groups of specialized training of 3rd year of study at Complex Youth Sports School №2 and SC "Slobozhanets" in Kharkiv. A total of 20 judokas, aged 15-16 years, took part in the pedagogical experiment. Athletes were divided into two groups: control and experimental, 10 judokas in each. The pedagogical experiment lasted three months (September - November 2020). The control group was engaged in the curriculum for Children's and Youth Sports School [1], and the judoists of the experimental group used a set of dynamic exercises in the training process:

1st set of exercises: push-ups; squats; 2-3 kg dumbbell side lateral raise (Monday, Wednesday, Friday).

2nd set of exercises: pull-ups on a low horizontal bar; abdominal crunches; hyperextension (Tuesday, Thursday, Saturday).

The exercises were distributed in such a way as to ensure the alternation of the load, mainly for the muscles of the legs, arms, back, abdomen, and general impact. Each exercise was performed with a reduced amplitude by bouncy movements, 3 sets each (30 s - exercising, 30 s - rest), the pace of exercising - 1 s = 1 time. Rest between exercises was 3 minutes. Sets of exercises were performed at the end of the main part of the lesson. Example of performing exercises of the 1st set:

- push-ups (30 s), rest (30 s); push-ups (30 s), rest (30 s); push-ups (30 s), rest (3 min);

- squats (30 s), rest (30 s); squats (30 s), rest (30 s); squats (30 s), rest (3 min);

- dumbbell side lateral raise (30 s), rest (30 s); dumbbell side lateral raise (30 s), rest (30 s); dumbbell side lateral raise (30 s).

Results of the research

Based on the analysis of scientific and methodological information, Internet sources, and generalization of best practical experience, it was found that the level of development of strength qualities largely determines the tactical and technical preparedness of a judoka, style, and nature of competitive fight [2, 5, 11].

As part of the pedagogical experiment, the assumption of a positive effect of dynamic exercises on the development of strength qualities was tested. At the beginning of the experiment, the control indicators of strength qualities between the control and experimental groups according to Student's t-criteria did not reveal significant differences (p> 0.05, the value of t ranges from 0.32 to 1.01) (Table 1).

Table 1

Indicators of strength preparedness of judokas of control (n = 10) and experimental (n = 10) groups at the beginning of the pedagogical experiment

№	Test		$\bar{X} \pm m$	t	p
1	100-metres race (s)	CG	14,21±0,22	0,45	>0,05
		EG	14,33±0,15		
2	push-ups in 20 s (number of times)	CG	18,30±1,08	0,32	>0,05
		EG	18,80±1,14		
3	pull-ups on horizontal bar in 20 s (number of times)	CG	10,30±0,42	-0,62	>0,05
		EG	9,90±0,48		
4	abdominal crunches in 20 s (number of times)	CG	14,20±0,84	0,48	>0,05
		EG	13,60±0,91		
5	standing long jumps (cm)	CG	191,60±4,78	0,78	>0,05
		EG	196,60±4,28		
6	maximum number of pull-ups on the horizontal bar (number of times)	CG	13,20±0,84	-0,48	>0,05
		EG	12,60±0,91		
7	maximum number of push-ups (number of times)	CG	52,90±1,93	-0,35	>0,05
		EG	51,90±2,07		
8	squats with a partner of equal weight (number of times)	CG	9,50±0,69	0,56	>0,05
		EG	10,10±0,87		
9	hanging leg lifts on the stall bars (number of times)	CG	9,96±0,48	-0,70	>0,05
		EG	9,10±0,53		
10	bent arm hang (c)	CG	40,70±0,79	1,01	>0,05
		EG	41,70±0,60		
11	Uchi-komi in 30 s (number of times)	CG	27,40±0,93	-0,58	>0,05

Note: reliability t = 2,093; p <0.05.

At the end of the pedagogical experiment, after training for three months, the final tests of strength qualities in the control and experimental groups were conducted and the results are presented in Table 2.

Comparing the average results of athletes in the control and experimental groups at the end of the pedagogical experiment, it can be noted that the judoists of the experimental group have significantly higher indicators of strength preparedness in the following tests: 100-metres race (t=-2,15; p<0,05); push-ups in 20 s (t=2,11; p<0,05); pull-ups on horizontal bar in 20 s (t=2,18; p<0,05); abdominal crunches in

20 s (t=2,12; p <0,05); standing long jumps (t=2,10; p<0,05); the maximum number of pull-ups on the horizontal bar (t=2,22; p<0,05); the maximum number of push-ups (t=2,14; p<0,05); squats with a partner of equal weight (t=2,34; p<0,05); hanging leg lifts on the stall bars (t=2.31; p<0,05); bent arm hang (t=2,15; p<0,05). In the Uchi-komi test in 30 s, the result is also better in the judokas of the experimental group, but it is statistically insignificant (t=1,07; p>0,05), this is due to the fact that this exercise is specific to Judo (Table 2).

Table 2

Indicators of strength preparedness of judokas of control (n = 10) and experimental (n = 10) groups at the end of pedagogical experiment

№	Test		$\bar{X} \pm m$	t	p
1	100-metres race (s)	CG	14,01±0,25	**-2,15**	**<0,05**
		EG	13,33±0,19		
2	push-ups in 20 s (number of times)	CG	18,80±0,84	**2,11**	**<0,05**
		EG	21,60±1,02		
3	pull-ups on horizontal bar in 20 s (number of times)	CG	10,50±0,34	**2,18**	**<0,05**
		EG	11,50±0,31		
4	abdominal crunches in 20 s (number of times)	CG	14,60±0,76	**2,12**	**<0,05**
		EG	16,40±0,37		
5	standing long jumps (cm)	CG	196,60±5,43	**2,10**	**<0,05**
		EG	208,90±2,18		
6	maximum number of pull-ups on the horizontal bar (number of times)	CG	13,50±0,72	**2,22**	**<0,05**
		EG	15,50±0,54		
7	maximum number of push-ups (number of times)	CG	53,90±1,52	**2,14**	**<0,05**
		EG	59,20±1,95		
8	squats with a partner of equal weight (number of times)	CG	9,90±0,57	**2,34**	**<0,05**
		EG	11,90±0,64		
9	hanging leg lifts on the stall bars (number of times)	CG	9,80±0,49	**2,31**	**<0,05**
		EG	11,10±0,28		
10	bent arm hang (c)	CG	41,70±0,60	**2,15**	**<0,05**
		EG	44,40±1,11		
11	Uchi-komi in 30 s (number of times)	CG	27,70±0,82	1,07	>0,05

Note : reliability t = 2,093 ; p <0.05; t = 2.8 61 ; p <0.01.

The obtained data show that the judokas of the control group at the end of the pedagogical experiment when testing strength qualities showed improvements in tests from 1.1% to 4.2%, and the athletes of the experimental group improved the results at the end of the pedagogical experiment - from 6,3% to 23,0% (Fig. 1).

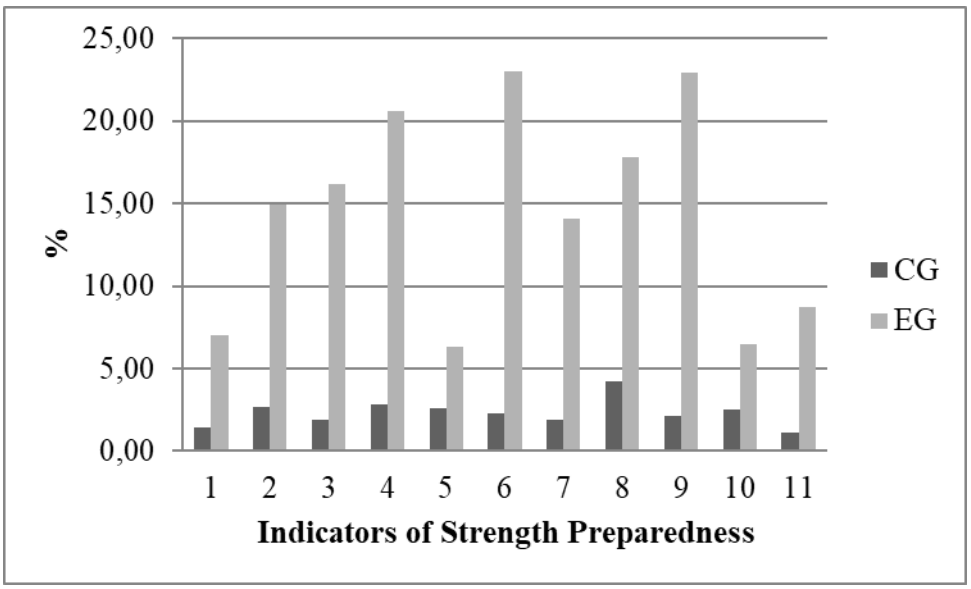

Fig. 1. Dynamics of indicators of strength preparedness during the pedagogical experiment in the control (CG) (n = 10) and experimental (EG) (n = 10) groups

Note: 1 - 100-metres race; 2 - push-ups in 20 s; 3 - pull-ups on horizontal bar in 20 s; 4 - abdominal crunches in 20 s; 5 - standing long jumps; 6 - maximum number of pull-ups on the horizontal bar; 7 - maximum number of push-ups; 8 - squats with a partner of equal weight; 9 - hanging leg lifts on the stall bars; 10 - bent arm hang; 11 - Uchi-komi in 30 s.

This dynamics of changes in the indicators of strength preparedness of judoists of the experimental group is associated with using sets of dynamic exercises in conjunction with the elements of technology in the training process.

Conclusions / Discussion

Many authors have studied strength preparedness of judokas in their works. Thus, A.F. Alekseev (2018), studied the features of the strength qualities of judoists in the groups of specialized training based on which he proposed and experimentally substantiated the program for the development of special strength qualities of 13-15-year-old judokas. Similar studies were conducted by I.O. Kriventsova, G.O. Ogar, O.O. Panina (2020), they developed a training microcycle for young judokas with extensive use of various general and special means of strength training. V.S. Dobrynsky (2016) experimentally substantiated the effectiveness of using the method of circuit training for the development of speed and strength qualities of young judokas aged 13-14 years. J. A. Dias and et. al. (2012) compared the grip strength of both judokas and non-judokas and found that judokas were not stronger than non-judokas in absolute terms (peak grip), but judokas were more resistant to fatigue. D.

Harris, S. Foulds, S. Latella (2019) based on the analysis of the special literature offered practical recommendations for the development of strength of the upper and lower extremities, speed force and strength endurance. M. Wyon and et. al. (2016) proved that the use of vitamin D3 had a positive effect on muscle function and strength in elite judokas when training indoors.

During the experiment, it was found that the use of complexes of dynamic exercises in the training process has a positive effect on the strength preparedness of judoists in the experimental group. This is evidenced by the results of the experiment. At the beginning of the experiment, the control indicators of strength qualities between the control and experimental groups did not reveal significant differences ($p>0,05$, the value of t ranges from 0,32 to 1,01). At the end of the experiment, it can be noted that the judokas of the experimental group have significantly higher indicators of strength preparedness in almost all tests ($p<0,05$, the value of t ranges from 2,10 to 2,34). In the Uchi-komi test in 30 s, the result is better by 4,3% in the judokas of the experimental group, but it is statistically insignificant ($t=1,07$; $p>0,05$), this is since this exercise is specific to Judo.

Prospects for further research will be aimed at determining the correlations between strength qualities and technical and tactical training of qualified judokas.

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Information about the Authors

Yuriy Tropin: Phd (Physical Education and Sport), Associate Professor; Kharkiv State Academy of Physical Culture: 99 Klochkivska St., Kharkiv, 61058, Ukraine.

ORCID.ORG /0000-0002-6691-2470

E-mail: tropin.yurij@gmail.com

Natalia Boychenko: PhD (Physical Education and Sport), Associate Professor; Kharkiv State Academy of Physical Culture: Klochkovskaya st., 99, Kharkov, 61058, Ukraine.

ORCID.ORG /0000-0003-4821-5900

E-mail: natalya-meg@ukr.net

Julia Kovalenko: senior lecturer; Kharkiv State Academy of Physical Culture: 99 Klochkivska St., Kharkiv, 61058, Ukraine.

ORCID.ORG /0000-0002-5736-4249

E-mail: julawa09@gmail.com

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DYNAMICS OF CHANGE IN INDICATORS OF COORDINATION ABILITIES OF QUALIFIED FEMALE VOLLEYBALL PLAYERS UNDER THE INFLUENCE OF USING A SET OF EXERCISES AND OUTDOOR GAMES

Alina Melnyk[1]

Ievgeniia Strelnykova[2]

Tamara Liakhova[1]

Natalya Pashchenko[1]

Kharkiv State Academy of Physical Culture[1]*,*
Kharkiv, Ukraine,
H.S. Skovoroda Kharkiv national pedagogical university[1]*,*
Kharkiv, Ukraine

Purpose: to study the dynamics of changes in coordination abilities of qualified female volleyball players under the influence of using a set of exercises and outdoor games.

Material and methods: the following research methods were used in the research: analysis of scientific and methodological literature; pedagogical experiment; pedagogical testing; methods of mathematical statistics. During the research, the pedagogical experiment was conducted and aimed at increasing the level of coordination abilities of qualified female volleyball players. A group of 10 qualified female volleyball players at the age of 18-21 years of the team "Kharkivyanka" (Kharkiv) was chosen for its holding, who takes part in competitions of teams of the Major League of Ukraine. Such means as a set of special exercises

and outdoor were proposed for the development of coordination abilities, and appropriate tests were used to evaluate them.

Results: the analysis of the results of the pedagogical experiment showed that the average arithmetic values of the indicators for each of the four selected tests after the experiment were significantly higher compared to the results of the corresponding tests obtained before the experiment. The results of the corresponding comparative analysis using the Student's test proved the validity of the difference between values of the indicators of these tests.

Conclusions: the proposed means to increase the level of coordination abilities of female volleyball players justified themselves as effective. They can be used by team coaches in practical work to prepare players for a defensive role, which will contribute to improving the team's game performance in training and competitive activities.

Keywords: test, a set of exercises, coordination abilities, pedagogical experiment, outdoor, female volleyball players.

Introduction

An effective game in defense is one of the main factors for achieving success in the competitive activity of the team in modern volleyball [9]. A large number of aspects of the performance of defensive actions by volleyball players are closely related to the development of their coordination abilities. Therefore, this work is devoted to a detailed analysis of these abilities of qualified volleyball players who take part in the defensive actions of the team.

In modern scientific and methodological literature, several works [2, 7, 10, 13, 18] are devoted to the study of problems related to the study of the development of the coordination abilities of volleyball players.

So, the detailed analysis of literary sources devoted to the development of coordination abilities in modern volleyball was carried out in the work [8]. Various aspects of the development of the coordination abilities of volleyball players related to their performance of certain technical and tactical actions were studied. In the

work [12], the authors emphasize that highly coordinated actions with the ball in a safe position are extremely important for volleyball players. To develop coordination abilities among volleyball players, they recommend complex exercises that are performed at a rapid pace. The program for the development of coordination abilities at the stage of initial training of volleyball players is proposed in the researches of Ustinov T. B. and Prekurat O. O. [14]. According to the authors, the introduction of the methods of coordination training of volleyball players in training activities will contribute to the rapid and high-quality absorption of elements of the volleyball game technique. It was proved that the system of selection of means of coordination training should include the application of the most diverse exercises and their various combinations, aimed both at solving problems of general physical training and at forming the necessary motor skills [13]. Authors Boychuk R. I., Korop M. Yu. and Beliavskyi I. L. proved in the research [2] that the use of means for the development of special dexterity with elements of volleyball technique at the stage of preparing volleyball players for the highest achievements contributes to increasing the effectiveness of their competitive activities.

In the work [7], authors Korzh N. L., Zhestkov S. G., Ivanova N. B., Barska N. L., Chechel M. M. analyzed the impact of acrobatic exercises on the development of coordination abilities of volleyball players in the training process. It is noted that the use of special acrobatic exercises in combination with the game is the most rational way to develop the ability to navigate the site.

The author in his work [19] studies the role of coordination in the initial stages of training in volleyball, in particular, notes that coordination abilities, especially during puberty, play an important role in creating the prerequisites for the development of physical fitness and acquisition of motor skills. The model of development of coordination abilities is proposed.

The research [20] focuses on the influence of coordination on the accuracy of sets in volleyball, as an important factor in the efficiency of its execution in the game. It is emphasized that coordination is firmly linked to technique and accuracy of sets. To improve the accuracy of sets, it is recommended in the training process to pay

special attention to the creation of a large number of different movement structures, which can contribute to a more complete formation of coordination among volleyball players.

The factor analysis was carried out, which made it possible to obtain a structure of coordination abilities of volleyball players from five relevant components, which significantly affect the formation of their technical and tactical training [16]. It is recommended to use game exercises and circuit training to improve the specific coordination abilities of volleyball players.

The method of using the coordination ladder to improve technical skills and psychophysiological functions of young volleyball players was developed and tested experimentally [18]. Its positive impact on the quality of the training process of volleyball players was determined.

The analysis of literary sources showed that insufficient attention was paid to improve the coordination abilities of players participating in the organization of defense.

The purpose of the research is to study the change in coordination abilities of qualified volleyball players under the influence of the use of special means.

Material and Methods of research

The following research methods were used in the research: analysis of scientific and methodological literature; pedagogical experiment; pedagogical testing; the consistent pedagogical experiment was conducted, which was aimed at increasing the level of coordination abilities of qualified volleyball players and lasted 12 weeks. The research was attended by 10 volleyball players aged 18-21 years of the Kharkiv team, who take part in competitions of teams of the higher league of Ukraine. To evaluate the coordination abilities of volleyball players, appropriate tests were used during the pedagogical experiment. The time of the tests, the nature of the rest between attempts was constant for all volleyball players who took part in the experiment.

Results of the research

The development of physical qualities of volleyball players is to develop speed, strength, coordination abilities, and endurance in the course of physical exercises. This process is closely related to the formation of motor skills and is due to the volume and nature of the motor activity. The results of the performance of technical elements of the game depend on the level of development of motor qualities [1, 5].

There is no need for a versatile development of all physical qualities for players who perform certain functions in game actions during the game. So, the players of the defensive plan need to focus only on those of them who play a significant role in solving the specific tasks of performing the corresponding techniques of the game in which they have to participate. In particular, the development of coordination capacities is important for them. They manifest themselves in the ability to rebuild quickly their actions, which are organically associated with strength, speed, endurance, dexterity by an instant change in the playing situation on the playground. The coordination abilities of the defender are manifested in throws, falls, and roll-up actions during the game in defense [3].

As for the development of coordination abilities, the main means include acrobatic, imitation exercises of elements of the technique of playing volleyball and outdoor games. To this end, a wide variety of exercises are used in the training process, in which the player must proceed from unexpected situations on the site with the help of resourceful and quick actions [8, 11].

Among the physical qualities of volleyball players, coordination abilities occupy a special place. Their high level of development is a crucial prerequisite for the quality of development and improvement of the game technique. A player with a high level of coordination abilities quickly adapts to constantly changing conditions in the game and chooses the most effective means of its management [6, 19].

Any technical admission is based on old coordination links. The greater the reserve of various motor skills the player has, the more successful the mastery of the game technique is. In this regard, the main way to develop coordination abilities is to

enrich players with new diverse skills, to develop the coordination of movements [17].

The main means of developing the coordination abilities of volleyball players are physical exercises of increased coordination complexity, which contain elements of novelty. The complexity of physical exercise can be increased by changing spatial, temporal, and dynamic parameters, as well as by external conditions, combining motor skills, combining walking with jumps, running and catching objects, performing exercises on a signal or with a limited period [19].

Exercises in raising a sense of space, time, and the degree of development of muscle efforts are a special group of means. Exercises aimed at developing coordination abilities are effective until they are performed automatically. Then they lose their effectiveness because any skill that has been mastered up to this point doesn't stimulate the further development of coordination abilities [15].

The purpose of the pedagogical experiment proposed by us is to increase the coordination abilities of 10 qualified volleyball players who take part in the defensive actions of the Kharkiv team. We note that the central blockers weren't involved in the experiment, because they almost don't take part in the defensive actions of the team in competitive activities.

After the initial testing of this group of volleyball players, before the start of the experiment, the proposed by us a set of special exercises and outdoor games were introduced into the training process, which, in our opinion, will contribute to the development of the coordination abilities of volleyball players. Volleyball players used these means 2 times a week in the special preparatory or at the beginning of the main part of the training session for 12 weeks. When performing the proposed set of exercises, the repeated method and the method of "circuit training" were used as the most effective.

Special means were used, for example: in pairs: the first player is with the ball at the wall, the second is on the front line in different initial positions (sitting face or back to the partner, lying on the stomach or the back), the first player hits the ball in

the floor, the second player after bouncing the ball off the floor must catch up with the ball and perform a set from below with two hands to the partner.

Volleyball players are divided into two levels of the team, which line up in columns. According to the coach's signal, they make four falls from acceleration in a row, simulating the receiving of the ball with a turn over the right and left shoulder, and then make a get-away at 10-15 m and jump on two legs return to the corresponding column. Next, the next player does, etc. The team that wins faster and with fewer errors will finish the relay.

After using the proposed complex of exercises and outdoor games, this group of volleyball players was re-tested. As a result of a series of volleyball tests, before and after the experiment, relevant statistics on their coordination abilities were obtained.

The results of the absolute increase of the arithmetic mean values of the corresponding indicators after the experiment concerning their values obtained before its start are given in Fig. 1.

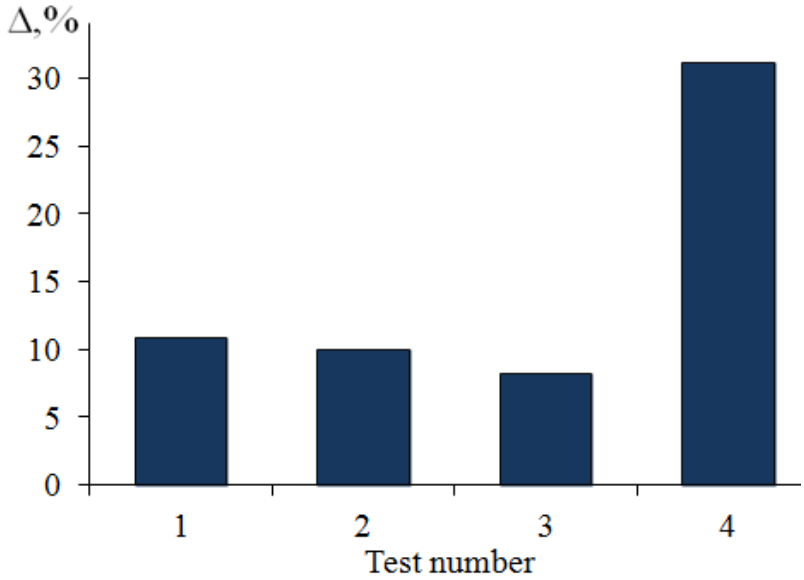

Fig. 1 Diagram of the change in the arithmetic mean values of the corresponding tests after the pedagogical experiment

Note: Test 1. Start from the front line of the platform. Jumping forward, running on the gymnastics bench, and imitating the attack hit at the net, insurance on the attack line, throw back, running to the front line.

Test 2. Running around the perimeter of one side of the site counterclockwise. Stuffed balls No. 1, 2, 3 lie on the attack line: No. 1 and 3 at a distance of 1 m from the side line, No. 2 - in the middle. Two players, who are located between balls No. 1 and 2 and 2 and 3, hold hoops vertically to the floor. Start from zone 1. Acceleration to ball No. 1, take the ball, run-off for the attacker strike and throw with two hands through the net into the attack zone; climb into the hoop, get-away to the ball No. 2, and further the same actions. After throwing ball No. 3 through the net, the player finishes with his back running forward along the sideline to the front.

Test 3. Shuttle running *5×6 m* with the transfer of cubes.

Test 4. Imitation of the block at the net, insurance on the attack line then throw back. Performing the set from below with two hands for accuracy at the target sequentially from 8, 6, 3 m to 5 times from each point. Sets are considered lost that don't fall within the target.

As we can see in Figure 1, the highest increase in absolute value was obtained by the calculated value of test indicator No. 4 – 31,2%, the lowest increase received test result No. 3 - at the level of 8,2%, the results for test values 1, 2 improved by 10,8%, 9,9% compared to the results of the corresponding tests obtained before the experiment.

The results of the comparative analysis of the average statistical values of the indicators of coordination abilities of volleyball players in the pedagogical experiment are shown in Table 1.

Table 1

Results of evaluation of statistical validity of change in indicators of coordination abilities of qualified volleyball players in the pedagogical experiment (n1 = n2 = 10)

№	Test number	Before the experiment	After the experiment	t	p
		$\bar{X} \pm \sigma$			
1	Test №1, (s)	9,26±0,58	8,26±0,49	3,95	<0,05
2	Test №2, (s)	15,54±1,30	14,00±1,10	2,71	<0,05
3	Test №3, (s)	9,55±0,51	8,77±0,42	3,53	<0,05
4	Test №4, (number of times)	6,10±1,90	4,20±1,30	2,48	<0,05

Based on its results, it can be concluded that the values of all indicators increased after the pedagogical experiment. That is, the use of the proposed complex of various special exercises and outdoor games ensured such an effect in the training

process of volleyball players during the experiment. One of the reasons for improving the corresponding results is the use of various tasks in the training activity, which caused players more interest and, in this regard, increased motivation to perform these exercises and outdoor games.

The statistical validity of differences in the results of the comparative analysis of the average statistical values in indicators of these tests was evaluated, which were determined before and after the pedagogical experiment using Student's test, (see [4]). As Student's test value is $t>t_{gr}$, the difference between the calculated measures for all tests is statistically significant. Considering a valid positive change in values, the introduction of the proposed complex of exercises and outdoor games in the practice of the training process of qualified volleyball players can be considered effective. The results of our research allow us to recommend the proposed means for wide use by coaches in training and competitive activities to improve the values of these indicators of the coordination abilities of players of the defensive plan.

Conclusions / Discussion

The pedagogical experiment was conducted aimed at increasing the level of coordination abilities of qualified volleyball players. It used the proposed by us complex of special exercises and outdoor games, which contribute to the development of these qualities of volleyball players. The effectiveness of its implementation to increase the level of coordination abilities of volleyball players was assessed using the specially selected by us four tests. The comparative analysis of the results of the tests showed that the arithmetic average for each test obtained after the experiment was significantly higher than before its start.

Thus, it can be concluded that the proposed means to increase the level of coordination abilities of volleyball players proved their value as effective and can be used by team coaches in practical work to prepare players for a defensive role.

Prospects for further research. To research the influence of coordination abilities of qualified volleyball players on quantitative indicators of the effectiveness of defensive actions in the competitive activity of women's teams of the higher league.

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Information about the Authors

Alina Melnyk: PhD (Physical education and Sport), Associate Professor; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.
ORCID: https://orcid.org/0000-0001-5612-0333
E-mail: alina.melnik1987@ukr.net

Ievgeniia Strelnykova: assistent; H.S. Skovoroda Kharkiv national pedagogical university: Alchevskykh Street 29, Kharkiv, 61002, Ukraine.
ORCID: https://orcid.org/0000-0003-0010-6369
E-mail: zenastrel@gmail.com

Tamara Liakhova: assistent; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000-0003-4853-0513

E-mail: tamara.liakhova@yandex.ru

Natalya Pashchenko: assistent; Kharkov State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000 0003-3219-9248

E-mail: paschenko130@ukr.net

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RELATIONSHIP BETWEEN SPECIAL PHYSICAL PREPAREDNESS INDICATORS OF ATHLETES AND STRUCTURAL COMPONENTS OF THE COMPETITION PROGRAM IN ACROBATIC ROCK AND ROLL

Larysa Lutsenko[1]

Inna Bodrenkova[1]

Yulia Lutsenko[2]

Yaroslav the Wise National University of Law[1]*,*
Kharkiv, Ukraine
Kharkiv State Academy of Physical Culture[2]*,*
Kharkiv, Ukraine

Purpose: to establish the relationship between the structural components of the competition program with the indicators of special physical fitness in athletes "main class contact style" in acrobatic rock and roll.

Materials and methods: the study involved 16 qualified athletes aged 14-17 years, 8 men and 8 women (8 sports couples). Research methods: analysis and generalization of data of scientific and methodical literature, pedagogical observation, pedagogical testing and methods of mathematical statistics.

Results: competitive programs and indicators of the level of special physical fitness of qualified athletes are studied. Reliable connections between the components of the competition program and indicators of special physical fitness have been identified and established. It is experimentally proved and mathematically confirmed that the developed and tested tests are the most informative for determining the readiness for competitive activities of qualified athletes and are objective criteria for

selection and orientation of athletes in the system of training and competitive activities in acrobatic rock and roll.

Conclusions: the obtained data systematize the means of special physical training of athletes and give the opportunity to plan the algorithm of correction and improvement of competitive programs of qualified athletes "main class contact style". Used by coaches of sports clubs to assess the state of fitness of athletes and improve the competitive programs of sports couples of the category "main class contact style" in acrobatic rock and roll.

Keywords: acrobatic rock and roll, "main class contact style", qualified athletes, structural components of the competitive program, special physical training, correlation analysis.

Introduction

The competition program of qualified athletes "Main Class Contact Style" in acrobatic rock and roll is based on the objectively existing laws of modern competition rules of the World Confederation of Acrobatic Rock and Roll [11], which have specific differences in certain categories. These patterns are due to factors that determine the effectiveness of competitive activities and the optimal structure of the competitive program, features of adaptation in this sport, means and methods of influence, individual characteristics of athletes, calendar of major competitions and their age to achieve the highest results at long-term sports improvement [1, 6, 9, 13].

In the works of leading experts, enough attention is paid to the problems of training athletes in acrobatic rock and roll [1, 3, 6]. At the same time it is necessary to find modern approaches to the organization not only of long-term training process [8, 9, 13], but also to assess the effectiveness of compiling, improving and correcting competitive programs in qualified athletes "Main Class Contact Style" in acrobatic rock and roll [5, 7]. The modern competitive program of acrobatic rock and rollis a high-intensity complex of continuous exercises, which includes the combination of acyclic movements with complex coordination, combines the sequence of the

obligatory "basic step" of rock and roll and its modification with acrobatic elements. made in contact and decorated with expressive movements.

One of the main tasks to be solved in the process of sports training of qualified athletes "Main Class Contact Style" is to achieve the required level of development of motor skills that carry the main load in this sport. [1, 6, 11, 17]. The solution of this problem is carried out within the framework of physical training, which ensures the formation of general and special training and their manifestation in the conditions of competitions. It is known that each of these, as well as other aspects of training, is combined into a complex complex aimed at achieving the highest sports results [2, 10, 19]. The degree of inclusion of various elements in such a complex, their relationship and interaction are determined by the laws of formation of functional systems aimed at the final, sport-specific effect of training and competitive activities [1, 7, 11, 16]. There is no doubt that acrobatic rock and rollforms its own special range of relationships and interrelationships of the structural components of the competition program and indicators of special physical training, accounting for which at all stages of long-term training can create favorable conditions for optimizing the training process and achieving high sports performance. Therefore, work in this area of research is relevant.

Purpose of the study - to establish the relationship between the structural components of the competitive program with indicators of special physical fitness of qualified athletes "Main Class Contact Style" in acrobatic rock and roll.

Material and Methods of research

*Study participants.*16 qualified athletes aged 14-17 years (sports category CMS) voluntarily took part in the study and agreed to be examined: 8 men and 8 women (8 sports couples). Participants gave informed consent to participate and process the data.

The study was conducted from 2016 to 2019 on the basis of acrobatic rock and roll sports clubs in Ukraine.

Organization of the study. To solve these goals, research methods were used: analysis and generalization of data from scientific and methodological literature,

pedagogical observation, pedagogical testing, pedagogical experiment and methods of mathematical statistics.

Selection of tests to obtain information about the level of development of physical qualities was carried out on the basis of the analysis of the dominating motor mode of competitive exercises and specificity of acrobatic rock and roll, age of sportsmen and requirements of modern competition rules, and also on data of previously conducted research in complex coordination sports (gymnastics, sports acrobatics, sports aerobics, figure skating, etc.) [2, 5, 12]. Given this, to assess the special physical preparedness of qualified athletes "Main Class Contact Style", a set of control exercises (15 tests) was developed and used. They are presented in the works of the authors [12] and are all justified and meet the requirements of test standardization theory and sports metrology.

*Determination of speed qualities:*1) running on the spot for 5 seconds (number of steps); 2) 10 forward bends from the position of the main stand, hands up [12].

*Determination of speed and power qualities:*5) jumping up from a deep squat for 20 s (number of times); 6) 6 rock and roll jumping "basic steps" (s) [11]; 7) special rock and roll arms movements for 20 s (number of times); 8) "kick-step" for 20 s (number of times).

Determination of coordination abilities: 9) shuttle running with a change of direction (c) [12]; 10) performing the maximum number of turns on an inverted gymnastic bench. The number of turns (N) and the time (c) of their execution are registered[12]; 11) two front rolls, jump with a rotation of 540°, roll back ** (points); 12) "basic step" with skipping rope ** (points); 13) test for musicality ("kick-ball-change") (points) [11].

***Description of the test "two rolls forward, jump with a rotation of 540°, roll back," round".* Starting position - the main rack. Consecutively, without stopping, perform two forward rolls, jump up with a rotation of 540° (1,5 turns); roll back and "tour" rotation (jump up with 360° rotation).

Result: test performance was evaluated by 5 experts from 0 to 10 points (10 - 8 points - quality coordination, rotation and rotation with error-free switching between

exercises while maintaining jumping movements; 8 - 6 points - error-free switching between exercises, but with a violation of pace (stop between exercises); 6 - 4 points - turns are performed partially and with a violation of the pace). Of the 2 attempts, the best result was recorded.

**Description of the "basic step" test with a skipping rope.* Perform the "basic step" as required by the WRRC Rules [11] on skipping ropes.

Result: test performance was evaluated by 5 experts from 0 to 10 points (10 - 8 points - quality performance of the "basic step" with the preservation of jumping movements with a skipping rope; 8 - 6 points - error-free performance of the "basic step", but with violation of the pace of jumping movements with a skipping rope; 6 - 4 points - performance of the "basic step" in violation of the requirements and jumping movements with a skipping rope with a violation of the pace, stop during the test). Of the 2 attempts, the best result was recorded.

Determination of force: 14) performing the exercise "chair" (c) and determining special endurance: 15) IGST (%).

The structural components of competition programs were studied on the basis of competition video materials of different levels, according to the requirements of modern international competition rules [15] and on the results of electronic protocols of competitions of independent experts in this sport. During the pedagogical observation the following indicators were recorded: 1) acrobatic elements and combinations (number); 3) "basic step" (number); 4) dancing figures (number); 5) choreographic programs (4 groups) (number of exercises) [12].

*Statistical analysis.*The obtained data were subjected to statistical processing. The obtained material was processed using SPSS and Statistica programs [4, 14]; Spearman's correlation coefficient (r) and concordance coefficient were calculated.

Results of the research

The quantitative composition of the main structural components of the competitive program "Acrobatics", qualified athletes is investigated and given (Table 1).

Table 1

Quantitative composition of structural components of the competitive program of qualified athletes "Main Class Contact Style" in acrobatic rock and roll (n=16)

№ i.o.	Rank place in competitions		World Cup			Championship of Ukraine		
			I	II	III	I	II	III
	Indicators of the competitive program							
1	Elements of acrobatics (number)		6	6	6	6	6	6
2	Acrobatic combinations (number)		2	2	2	4	1	1
3	"Basic step" (number)		6	6	6	6	6	6
4	Dance figures (number)		7	4	5	4	4	5
5	Choreography	1 group (changes with the basic step) (number)	6	5	4	5	6	4
6		Group 2 (variations of the basic step) (number)	3	2	2	1	1	1
7		Group 3 (dancing figures in contact without basic step) (number)	2	2	2	1	2	3
8		Group 4 (everything else) (number)	8	5	4	4	4	2

To identify the most informative indicators of the competitive program and to establish reliable links between indicators of special physical fitness, a correlation analysis was conducted. Figure 1 shows the correlation field of the structural components of the competition program, which revealed 11 of 28 cases of strong and 8 medium connections (statistically significant, $p<0,05$).

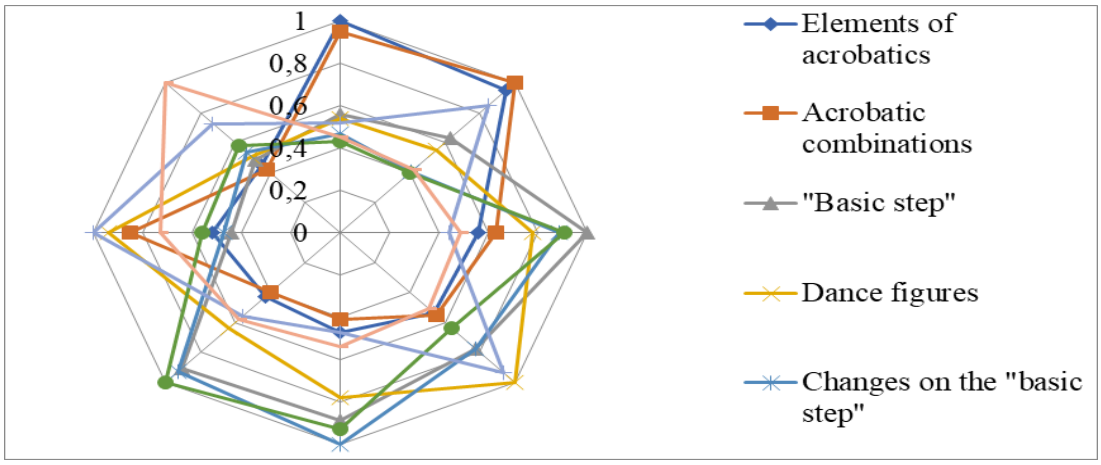

Fig. 1. Correlation field of structural components of the competitive program of qualified athletes "Main Class Contact Style" in acrobatic rock and roll

The graphic material is shown in Fig. 1 shows that the most informative and effective structural components of the competitive program of qualified athletes "Main Class Contact Style" in acrobatic rock and roll are: elements of acrobatics

(r=0,95) and acrobatic combinations (r=0,95), "basic step" (r=0,94) and dance figures (r=0,91), changes with the "basic step"(r=0.93) and variations of the "basic step" (r=0,94), dancing figure in contact without the "basic step" (r=0,93), elements of choreography (r 0,73), which have the main load when performing competitive programs. These indicators are objective criteria for building, correcting and improving competitive programs "Main Class Contact Style" in acrobatic rock and roll, they are a guide for athletes and coaches in the system of training and competitive activities in acrobatic rock and roll.

Table 2 presents the correlation matrix of the relationship between the identified main structural components of the competition program and indicators of special physical preparedness of qualified athletes "Main Class Contact Style". As a result of correlation analysis in 57 cases strong and average correlation loadings are revealed. This is due to the fact that the special physical fitness of athletes and quality performance of the structural components of the competition program are interrelated and with the optimal distribution of special physical training in the training process effectively affect the effectiveness of competitive activities of sports couples. The results of the study are typical for high-quality, error-free execution of the structural components of the competition program in compliance with all the requirements of the judge's protocol.

Strong and statistically significant values of correlation coefficients (from 0.70 to 0,87) were established in 20 cases, which indicates a high degree of correlation between the studied parameters. In particular, this applies to the following correlations: "basic step" - "basic step with a skipping rope" (r=0,87); "Acrobatic combination" - "two rolls forward, jump with a rotation of 540°, roll back "tour" (r=0,86); "Elements of acrobatics" - "10 forward bends from the position of the main stand, hands up" (r=0,84); "Dancing figures" - "test for musicality ("kick-ball-change")" (r=0,82); "Changes with the basic step" - "maintaining balance after 3 turns" (r=0,78); "Variations of the basic step" - "jumping up from a deep squat for 20s" (r=0,77); "Dancing figures without the basic step" - "two rolls forward, jump with a rotation of 540°, roll back "tour"(r=0,71).

Table 2

Matrix of correlation dependence of indicators of competitive program and indicators of special physical fitness of qualified athletes "Main Class Contact Style" in acrobatic rock and roll(n = 16; p <0,05)

	Indicators of the competitive program								
	Indicators of the competitive program / Indicators of special physical preparedness		Acrobatic elements	Acrobatic combinations	"Basic step"	Dance figures	Changes with the "basic step "	Variations of the "basic step"	Dancing figures in contact without "basic step"	Elements of choreography
			1	2	3	4	5	6	7	8
Tests on special physical fitness	Running on the spot for 5 seconds (number)	**1**	0.44	0.39	**0.85**	0.32	*0.55*	*0.58*	0.42	0.31
	10 forward bends from the position of the main stand, hands up (s)	**2**	**0.84**	**0.72**	0.23	0.20	*0.52*	0.33	0.17	0.22
	"Kick-step" 10 s (number)	**3**	0.49	0.14	0.42	*0.59*	*0.58*	0.47	0.49	*0.56*
	Dietrich falling stick grip (cm)	**4**	*0.56*	*0.67*	0.41	0.31	*0.53*	0.09	0.15	0.13
	Performing the exercise "chair" (s)	**5**	*0.58*	*0.63*	**0.75**	0.33	*0.65*	*0.50*	0.45	0.21
	Jumping up from a deep squat for 20 s (number)	**6**	**0.75**	**0.71**	**0.73**	0.47	0.47	**0.77**	0.41	0.34
	6 "basic rock and roll steps" (s)	**7**	0.03	0.44	**0.82**	0.17	*0.57*	*0.64*	0.46	0.28
	Special rock 'n' roll arms movements for 20 s (number)	**8**	0.15	0.17	0.38	*0.66*	0.19	0.44	*0.55*	*0.53*
	"Kick-step" for 20 s (number)	**9**	0.22	0.19	0.42	*0.58*	*0.53*	0.42	*0.58*	*0.55*
	Shuttle running with a change of direction 4x9 m (s)	**10**	0.44	*0.55*	0.36	0.42	*0.62*	*0.53*	0.38	**0.70**
	Maintaining balance after turns (c)	**11**	*0.63*	*0.58*	0.44	*0.53*	**0.78**	0.42	0.44	*0.61*
	Two rolls forward, jump with a rotation of 540 °, rollback "tour" (points)	**12**	**0.81**	**0.86**	0.48	0.33	**0.70**	0.32	**0.71**	*0.51*
	"Basic step" with skipping rope (points)	**13**	0.16	0.22	**0.87**	0.41	**0.73**	*0.63*	0.24	0.35
	Musicality test. Kick-ball-change (points)	**14**	0.13	*0.55*	**0.82**	**0.82**	0.49	*0.55*	0.47	*0.50*
	Harvard Step Test Index (%)	**15**	0.13	**0.73**	*0.65*	*0.55*	0.22	0.23	0.33	*0.53*

In 37 cases, the correlation coefficients were also statistically significant, but lower in their absolute value (from 0.50 to 0.68), namely, between the following: "AAcrobatic combinations" - "grip of a falling stick Dietrich" (r=0,67); "Dancing figures" - "special rock and roll arm movements for 20s" (r=0,66); "Basic step" - "IGST" (r=0,65); "Elements of acrobatics" - "maintaining balance after 3 turns" (r=0,63); "Dancing paired figures without" basic step "-" kick-step for 20s "(r=0,58); "Changes on the basic step" - "running in place for 5s" (r=0,55); "Variations of the basic step" - "shuttle running with a change in the method of movement 4x9 m" (r=0,53); "Elements of choreography" - "test of musicality" (r=0,50). In general, the results of the study confirmed that the success of competitive activities of athletes in acrobatic rock and roll depends on the rational balance of the considered informative indicators of the competitive program, which harmoniously interact in a set of training activities, effectively affect the complex structure of training. The data obtained during the study should be taken into account when organizing and planning the training process.

Conclusions / Discussion

It was assumed that the correlation between the structural components of the competitive program and indicators of special physical fitness will reveal strong relationships. The obtained data systematize the means of special physical training of athletes and make it possible to plan an algorithm for correction and improvement of competitive programs of qualified athletes "Main Class Contact Style". The results of the study [2, 16, 20] complement the effectiveness of means and methods used in training to increase the level of development of physical qualities and dosage of load in the training process in complex coordination sports.

It is confirmed [2, 15, 18] that the means of special physical training used in the training process of qualified athletes contribute to the improvement of skills for mastering complex coordination movements of acrobatic rock and roll, developing the ability to maintain balance, skills of rotational movements, improving speed , power and speed-power abilities. Performing fast and complex movements in combination with acrobatic elements and combinations is impossible without

coordination, accuracy of movements and the ability to maintain balance. In this regard, special training plays an important role in the development of coordination skills in qualified athletes: space-time characteristics; ability to orient in space and to maintain balance; coordination of movements; flexibility, power, speed and speed-power abilities. The level of development of these qualities is interrelated with the qualitative performance of the constituent parameters of the competitive program of qualified athletes "Main Class Contact Style" and are manifested not in isolation, but in complex interaction.

It is mathematically confirmed that the most informative and effective structural components of the competitive program of qualified athletes "Main Class Contact Style" in acrobatic rock and roll are: elements of acrobatics and combinations; "basic step"; dance figures and elements of choreography, which have the main load when performing competitive programs.

It is experimentally proven that qualified athletes of the "Main Class Contact Style" to perform modern complex competitive programs need to have a high level of development of coordination skills, speed-power, strength and speed abilities. In addition, to be able to perform significant training and competitive loads, it is necessary to have a high level of special endurance.

The relationship between the structural components of the competitive program and indicators of special physical fitness was established. It was found that with the optimal distribution of means of special physical training in the training process of qualified athletes, effectively improves the performance of competitive programs of "Main Class Contact Style" in acrobatic rock and roll.

These indicators are a guide for athletes and coaches in the system of training and competitive activities in acrobatic rock and roll.

In the future of further research development of theoretical and methodological bases of construction, improvement and correction of competitive programs of qualified athletes of acrobatic rock and rollis provided.

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Information about the Authors

Larisa Lutsenko: PhD (Physical education and Sport), Associate Professor; Yaroslav Mudryi National Law University: 61024, Ukraine, Kharkiv, Pushkinskaya str., 77.
ORCID: https://orcid.org/0000-0002-2761-872X
E-mail: l.s.lutsenkosport@gmail.com

Inna Bodrenkova: PhD (Physical education and Sport), Associate Professor; Yaroslav Mudryi National Law University: 61024, Ukraine, Kharkiv, Pushkinskaya str., 77.
ORCID: https://orcid.org/0000-0002-3454-1118
E-mail: Innasport2009@gmail.com

Yuliya Lutsenko: graduate student; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.
ORCID: https://orcid.org/0000-0001-6443-0470
E-mail: yulia.m.lutsenko@gmail.com

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SPECIAL FORCE TRAINING OF QUALIFIED CROSS-COUNTRY SKIERS 18-20 YEARS OLD IN THE PREPARATORY PERIOD

Serhii Kotliar

Alexander Toporkov

Tatiana Sidorova

Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

Purpose: improving special strength training of qualified cross-country skiers of 18-20 years old in the preparatory period of annual macrocycle.

Material and methods: the study was attended by athletes aged 18-20 years, who had training at the level of the first sports category, Candidate Master of Sports, experience of skiing 8-10 years old. The control group (n=10) conducted a training process according to the children's and youth sports school program, experimental (n=10) with the use of special exercises taking into account the style of movement and muscles involved. At the end of the stages of training with the help of special tests on inline skates and a ski simulator, a control test of the development of special strength qualities was conducted, and after the study, athletes took part in competitions with inline skates in different styles.

Results: as a result of the use of special strength training in the mode (special physical training and general physical training – 80/20 %), there was an improvement in the results of test indicators of special training by 3,33-18,09% and indicators obtained during the competition: the results in the sprint race in the classic style improved by 23,63% ($t=5,67$; $p<0,01$); sprint in skating style by 24,86% ($t=8,13$; $p<0,01$); in the 10 km classic race 9,77% ($t=4,01$; $p<0,01$); in the 10 km skating style race 6,82% ($t=2,43$; $p<0,05$).

Conclusions: continuous strength training by skiers-racers in the preparatory period made it possible to ensure control and management of the training process, despite the conditions of quarantine. Using of the proposed method, promoted more rational and productive training process of skiers-racers. The ratio of special physical training and general physical training in the preparatory period has a crucial role in the training process of qualified cross-country skiers-racers of 18-20 years old.

Keywords: cross-country skiing, distance training, strength training.

Introduction

Cross-country (XC) skiing include disciplines that vary significantly for biomechanical characteristics (classic and skating moves), energy supply regimes (sprint, races on medium and long distances), technical and tactical actions (separate / individual start race, general / mass start, skiatlon, relay, ski-cross). Therefore, there is no single approach to building power training [4, 6, 9].

Much attention to special force preparation in sport ski is due to an increase in the intensity of the training process associated with the development of skiing: complications of ski trails, the emergence of more energy-intensive moves and constantly increasing competition in international competitions [5, 6, 7, 11].

The study of many specialists in the field of sports training show that physical exercises are the main means of special force training: competitive, special-preparatory and general preparatory [4, 6, 8, 12, 13].

Increasing the efficiency of the training process in XC skiing occurs due to the rationalization of the training process aimed at increasing the efficiency of power training, individualization and selection of effective methods, the distribution of training load, balance between various means of training. These problems at the present stage of development of skiing are quite important and require special attention to specialists, trainers and athletes [10, 11].

In connection with the situation that has developed recently, associated with pandemia COVID 19, a quarantine was announced in Ukraine with a restriction of

home, so there was a need for the introduction of distance techniques for the preparation of athletes [1, 2, 6].

The problem of remote training has determined the direction of research and search for the most effective means and methods for improving special power training necessary in the implementation of competitive activities of XC skiers of 18-20 years old, which is an important issue of the theory and practice of skiing, especially during quarantine COVID 19.

Purpose of the study: Improving special strength training of qualified cross-country skiers of 18-20 years old in the preparatory period of annual macrocycle.

Material and Methods of research

The studies were conducted from april to september partly in terms of distance training and during the training duties. The studies were attended by athletes aged 18-20 years old. Athletes had preparation at the level of the first sports discharge, a candidate for the masters of sports, and were part of the team of Kharkiv region from ski racing, an experience of skiing 8-10 years old. The control group (n = 10) conducted a training process under the program for children and youth sports schools in Ukraine, experimental (n = 10) with the use of special exercises, taking into account the style of movement and muscles that take part in the work. The influence on the body of skiers of training power was clarified. Complexes, with different robot regimes (static, dynamic, state-dynamic and others). The research was conducted in distance mode (april-may) and during the training duties. Three independent special power complexes of exercises were developed: for the muscles of the lower extremities (for the classic and skating style of movement), muscles of the trunk and upper extremities. The time of each complex exercises occupied 10-15 minutes, time of rest between complexes 60-90 s. For the development of high-speed qualities, special exercises were performed with additional encumbrance, with an artificial impedance (rubber shock absorber, movement on an encumbrance system), with a resistance of the external environment (water, snow, wind, mild ground), simulation exercises, jumping exercises, work on ski simulators. Total workout time amounted to 50-60 minutes. Power complexes were performed three times a week.

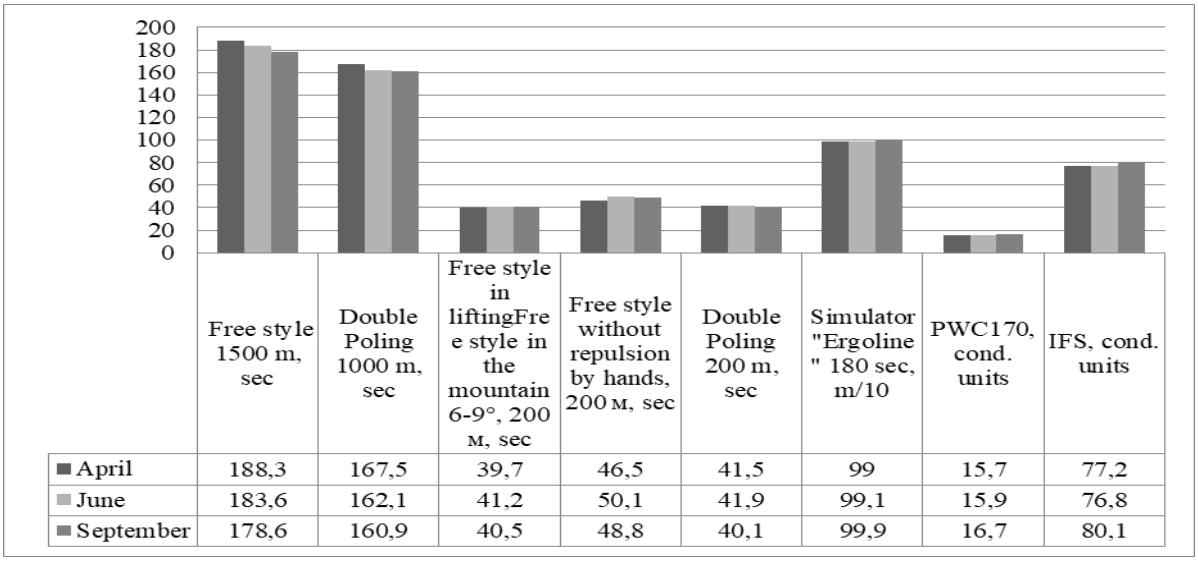
In order to assess the dynamics of special power indicators, testing for vice and recorded results of participation in competitions of different movement styles.

The following methods were used in the investigated methods: analysis and generalization of scientific-methodic literature, survey, pedagogical observation, pedagogical testing, pedagogical experiment, methods of mathematical statistics.

In order to achieve the research goal, a sports training program was adjusted, individual-group remote training tasks were made up, control over their execution. During the remote training process, classes were conducted using Zoom and Meet platforms.

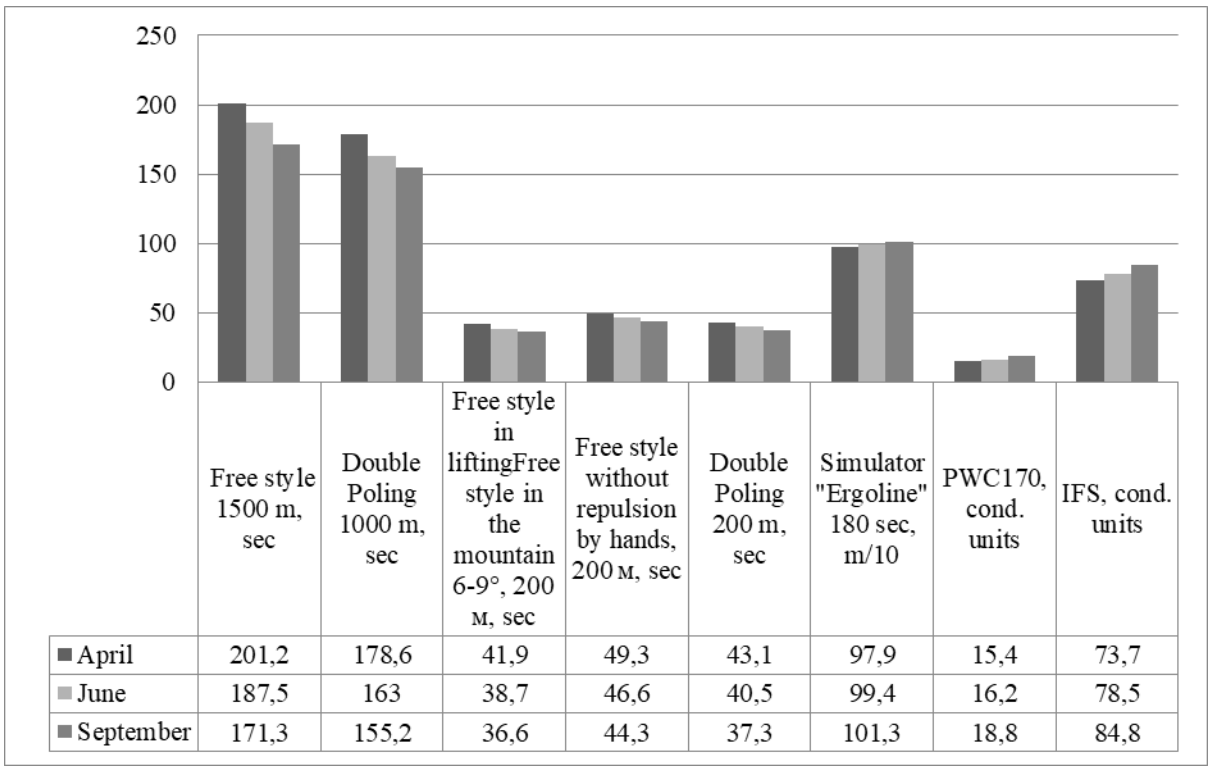
Results of the research

During the study, the method of special power training of skilled racers in 18 - 20 years in the preparatory period was developed. Particular attention in the experimental group at this stage was given special power preparation (Generally physical training (SPP) / Specially physical training (GPP) - 80/20%), and in the control of the same time special and general training (SPP / GPP - 50/50%). At the end of each period of preparation (April, June, September), a control testing of physical fitness of athletes of control and experimental groups of conducting tests was carried out in the first training day of the microcycle (Fig. 1 and 2).



	Free style 1500 m, sec	Double Poling 1000 m, sec	Free style in liftingFree style in the mountain 6-9°, 200 м, sec	Free style without repulsion by hands, 200 м, sec	Double Poling 200 m, sec	Simulator "Ergoline" 180 sec, m/10	PWC170, cond. units	IFS, cond. units
April	188,3	167,5	39,7	46,5	41,5	99	15,7	77,2
June	183,6	162,1	41,2	50,1	41,9	99,1	15,9	76,8
September	178,6	160,9	40,5	48,8	40,1	99,9	16,7	80,1

Fig. 1. Dynamics of the level of special preparedness of cross-country skiers 18-20 years of the Control group for April-June-September (means of preparation of roller skiing and simulator "Ergoline")



	Free style 1500 m, sec	Double Poling 1000 m, sec	Free style in liftingFree style in the mountain 6-9°, 200 м, sec	Free style without repulsion by hands, 200 м, sec	Double Poling 200 m, sec	Simulator "Ergoline" 180 sec, m/10	PWC170, cond. units	IFS, cond. units
April	201,2	178,6	41,9	49,3	43,1	97,9	15,4	73,7
June	187,5	163	38,7	46,6	40,5	99,4	16,2	78,5
September	171,3	155,2	36,6	44,3	37,3	101,3	18,8	84,8

Fig. 2. Dynamics of the level of special preparedness of cross-country skiers 18-20 years of the Experimental group for April-June-September (means of preparation of roller skiing and simulator "Ergoline")

An analysis of the results of the tests showed that the indicators characterizing the special endurance of skiers on castor graders at a distance of 1500 m free style (F) in the experimental group (EG) have improved by 14.86% ($t=3,75$; $p<0,05$), and in the control group (CG) by 5,15% ($t=2,20$; $p<0,05$); at a distance of 1000 m double poling in (EG) improved by 13.10% ($t=2,47$; $p<0,05$), and in (CG) by 3,94% ($t=1,01$; $p<0,05$). In tests on the ski simulator "Ergoline" for 180 seconds in (EG) improved by 3,33% ($t=2,62$; $p<0,05$), and in (CG) by 0,89% ($t = 0,59$; $p>0,05$) (Table 1).

In the test indicators in roller skiing that characterize the speed-strengths of athletes found the following changes: the rate of overcoming the lifting Free style in (EG) improved by 12,65% ($t=0,75$; $p<0,05$), and in (CG) by 1,98% ($t=0,14$; $p<0,05$); the movement of the free style without the help of hands in (EG) improved by 10,14% ($t=0,53$; $p<0,05$), and in (CG) by 4,71% ($t=0,31$; $p<0,05$); Double poling 200 m in (EG) improved by 13.46% ($t=0,94$; $p<0,05$), and in (CG) by 3,37% ($t=0,17$ $p<0,05$) (Table 1).

Table 1

Indicators of special physical training of cross-country skiers 18-20 years at the beginning and upon completion of the study ($n_к=n_e=10$)

№	TESTS	April		September		t_{C1-C2} t_{E1-E2}	p
		CG	EG	CG	EG		
		$X_{C1}\pm m_{C1}$	$X_{E1}\pm m_{E1}$	$X_{C2}\pm m_{C2}$	$X_{E2}\pm m_{E2}$		
1	Free style 1500 m, *s*	188,3±3,4	201,2±7,4	178,6±2,8	171,3±3,0	2,20 3,75	> 0,05 < 0,05
2	Double Poling 1000 m, *s*	167,5±5,5	178,6±8,9	160,9±3,5	155,2±3,2	1,01 2,47	> 0,05 < 0,05
3	Free style in liftingFree style in the mountain 6-9°, 200 m, *s*	39,7±4,8	41,9±6,4	40,5±3,2	36,6±3,0	0,14 0,75	> 0,05 > 0,05
4	Free style without repulsion by hands, 200 m, *s*	46,5±6,3	49,3±8,8	48,8±4,0	44,3±3,3	0,31 0,53	> 0,05 > 0,05
5	Double Poling 200 m, *s*	41,5±7,0	43,1±5,3	40,1±4,1	37,3±3,2	0,17 0,94	> 0,05 > 0,05
6	Simulator "Ergoline" 180 s, *m*	989,6±12,3	978,8±11,3	998,5±8,7	1012,5±6,2	0,59 2,62	> 0,05 < 0,05
7	PWC_{170}, *cond. units*	15,7±2,4	15,4±2,7	16,7±1,2	18,8±1,1	0,37 1,17	> 0,05 > 0,05
8	IFS, *cond. units*	77,2±2,7	73,7±3,0	80,1±1,7	84,8±1,6	0,91 3,27	> 0,05 < 0,05

Note: CG - control group, EG - experimental group, IFS - Indicator of functional state

According to tests that characterize the functional state of athletes revealed the following changes: in the PWC_{170} in (EG) tests have improved by 18,09% (t=1,17; p<0,05), and in (CG) by 5,99% (t=0,37; p<0,05); In the indicators the Indicator of functional state (IFS) in (EG), the results have improved by 13,09% (t=3,27; p<0,05), and in (CG) by 3,62% (t=0,91; p<0,05) (Table 1).

At the beginning of the experiment, the indicators of both groups were approximately the same. In the middle of the experiment, after the first stage of preparation, the results in both groups have changed, but upon completion of the study in the (EG), the improvement of the results occurred more (p<0,05), and their growth in all test indicators was 3,33 – 18,09 %.

In September, the growth of results in the (EG) was much larger than in the (CG). This is explained by the fact that at the preparatory period in all groups, the main power trained was loaded, and an additional general physical training (SPP /

GPP - 80/20%), which were performed by the interval method (Tabata) with the mode of operation 20/20, 30/30 according to specially designed complexes of power training.

In september, the athletes of both groups took part in roller skiing of sprint (prologue) and races at 10 km classical (Cl) and skate (F) styles on castorals, the results of which are presented in Table 2.

Table 2

Indicators of competitions of control and experimental groups of cross-country skiers 18-20 years after the experiment ($n_к = n_е = 10$)

№	Competition	CG	EG	t	P
		$X_C \pm m_C$	$X_E \pm m_E$		
1	Sprint classic style (CL) prolog, *s*	232,3±7,34	177,4±6,32	5,67	<0,01
2	Sprint skate style (F) prolog, *s*	179,8±4,53	135,1±3,12	8,13	<0,01
3	Classic style race (CL) 10 km, *s*	2275,5±36,06	2053,1±42,11	4,01	<0,01
4	Skate style race (F) 10 km, *s*	2010,2±46,45	1873,1±32,11	2,43	<0,05

Comparative analysis of the competitions found that athletes of the experimental group (EG) showed results during classic (Cl) and skate (F) style are much better than the skier of the control group (CG): the results in the race sprinted with classical style have improved by 23,63% ($t=5,67$; $p<0,05$); sprint skating styles by 24,86% ($t=8,13$; $p<0,05$); race classic style 10 km by 9,77% ($t=4,01$; $p<0,05$); in the race of the skating style 10 km by 6,82% ($t=2,43$; $p<0,05$) (Table 2).

During the study, it was found that special security for qualified of cross-country skiers 18-20 years old in the preparatory period under training (SPP / GPP - 80/20%), led to an improvement in special indicators of power qualities and increase the indicators of distance athletes.

Conclusions / Discussion

Distance learning exists not the first year and successfully used in various educational programs, mainly aimed at theoretical training and as an additional tool for physical or sports training, when it is possible to go outside, visit stadiums, sports sections [1; 3].

But in the mode of self-isolation, the distance learning method and sports preparation acquires a slightly different character, in connection with which there is a need to revise funds and methods of sports and physical training at home [8].

As a result of the research, it has been found that the development of special power qualities depends not only on training means, but to a greater extent from the methodology of their application: the intensity of execution (20/20, 30/30), the length of segments, the number of repetitions, recreation intervals, total time performance.

Thus, pedagogical testing of the level of strength preparedness of XC skiers allowed to file a training process in order to increase special power preparedness in the preparatory period during quarantine COVID 19.

The performed remote work allowed to provide a continuous training process of XC skiers, manage and control over training, contrary to quarantine conditions. The use of the proposed methodology for power training during quarantine has contributed to a more rational and productive training process of XC skiers-racers at the stage of self-isolation. A decisive role in the training process of skilled racers 18-20 years old has the ratio of the SPP / GPP in the preparatory period. The use of a remote form is not a reason for the future to exclude conducting eye training activities, but only acts as a form of temporary work during self-isolation. In the future, such a form of work can be used as theoretical education of athletes or as an individual work during the disease.

Prospects of further studies is to develop distance tasks of technical and tactical skill, development of equilibrium and balance of skiers-riders during self-isolation.

Conflict of interest. The authors state that there is no conflict of interest that may be perceived as prejudicial to the impartiality of a state, public or commercial organization.

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Information about the Authors

Serhii Kotliar: PhD (Physical Education and Sport), Associate Professor; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.
ORCID: http://orcid.org/0000-0002-8837-8002
E-mail: skotlyr71@gmail.com

Oleksandr Toporkov: PhD (Physical Education and Sport); Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.
ORCID: http://orcid.org/0000-0002-8949-9893
E-mail: a.toporkov@meta.ua

Tetiana Sidorova: PhD (Physical Education and Sport), Associate Professor; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

ORCID: http://orcid.org/0000-0003-3140-8562

E-mail: sidorova.tetyana@gmail.com

UDC [796.323.2:796.015.58:796.012.11+796.012.13]-053.6

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USING THE METHOD OF CIRCUIT TRAINING IN THE DEVELOPMENT OF HIGH-SPEED AND POWER ABILITIES OF 15-16-YEAR-OLD BASKETBALL PLAYER

Irina Pomeshchikova

Nataliia Chucha

Iryna Shyriaeva

Kharkiv State Academy of Physical Culture,

Kharkiv, Ukraine

Purpose: to determine the effectiveness of using a set of high-speed and power exercises by the circular training method in the training process of 15-16-year-old basketball players.

Material and methods: two groups of 15-16-year-old basketball players of Kharkov BC "Junior" in the total number of 20 sportsmen (control group, n=10, experimental group, n=10) took part in the research. The pedagogical experiment lasted 2 months and consisted of the introduction in the educational and training process of the experimental group of specially selected exercises which were used by means of the method of circuit training. The set of exercises included jumps through a gymnastic bench, jumps out from a deep squat, jumps in-depth, throwing of a stuffed ball sitting and standing, jumps up with reaching out the suspended ball. The offered set of exercises was applied on each training classes at the beginning of the main part. The total number of training classes in a week of control and experimental group equaled four lasting 135 minutes.

Results: introduction to the educational and training process of experimental group of 15-16-year-old basketball players of specially selected exercises aimed at the development of high-speed and power abilities with using the method of circuit

training, was revealed the reliable improvement of indicators of test exercises: standing long jump ($t=2,13$; $p<0,05$), standing high jump ($t=2,14$; $p<0,05$), high jump from running start ($t=2,24$; $p<0,05$). The reliable difference wasn't revealed in the test "Throwing of a stuffed ball weighing 1 kg, standing" ($t=0,86$; $p>0,05$).

Conclusions: the improvement of manifestation of indicators of high-speed and power abilities of 15-16-year-old basketball players of the experimental group after the introduction of specially selected exercises with using the method of circuit training was: in the test "Standing long jump" – 2,73%, "Standing high jump" – 5,54%, " High jump from running start" – 6,32%, "Throwing of a stuffed ball weighing 1 kg, standing" – 7,62%.

Keywords: basketball players, high-speed and power qualities, method of circuit training.

Introduction

A significant manifestation of high-speed and power abilities is characterized by competitive motor activity in sports games [9].

About 70% of all movements of a basketball player are high-speed and power nature in basketball. This is because the basis of a basketball player's competitive motor activity is made up of various types of running, jumping, throwing the ball - motor actions that, in conditions of earth gravity and opponent's opposition, require the manifestation of significant muscle strength at short intervals. In this regard, high-speed and power training of basketball players was paid and is paid a lot of attention [18].

Some specialists in sports games indicate that high-speed and power exercises are the basis for mastering some techniques of the game [11, 14, 20].

The authors propose to use a variety of jumps, throwing stuffed balls [19], exercises with a resistance of partners and exercises with stuffed balls [10], jump exercises on sand [1], jump exercises in combination with elements of the technique [12], etc.

In our previous researches, indicators of high-speed and power abilities of basketball players [17], high-speed and power preparedness of pupils of the vocational institution were considered [5]. It was found that the state of high-speed and power abilities of student basketball teams have a rather high level at the end of the school year. This indicates that physical exercises that are used in the training process of basketball players positively affect high-speed and power abilities [17]. The results of our past researches made it possible to establish the influence of specially selected complexes of exercises with a resistance of partners and exercises with aggravation on the indicators of high-speed and power preparedness of 17-20-year-old basketball players [12]. Based on the results of our previous researches, we found a reliable improvement in the results in throwing a basketball ball and a ball weighing 2 kg per range, the result of standing jump up, the amount of lifting the torso sitting from the lying position in 15 seconds. Earlier, we conducted researches of the indicators of high and speed power abilities of 14-15-year-old beach handball players, the developed by us system of specially directed exercises on sand reliably influenced the indicators of standing jump, standing jump up, standing jump up with a turnover of 180° [12]. The obtained results are a fairly reliable basis for our approaches for this research.

A significant number of authors indicate that one of the effective methods for developing high-speed and power abilities of basketball players is the method of circuit training [4, 13, 15, 16].

We suggested that using the method of circuit training with specially selected exercises can increase the performance of high-speed and power abilities of 15-16-year-old basketball players.

Connection of the research with scientific programs, plans, topics. The research was carried out by the theme of the research plan of Kharkiv state academy of physical culture “The improvement of the educational and training process in sports games” for 2019-2023.

The purpose of the research is to determine the effectiveness of using a set of high-speed and power exercises using the method of circuit training in the training process of 15-16-year-old basketball players.

Research tasks:

1. To conduct the analysis of scientific-methodological literature on the development of high-speed and power abilities among young basketball players.

2. To prove experimentally the effectiveness of using the method of circuit training to develop high-speed and power abilities of basketball players.

Material and Methods of research

Two groups of basketball players of BC "Junior" in Kharkiv at the age of 15-16 years in the total number of 20 people (control group, n = 10, experimental group, n = 10) took part in the research. To determine indicators of the manifestation of high-speed and power abilities, tests were used: standing long jump, standing jump up, running jump up, and throwing a stuffed ball weighing 1 kg, standing. The pedagogical experiment lasted 2 months and consisted of introducing into practice specially selected exercises of the experimental group that were used using the method of circuit training. The set of exercises is shown in Figure 1.

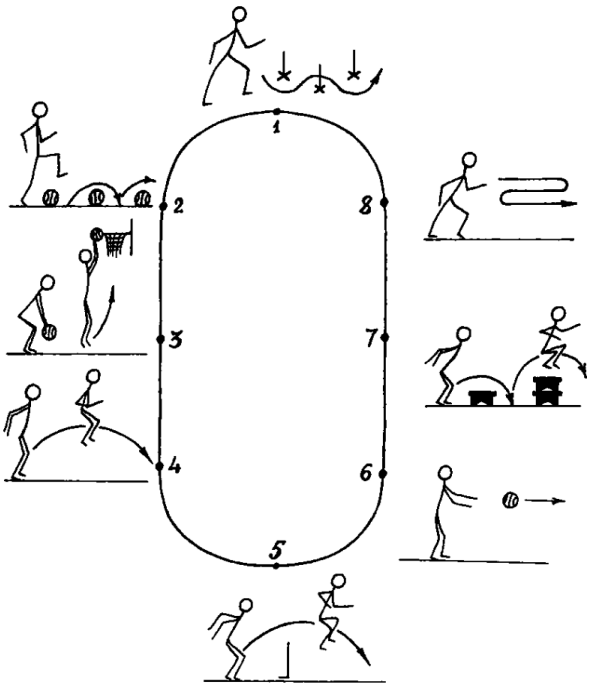

Fig. 1. The example of exercises included in the experimental program using the method of circuit training

The complex of exercises included running zigzag around the stands, jumps through stuffed balls, jumps up with finishing the ball in the shield, jumping out of the squat, jumps through barriers, throwing the stuffed ball, standing, jumps through tumbles of different heights, speed up. The proposed complexes of exercise were used at each training session at the beginning of the main part. The total number of training sessions per week of the control and experimental groups was four for 135 minutes.

The following research methods were used the research: analysis of scientific-methodological literature, pedagogical testing, pedagogical experiment, methods of mathematical analysis.

To analyze the obtained information, the application package Microsoft Excel was used, the validity of the discrepancies was established based on the calculation of Student criterion, at $p<0,05$.

Results of the research

At the beginning of the pedagogical experiment, the control and experimental groups probably didn't differ from each other in all indicators of testing the manifestation of high-speed and power abilities (Table 1).

Table 1

The comparison of indicators of high-speed and power abilities of 15-16-year-old basketball players of experimental and control groups before the pedagogical experiment

Tests	Indicators $\bar{X} \pm m$			
	EG(n=10)	CG(n=10)	t	p
Standing long jump (cm)	222,8±2,04	225,5±2,30	0,88	>0,05
Standing jump up (cm)	53,25±1,12	54,12±1,25	1,12	>0,05
Running jump up (cm)	60,1±1,27	59,7±1,34	0,22	>0,05
Throwing a stuffed ball weighing 1 kg, standing (m)	10,5±0,71	10,7±0,80	0,19	>0,05

After experimenting, comparing the test results in the experimental group, the reliable improvement in the results of the tests was revealed: standing long jump, standing jump up, running jump up ($p<0,05$). A probable difference wasn't found in

the test throwing a stuffed ball weighing 1 kg, standing (p>0,05). The results of the changes are shown in Table 2.

Table 2

Indicators of the manifestation of high-speed and power abilities of 15-16-year-old basketball players of the experimental group before and after the pedagogical experiment

Tests	Indicators $\bar{X} \pm m$			
	Before the experiment (n=10)	After the experiment (n=10)	t	p
Standing long jump (cm)	222,8±2,04	228,9±2,01	2,13	<0,05
Standing jump up (cm)	53,25±1,12	56,20±0,80	2,14	<0,05
Running jump up (cm)	60,1±1,27	63,9±1,12	2,24	<0,05
Throwing a stuffed ball weighing 1 kg, standing (m)	10,5±0,71	11,3±0,60	0,86	>0,05

The improvement in the manifestation of the high-speed and power abilities of 15-16-year-old basketball players of the experimental group was: in the test "Standing long jump" – 2,73%, "Standing jump up" – 5,54%, "Running jump up" – 6,32%, "Throwing a stuffed ball weighing 1 kg, standing" – 7,62% (Fig. 2).

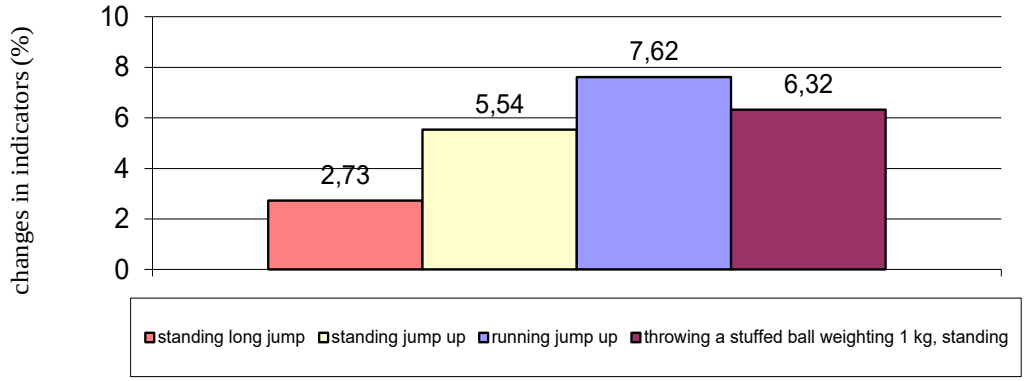

Fig. 2. Qualitative indicators of changes in the manifestation of high-speed and power abilities of 15-16-year-old basketball players of the experimental group after the pedagogical experiment (percentages)

It should be noted that the largest changes in indicators of the manifestation of high-speed and power abilities of 15-16-year-old basketball players of the experimental group occurred in the indicators of running jump up.

Conclusions / Discussion

Our research was carried out based on recommendations of specialists in sports games on the need to preserve and increase the level of physical fitness of young sportsmen, including high-speed and power abilities, which are the basis for mastering the techniques. Kaftanova T.V., Husakovskyi A.V. proposed the methods for the development of high-speed and power abilities of basketball players of the student team. The data of the authors' pedagogical experiment show the significant improvement in results of the test "pull-up" by 22,8%, in the test "lifting the torso from the lying position" by 34,7%, in the test "knee extension" by 55%, in the test "raising the legs to the crossbar" - by 36,8%, in the test "throwing a stuffed ball" - by 36,1% [6].

Vorontsov N. D., Pavlov P.V., Zhelezniakov A. G., applying the method of circuit training in physical training of basketball players of the sports section of the university, noted the dynamics in the results of basketball players of the experimental group in throwing a stuffed ball from behind the head by 15,7%, in standing jump up by 7,7%. [3]. Bondar A. A. came to the conclusion that specially selected exercises inserted into the complex of the circuit training have a positive effect on special physical training, as evidenced by a reliable improvement in indicators of jump up [2].

The results of our research continue several works to study and improve the methods for the development of high-speed and power abilities of basketball players. The results of our research are consistent with the data of other researchers [2, 3, 7]. The authors note that regular physical exercises using the method of circuit training positively affect the manifestation of high-speed and power abilities of basketball players [6, 8].

So, the complex of developed by us exercises, which were carried out by the method of circuit training, improved the indicators of the manifestation of high-speed and power abilities of 15-16-year-old basketball players of the experimental group. This is expressed in the reliable improvement in results of the tests: standing long jump, standing jump up, running jump up ($p<0,05$). The results of our research allow

us to recommend to coaches to improve the manifestation of high-speed and power abilities to use the method of circuit training in the training process of basketball players using a set of high-speed and power exercises.

Prospects for further research. Further research is planned to focus on determining the effectiveness of using the method of circuit training in developing other physical qualities of basketball players.

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Information about the Authors

Irina Pomeshchikova: PhD, assistant professor; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.
ORCID: https://orcid.org/0000-0003-1343-8127
E-mail: pomeshikovaip@ukr.net

Nataliia Chucha: Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000-0002-2564-4860

E-mail: natali.chucha@ukr.net

Iryna Shyriaeva: Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000-0002-9241-1506

E-mail: shiryaeva90@list.ru

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RESULTS OF THE APPLICATION OF THE PHYSICAL THERAPY PROGRAM USING ETHNIC MASSAGE TECHNIQUES FOR INJURIES OF THE ANKLE JOINT

Youssef Charbel

Tetiana Podkopai

Denis Podkopai

Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

Purpose: to evaluate the results of physical therapy of sportsmen football players with intra-articular injuries of the ankle joint at the outpatient stage when using measures of the physical therapy program using the techniques of ethnic oriental massage.

Material and methods: the study analyzes the results of a study conducted in Beirut (Lebanon), the clinic of the Mir Majid Erslan Medical Center. The effectiveness of physical therapy of 36 football players with intra-articular injuries of the ankle joint at the outpatient stage was assessed according to the method of A.V. Kalashnikov and LEFS scale.

Results: it was found that with positive changes in the functional state of the injured athletes of both clinical groups, reliably better results were revealed among the football players of the main group, who were offered physical therapy according to the program we developed.

Conclusions: the analysis of the research results showed that in the injured athletes of the main group, with the same periods and volumes of observation, the

results of the research methods were significantly higher and objectively more pronounced than in the control group.

Keywords: intra-articular injuries of the ankle joint, physical therapy, oriental massage, oriental bath, outpatient stage.

Introduction

In a study that lasted over 16 years, J. M. Hootman et al [15] observed athletes in 15 different sports in the United States and concluded that lower limb injuries account for more than 50% of all sports injuries, with the knee and bones being predominantly involved. Most of the injuries were contact injuries, with a significantly higher number of injuries observed during the competition compared to training. With 15 sports, football had the highest injury rate, followed by competitive wrestling.

The most common type of fracture in the AJ in all age groups is the lateral ankle fracture, the frequency of which reaches 55% of all ankle fractures. Bones are one of the most common sites of injury in 24 out of 70 sports. The causes of injuries in 61% of cases are falls, in 22% - sports [14]. Despite the fact that in most cases there is a complete recovery of the AJ function after this type of injury, about half of patients, despite complete recovery, report constant problems with physical and psychological health [16].

Massage is widely used in the treatment of patients with fractures of various localization. The therapeutic effect of the massage consists in a mechanical effect on the skin, muscles, tendons, the capsule-ligamentous apparatus of the joints, and lymphatic vessels. In addition, under the influence of massage, complex processes develop in the cerebral cortex, causing corresponding reactive responses in body systems and organs [2].

The effect of massage on the body occurs through mechanical irritation of tissues using special techniques: stroking, rubbing, kneading, shock techniques, vibration. Massage acts on the body in a complex way, since any irritation caused by

massage techniques acts not only in the place of direct impact, but also indirectly affects the state of the body as a whole [1].

The therapeutic effect of massage on the circulatory system, ligamentous-muscular and articular apparatus of the human body occurs through reflex connections. The therapeutic effect of massage is manifested in the improvement of blood supply and tissue trophism, and prevents the development of muscle wasting. It is known that massage improves the contractility of muscles and increases their elasticity, affects muscle tone [8].

The massage accelerates the regeneration of bone tissue, as its techniques increase the blood supply to the injured area. This explains the requirement for the earliest possible use of massage in the recovery period after injuries [10].

The therapeutic effect of therapeutic massage during therapy after injuries of the foot and AJ leads to clinically significant improvements in the function of the joint, an increase in its mobility and range of motion. [7].

E. E. Painter et al. [17] observed an improvement in the movements of the AJ, a decrease in joint pain in injured athletes after immobilization with stable fractures of the AJ after an average of 6 massage sessions, while the majority of injured athletes noted an improvement after 4 weeks.

M. S. Crowell et al. [13] drew attention to the need for an individual approach to the injured athlete, based not on the treatment protocol, but on the decision making, which is based on the assessment of the response of the injured athlete to each massage technique, increasing the degree or duration of the techniques that had the desired effect.

The use of ethnic directions of oriental massage in the literature is described somewhat fragmentarily, more often for restorative and recreational purposes, but the physiological effect of oriental massage techniques is considered to be quite pronounced and directed. The use of oriental massage techniques for reparative effects on the structures of the joints, fascial and periarticular tissues with the correct technical and methodological application, according to Mercato M. (2002), and Lambert J. (2005), is an effective influence on the process of returning and

increasing the passive flexibility of the majority joints of the human body, especially large joints of the spine and lower extremities. The implementation of the oriental massage procedure, according to the authors, has certain age restrictions and medical contraindications (for persons over 60 years old, the presence of acute or chronic diseases of the joints, etc.), which should be taken into account by changing the amplitude and intensity of the massage techniques , the selection of massage techniques and the duration of the procedure [5].

Separately, experts note the advisability of combining massage, especially oriental massage procedures with thermal procedures (bath procedures) in the treatment of traumatic and inflammatory diseases of the ligamentous and muscular apparatus in the subacute period, as well as in chronic processes, joint stiffness, muscle contractures, vascular disorders, the possibility of spasms. In case of functional disorders of the musculoskeletal system, which include: joint stiffness, articular adhesions, delayed callus formation, muscle atrophy, paresis, neuritis, neuralgia, in rehabilitation practice it is recommended to first apply heat, and then a massage procedure using massage techniques with amplitude movements in the joints, it is clearly used in the technique of oriental (Thai) massage [6].

The foregoing indicates a significant attention to this problem and the possibility of creating effective programs for physical therapy of athletes with intra-articular injuries of the ankle joint at the outpatient stage with the involvement of ethnic massage techniques.

The purpose of the study is to evaluate the results of physical therapy of sportsmen football players with intra-articular injuries of the ankle joint at the outpatient stage when using measures of a physical therapy program using ethnic massage techniques.

Material and Methods of research

The study was carried out at the Mir Majid Erslan Medical Center in Beirut, Lebanon in a physical therapy room from 2016 to 2018. The study involved 36 athletes, football players. All affected athletes were males between the ages of 18 and 24. The injured athletes were divided into the main group and the control group (18

people each). The main and control groups were the same in terms of manifestations of functional disorders, localization of injuries, age and level of sports qualifications.

The duration of the injury of the athletes participating in the study was 4-6 months. The injured athletes of the main clinical group underwent a course of physical therapy simultaneously with the resumption of the training process.

The study involved injured athletes with closed injuries of the ankle joint of types A1, A2, C1 and C2 according to the AO / ASIF classification [18].

Injured athletes from both groups underwent initial and repeated examination - immediately before physical therapy and at its completion, namely, 30 days after its start, which made it possible to objectively assess the dynamics of changes in the indicators of research methods.

We assessed the effectiveness of physical therapy using the LEFS scale (The Lower Extremity Functional Scale) [12], which contains a differentiated characteristic of social and domestic functions, the degree of physical activity and normalization of the gait of injured athletes.

Anatomical and functional results of treatment of injured athletes with intra-articular injuries of the ankle joint were assessed using the standards for assessing the quality of treatment of injuries and diseases of the organs of movement and support set forth in the Order of the Ministry of Health of Ukraine No. 41 dated 03.30.94 "On the regulation of orthopedic and traumatological care in Ukraine" to the changes proposed by A.V. Kalashnikov (2006) [3].

The volume of digital material obtained in the course of the study was processed using the general-purpose data processing software Statisticafor Windows version 6.0. [9].

Results of the research

Patients of the main group, instead of a complex of physiotherapeutic procedures and classical massage in the control group, were prescribed a complex consisting of a combined application of a bath procedure of a conventional Arab bath and a procedure of oriental massage of the lower extremities.

The bath procedure was used as a preparatory tool for further use, as the main tool, of oriental massage techniques. The previous deep heating of the soft tissues and the osteoarticular apparatus of the injured limbs activated internal arterial hyperemia, increased the elastic qualities of fibrous tissue, somewhat reduced the pain sensitivity threshold when performing high-amplitude movements. In turn, the techniques of oriental massage, used against the background of the action of the hyperthermic bath procedure, were used to increase the amplitude of passive movements in the injured ankle joint, which led to a decrease in both the structural and functional contracture of the injured joint.

For the muscles and joints of the affected limb, oriental massage was also intended with an emphasis on activating blood and lymph flow. Physiotherapy procedures were replaced by mixed Arab bath procedures - an oriental bath with a fixed technological and methodological sequence.

The therapeutic massage technique, which was used during the modified Arab bath procedure, was carried out in the bath room on a massage bench and included a combination of oriental and Thai techniques for the limbs [5].

The massage procedure was performed for 30 minutes. Each technique was performed three times, with fixing the initial position in the extreme positions of the limb links for 3-5 s in the first phase of therapy, up to 6-8 s in the second phase, up to 8-10 s in the third and fourth phases of therapy.

The degree of intensity (strength, applied) when performing techniques for stretching the ligamentous apparatus of the joints gradually increased from the initial to the fourth phase of therapy and depended on the pain threshold of the injured athlete and his general condition.

The massage technique was methodically divided into three parts according to topographic and physiological principles. First, a healthy limb was massaged, and then the muscles and joints of the damaged.

The technique of oriental massage for injured athletes of the main group was performed in the following methodological sequence: the massage procedure was started by treating the muscles and joints, first of a healthy, and then of an injured

limb in the initial position lying on the stomach. In this position, the techniques of pressing and kneading the limb muscles, dosed flexion, extension and abduction of the hip joints with stable and soft dynamic stretching of the capsular-ligamentous apparatus of these joints were performed.

Massage of the muscles of the lower extremity consisted of techniques of oriental massage of the thigh and lower leg in the form of a pressing (surging) massage with a number of pressure on the muscle, and classical massage techniques such as squeezing, exciting and squeezing kneading, deep classic fascinating and pressing kneading of muscles and rubbing of joints.

Next, flexion and extension of the knee and extension of the capsular-ligamentous apparatus of the ankle joints into flexion-extension and abduction-adduction with increased amplitude, with stable and soft dynamic stretching of the capsular-ligamentous apparatus of these joints were performed.

In the future, the procedure of massage of joints and muscles was continued, first of a healthy, and then of an injured limb in the initial position lying on the back.

In this position, the techniques of stable pressure on the muscles and joints of the limb, dosed stable and soft dynamic stretching, flexion and extension of the hip, knee and ankle joints were performed..

The techniques were performed in flexion-extension and abduction-adduction with increased amplitude and constant control of the level of pain in the injured athlete.

Flexion-extension and adduction-abduction of the foot in the ankle joint were performed both in isolation and with simultaneous extension of the entire limb and movements in adjacent joints with their simultaneous extraction. This allows you to stabilize blood circulation and synchronize the muscle tone of the limb. Local pain sensations with these techniques are significantly reduced.

Flexion-extension and adduction-abduction of the foot in the ankle joint was carried out both in isolation and in simultaneous extension of the entire limb and movement in adjacent joints and its simultaneous abduction, adduction and rotation. Flexion-extension and adduction-abduction of the foot in the ankle joint was also

carried out in isolation with additional load in special four techniques, which were used only in the 4th phase of the complex of physical therapy.

At the end of the oriental massage procedure, in the absence of individual intolerance (excessive tickling or significant pain), Thai foot massage techniques were performed for all injured athletes - extension and pressure in the area of the joint space of the toes, the metatarsal surface of the foot and pressure on the active points of the toes and the sole of the foot (the so-called "plantar massage"), which were carried out according to the method of Thai massage Lambert (2005) [4].

The results of physical rehabilitation, obtained according to the LEFS scale, showed that after a course of physical rehabilitation according to the generally accepted program in the control group, the number of unsatisfactory results decreased by 11,1%, the number of satisfactory results did not change, and the number of good results slightly increased – by 11,1%. The results of evaluating the data of the main group convincingly indicate a significant increase in the number of good results, namely, 6.5 times, and a significant decrease in the number of satisfactory results - almost 2.3 times, and, especially, a decrease in the number of unsatisfactory results (almost 7 times), which shows the effectiveness of our proposed program of physical rehabilitation (Table 1, Figure 1).

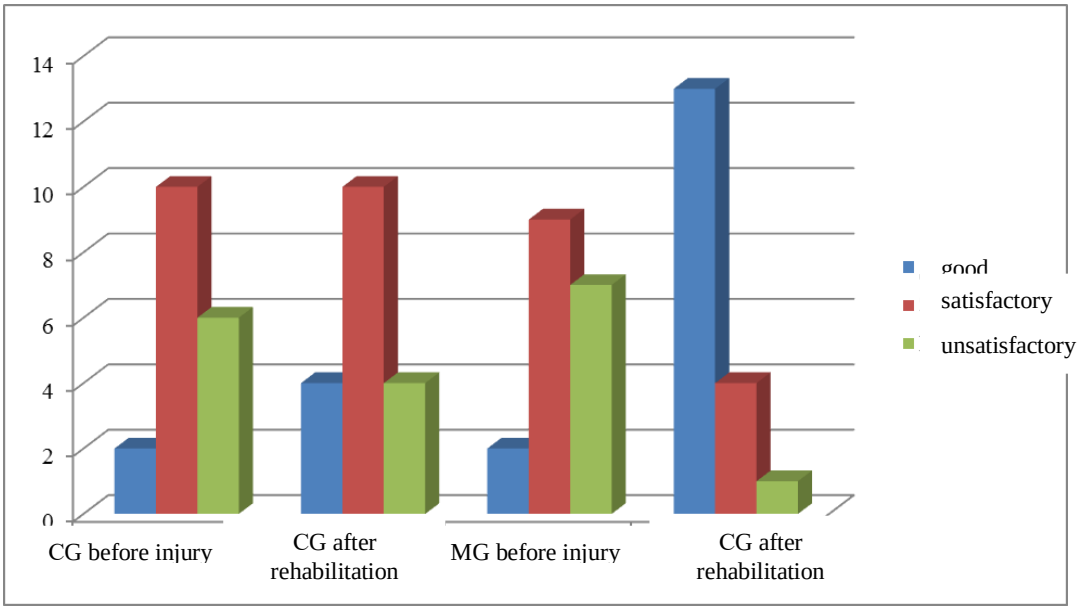

Fig. 1. Comparative results of rehabilitation measures for injured athletes of both clinical groups on the LEFS scale

Table 1

Results of physical rehabilitation of injured athletes, obtained according to the LEFS scale

Results	Control group				Main group			
	before reabilitation		after reabilitation		before reabilitation		after reabilitation	
	abs.	%	abs.	%	abs.	%	abs.	%
Good	2	11,1	2	22,2	2	11,1	13	72,2
Satisfactory	10	55,6	9	55,6	9	50	4	22,2
Unsatisfactory	6	33,3	7	22,2	7	38,9	1	5,6
Total	18	100	18	100	18	100	18	100

From the analysis of the assessment of the results of physical rehabilitation performed according to the method of A.V. Kalashnikov, it can be seen that after a course of physical rehabilitation according to the generally accepted program, the number of unsatisfactory results decreased by half, the number of satisfactory results decreased by 22.2%, and the number of good results doubled (up to 66,7%) (Table 2, Figure 2).

In the main group, there was a significant increase in the share of good results, namely, 2,1 times to 83,3%, due to which the number of satisfactory results decreased by half to 16,7%, in the absence of unsatisfactory results..

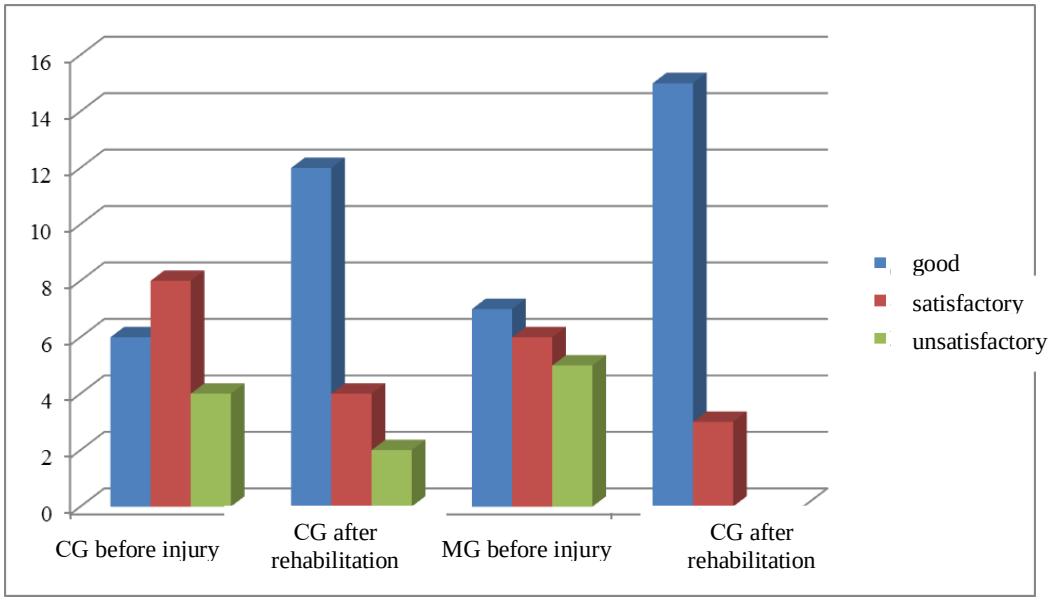

Fig. 2. Comparative results of assessing the orthopedic status of injured athletes of both clinical groups according to the method of A.V. Kalashnikov

Table 2

Results of physical rehabilitation of injured athletes, obtained by the method of A.V. Kalashnikov

Result	Control group				Main group			
	before reabilitation		after reabilitation		before reabilitation		after reabilitation	
	abs.	%	abs.	%	abs.	%	abs.	%
Good	6	33,3	12	66,7	7	38,9	15	83,3
Satisfactory	8	44,4	4	22,2	6	33,3	3	16,7
Unsatisfactory	4	22,2	2	11,1	5	27,8	-	-
Total	18	100	18	100	18	100	18	100

The analysis of the results of the performed physical therapy indicates that more pronounced positive results were obtained in the injured athletes of the main group who received physical therapy according to the program we proposed, with a positive dynamics of changes in the functional state of the injured athletes of both clinical groups.

In addition, in the victims of the main group, at the same time of observation, there were significantly better indicators than the control group, the indicators of the above methods and the scale of assessing the results, which indicates a pronounced positive dynamics of the condition of the injured athletes after the physical therapy program.

Conclusions / Discussion

It is generally accepted that the most important problem of modern physical therapy for injured athletes is the rapid and complete return of sports performance.

It is also known from many scientific sources that injuries of the ligamentous-capsular apparatus of the ankle joint in terms of prevalence rank second among all joint injuries and injured athletes need long-term treatment.

In this case, it is advisable to argue only about the choice of the tactics of physical therapy, depending on the nature of damage to the osteochondral structures of the joint. An effective return to active professional activity of injured athletes occurs provided that new treatment technologies are added to existing traditional approaches and methods of physical therapy to accelerate recovery processes. The authors of the study developed and tested a program of physical therapy, which

contained the methods of oriental massage in combination with the procedures of the oriental bath specifically for solving the problem of the fastest restoration of the proper functional state of qualified sportsmen football players and their return to productive professional activity.

The activities of the traditional program of physical therapy for injured athletes with the consequences of intra-articular injuries of the ankle joint, which included the use of classical massage techniques, according to the LEFS scale, reduced the number of unsatisfactory results by 11.1% in the control group, and the number of good results doubled to 22,2%.

The activities of the physical therapy program, which included the oriental massage technique in combination with the oriental bath for the athletes of the main group, increased the number of good results by 61,1%, which reduced the number of satisfactory results by 27,8%, and by 33,3% unsatisfactory results, which indicates on the objective effectiveness of the proposed physical therapy program.

The therapy program according to the traditional program allowed in the control group to reduce the number of unsatisfactory and satisfactory anatomical and functional results according to the method of A.V. Kalashnikov by 11,1% and 22,2%, respectively, and increase the number of good ones to 66,7%.

The athletes of the main group, according to A.V. Kalashnikov, the number of good results increased by 44,4%, due to which the number of satisfactory results decreased by 16,6%, and the absence of unsatisfactory results was recorded, convincingly demonstrates the advantages of the proposed physical therapy program.

To solve the problem of returning qualified athletes to active training and competitive activity, we have developed and objectively successfully implemented a program of rehabilitation measures using oriental massage techniques in combination with an oriental bath, can be recommended for general use.

Prospects for further research. Implementation of the proposed program of physical therapy for athletes with intra-articular injuries of the ankle joint using the procedures of a modified oriental bath and the sequential use of procedures with

elements of oriental massage in specialized healthcare institutions of Ukraine and Lebanon.

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Information about the Authors

Youssef Charbel: Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.
ORCID: https://orcid.org/0000-0002-4442-9509
E-mail: twintracker@gmail.com

Tetiana Podkopai: Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000-0002-7890-0215

E-mail: alicepodkopay@gmail.com

Denis Podkopai: PhD (Physical Education and Sport), Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000-0001-9845-7639

E-mail: frir@ukr.net

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FEATURES OF THE REHABILITATION MASSAGE FOR DYSFUNCTIONS OF THE FOREARM MUSCLES

Pavlo Yefimenko

Oksana Kanishcheva

Kharkiv State Academy of Physical Culture,

Kharkiv, Ukraine

Purpose: to find the possibility of rehabilitation massage, forearms in the presence of pain in their muscles.

Material and methods: the study was conducted in two stages. The first stage of observation was carried out by the current method. It was attended by 14 respondents. The reaction of the muscles of the inner surface of the forearms to one procedure of classical massage, which was performed with talcum powder on the corresponding tendons, was checked. Research methods were used: dynamometry, myotonometry. The second stage of the observation was attended by 7 respondents, musicians with hypertension and muscle pain of the inner surface of the forearm, which arose for various reasons. When visiting a doctor, they were advised to stay calm for up to one month, which did not suit them due to the hard work associated with executive activity. Therefore, all its participants also formed one observation group. The following research methods were used: Quadruple Visual Analogue Scale (VAS), myotonometry.

Results: the results of the first observation showed that after one procedure of muscle tendon massage, the difference between the tone of rest and the tone of tension of healthy muscles - contraction, increased by an average of 11,7%. And the average dynamometry of the same brush increased by 4%. The result of the second stage of the observation, conducted on the hands with complaints of muscle pain in

the forearm, after ten procedures of massage of the tendons, revealed a reduction in pain almost twice and a decrease in muscle hypertension by an average of 11,3%.

Conclusions: massage of tendons of pathological muscles gave reason to believe that the massage technique developed by us has an analgesic effect and significantly reduces the hypertonicity of muscle tissues. The obtained indicators of the tone of rest and the level of muscle pain confirm the positive effect of our proposed massage technique on the pathological condition of the forearm muscles and the possibility of their early rehabilitation.

Keywords: pathological muscles, rehabilitation massage, myotonometry, hand dynamometry, massage techniques.

Introduction

The professional activity of a modern person is associated with certain movements. Monotonous short movements, the number of which in a working day is tens of thousands, cause occupational diseases of the musculoskeletal system, which eventually lead to disability. Such a person is forced to slow down the production pace, and sometimes take a break for treatment and restoration of his professional ability to work.

Among the occupational diseases of the human musculoskeletal system, diseases of the upper extremities occur most often, the cause of which is constant overstrain. This side of occupational pathology includes a large number of certain painful forms that affect various tissues of the upper limb: muscles, bones, peripheral nerves. The most common pathology is focal hand dystonia. It mainly covers people who carry out highly coordinated brush movements with a significant excess of the number of stereotyped movements per working day. One of its forms, this is neural, which manifests itself during exercise in the form of sudden pain in the muscles, progressing on the forearm or shoulder [7, 9].

Among the professions that this pathology constantly covers, musicians are often found, especially those who play keyboards or string instruments. A musician must skillfully use the capabilities of the musculoskeletal and nervous systems of his

body. Playing a musical instrument requires controlled repetitive movements and often involves working in an unnatural posture during long hours of rehearsals and performances. Such loads on the body can lead to specific disorders of the musculoskeletal system. In addition, harsh working conditions: increased noise levels, extended periods of non-stop playing, and strenuous preparation for a new repertoire or instrument can affect the health of musicians of all ages and skill levels. [1, 7, 8].

All this in most cases leads to a state that musicians call "overplayed hands". In these cases, they begin to carry out certain rehabilitation measures. Massage is one of the common and effective measures of physical therapy in such situations. However, the presence of pain does not always allow this procedure to be carried out directly on such muscles and it is temporarily considered contraindicated.

According to experts in physical therapy, when carrying out rehabilitation massage in this direction, certain systems and methods of this procedure are used. So the classical system in most cases of the presence of pain syndrome of muscle tissues provides for a drainage massage above the localization of the inflammatory process, while maintaining a certain time after the onset of an exacerbation. And only after its decay, the pathological tissues are massaged directly [3, 10].

Specialists of the segmental-reflex massage system, using special techniques, influence the zones of hyperalgesia and hyperesthesia of muscle tissues by massaging the paravertebral zones of the spinal segments innervating pathological tissues. A well-known effect is also achieved by massaging symmetrical, healthy areas of the body. For example, limbs or torso [3, 5].

Specialists of local massage systems offer various point presses on certain areas of the human body. So, the founder of the Su-Jok therapy system Pak Gde Wu claims that local manual or instrumental massage of special zones of correspondence eliminates pain in various pathological conditions of tissues of the human somatovegetative systems. They make up the zones of projection on the hands and feet in the form of the systems "main", "insects" and "mini" [2]. In the presence of pain syndrome of muscle tissues, analgesic and relaxing effects are achieved by

performing acupressure, that is, acupressure of certain biologically active points, and prestating trigger zones [11, 14].

Among the hardware methods, vibration massage partially or completely eliminates pain in the muscles after physical overload and injuries. It is carried out with a manual vibration massager, which produces mechanical vibrations of a certain frequency. But during an exacerbation, it is also a contraindication to carrying out such a procedure [6, 10].

Studying literary sources, we drew attention to the statement of specialists, rubbing of connective tissues, namely muscle tendons, has a positive effect on the trophic processes of the muscles to which they are attached [13, 15]. According to our previous observations, during the massage of the Achilles tendon, a response was observed in the form of a decrease in skin temperature in the area of the gastrocnemius muscle and an improvement in its rest tone and tension [4].

In our case, we considered the possibility of obtaining a relaxing effect within a fairly short period of time, lasting up to 1 - 2 hours after the massage procedure. And therefore, all the recommendations presented do not solve this problem, due to the fact that their action is designed for a longer time.

Purpose of our study was to find the possibility of carrying out a rehabilitation massage of the forearms, in the presence of pain syndrome of their muscles.

Material and Methods of research

The first stage of observation was carried out by the current method in academic classes in the discipline "Massage" with 4th year undergraduate students, specialization 017 "Physical culture and sports", while studying the topic "Restorative massage in short breaks". The study involved 14 people, including 4 men and 10 women, who had no complaints about the pathological condition of the muscle tissue of the forearms. We tested the reaction of the muscles of the inner surface of the forearms on the corresponding tendons to one procedure of classic massage.

For clarity, we used the following research methods:

- dynamometry using a wrist dynamometer;

- myotonometry - with a mechanical myotonometer by analogy with the measurement of the "Sirmai" myotonometer, made on the basis of the ICh-1 dial indicator. Unlike the analogue, the double platform of this device allows, during repeated measurement, to apply it to the registration site with the same force and in any position in space. The probe with an area of 42 mm, depending on the density of the investigated tissues, under the action of an internal spring, was immersed into the soft tissues of the body to a certain depth. The full range of motion of the probe was 10 mm, taken as 100%. The depth of its immersion in superficial tissues is calculated as a percentage in relation to the full range of motion.

In the second stage of observation, 7 respondents took part - musicians with tissue hypertonicity and muscle pains of the inner surface of the forearm. The cause of the pain syndrome was professional activity. Four of them were guitarists, two were violinists and one pianist, members of musical groups, colleges and amateurs who voluntarily expressed a desire to take part in this study. When visiting a doctor, they were advised to leave their limbs alone for up to one month, they were not satisfied with the hard work associated with performing activities. At this stage, we used the following research methods:

- visual analogue scale of pain (Quadruple Visual Analogue Scale (VAS)). When assessing the intensity of pain according to the VAS, the respondents subjectively determined the intensity of their pain, pointing to a certain mark, which is located on a straight line 10 centimeters long. The beginning of the line on the left corresponds to the absence of pain, the end of the segment on the right side corresponds to unbearable pain;
- myotonometry.

Results of the research

The research was carried out in the following sequence. The position of the massaged person: sitting on a chair, forearms on the table with the back of the hand up. A point on the skin in the abdominal area of the muscle of the superficial flexor of the fingers was marked with a marker. At this point, the resting tone was measured. Then, at the moment of measuring the strength of the hand with a

dynamometer, the tension tone was recorded. An indicator of certain functional capabilities of the examined muscles was the difference between the resting tone and the tension tone - contraction. The larger it is, the higher the contractile ability of the muscles. All data were entered into the study protocol.

Then, the distal half of the inner surface of the forearm was massaged. Started by alternately stroking the entire surface. Then, slowly, without jerking, the tendons were rubbed from the wrist joint to the places of their attachment to the muscles. After that, the palmar surface of the entire hand was rubbed. An important condition during the rubbing technique was the maximum increase in skin mobility in the area of the massaged area. Stroking was repeated periodically and at the end of the procedure. The duration of the massage was the same for all participants - 4 minutes of the forearm and 2 minutes of the palmar surface of the hand. Immediately after this procedure, a second examination was carried out. Indicators of measurement results are presented in table 1.

Table 1

Results of the first stage of observation (n=14)

Respondent	Initial indicators before massage				Final indicators after the massage			
	Tone at rest %	Tone in tension %	Contraction %	Brush strength kg	Tone at rest %	Tone in tension %	Contraction %	Brush strength kg
Respondent 1 w	15,0%	24,0%	9,0%	19	12,1%	57,0%	44,9%	25
Respondent 2 w	16,0%	62,0%	46,0%	26	12,0%	66,8%	54,8%	28
Respondent 3 w	21,0%	42,0%	21,0%	21	15,0%	45,0%	30,0%	24
Respondent 4 w	17,0%	39,0%	22,0%	20	15,5%	47,4%	31,9%	24
Respondent 5 w	20,0%	57,5%	37,5%	21	19,0%	58,9%	39,9%	24
Respondent 6 w	15,7%	41,0%	25,3%	19	14,0%	50,1%	36,1%	23
Respondent 7 w	14,8%	39,0%	24,2%	19	13,5%	49,6%	36,1%	24
Respondent 8 w	18,0%	35,2%	17,2%	21	15,8%	47,8%	32,0%	25
Respondent 9 w	16,7%	33,6%	16,9%	20	15,0%	40,0%	25,0%	24
Respondent 10 w	19,0%	37,4%	18,4%	18	16,6%	40,0%	23.4%	23
Respondent 11 m	31,0%	69,3%	38,3%	42	27,5%	78,0%	50.5%	45
Respondent 12 m	26,0%	79,0%	53,0%	40	19,0%	80,0%	61,0%	43
Respondent 13 m	25,3%	70,2%	44,9%	42	20,0%	79,0%	59,0%	44
Respondent 14 m	25,2%	67,8%	42,6%	43	23,2%	78,8%	55.6%	45

At the first stage of observation, we obtained indicators that massage is aimed at connective tissues, namely, rubbing the muscle tendons of the inner surface of the

forearm, has a positive reflex effect on muscle tone both at rest and in a state of tension. At the same time, we did not take into account the possibility of performing other massage techniques, with a pathological condition of the muscles, namely hypertonicity and pain, are contraindicated before they are performed. [3, 5, 6].

Table 1 shows that after the massage according to the proposed method, the rest tone decreased by an average of 3%, and the state of tension increased by an average of 8.7%. The difference in the "Contraction" indicator indicates that the functional state of the examined muscles improved by an average of 11,7%.

Dynamometry indicators were confirmation that contraction positively affects the state of muscle performance by an average of 4 kg (table 1).

The second stage of observation, due to the impossibility of massaging the muscle tissue directly, was also performed in one group. Here, the main indicators of the condition of the muscle tissue were the intensity of pain and tone of rest.

The results of the questionnaire for VAS showed the presence of pain at the level of 5,42 ± 0,29 points with a maximum value of 10 points. Thus, the present pain syndrome found in musicians is a dysfunction of the forearm muscles and a significant cause of discomfort..

All of the above respondents received 10 daily classical massage procedures using a similar methodology for the first stage of observation. According to the main guidelines for classical massage, this procedure must be carried out gradually penetrating into the required depth of the massaged tissues, namely those that are the ultimate goal of the massage procedure. In our observation, the tissues to be influenced were anatomically superficial. Therefore, we used two main massage techniques: stroking and rubbing. Each of them had a specific functional purpose. Stroking by its mechanical action was directed at the skin. Its main action, in this case, was calculated on the adaptation of the tissues of the massaged surface to the hands by massaging and reflex pain relief due to friction of the hands on its surface.

The action of rubbing, in this case, was directed to connective tissues - tendons and their connections with the flexor muscles of the hand and fingers and attachment to the bones of the hand and fingers. When rubbing them, the intensity of the intake

was determined by the avoidance of significant pain sensations. Other massage techniques involve a greater intensity of movement performed by the massage therapist. Indeed, with a given state of muscle tissues, this will cause pain and, as a protective reaction, an increase in their hypertonicity..

On re-examination, all participants noted a decrease in pain intensity. Their pain score according to the VAS was 2,57 ± 0,29 points, that is, it decreased 2,1 times ($p < 0.05$). It should be noted that 57% of individuals rated pain at 2 points. Indicators of muscle tissue rest tone, which were used for observation, also decreased by an average of 11,3%. At the same time, five of them experienced a significant reduction in pain after 5-6 procedures, it was already a prerequisite for the continuation of their creative and professional activities (Table 2).

Table 2

Results of detecting the state of inflamed muscles before and after 10 procedures of massage of their tendons (n=7)

Respondent	Initial indicators before massage		Final indicators after the massage	
	Pain intensity according to the VAS scale, points	Tone at rest %	Pain intensity according to the VAS scale, points	Tone at rest %
Respondent 1	6	36,7 %	4	28.0 %
Respondent 2	6	38,3 %	3	25,5 %
Respondent 3	6	29,9 %	2	18,1 %
Respondent 4	5	29,8 %	2	17,6 %
Respondent 5	5	30,2 %	2	18,2 %
Respondent 6	4	28, 3 %	2	17,0 %
Respondent 7	6	37,9 %	3	27,5 %

Conclusions / Discussion

A study of the state of hypertonicity of the muscles of the forearms in representatives of professions associated with constant overstrain, confirmed the impossibility of early rehabilitation, namely massage, of inflamed painful tissues. However, given that connective tissues and, in particular, tendons are involved in the work of the muscular apparatus, we proposed to transfer massage manipulations to these tissues, which practically do not experience pain. At the first stage, we studied the reaction of healthy muscles of the inner surface of the forearms to a one-time massage of their tendons. This observation has shown that tendon massage has a

positive effect on the condition of muscle tissue, a decrease in resting tone indices - relaxation and an increase in tension tone - with maximum static stress. And the growing difference between these indicators - contraction, indicates an improvement in their functional state, which is confirmed by an increase in the indicator of hand dynamometry.

The second stage of the research, we carried out with the participation of musicians with "overplayed hands". Massage of the tendons of pathological muscles gave grounds to assert that the massage technique developed by us has an analgesic effect and significantly reduces muscle tissue hypertonicity. Indicators of resting tone and level of muscle soreness noted the positive effect of the proposed massage technique and the possibility of early rehabilitation.

Prospects for further research in this direction are in the development, verification and implementation of methods for professional dysfunctions of the muscles of the forearms based on various methods of massage and self-massage.

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Information about the Authors

Pavlo Yefimenko: PhD (Pedagogical Sciences), professor; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000-0003-4674-6919

E-mail: pavlo748@gmail.com

Oksana Kanishcheva: PhD (Physical education and Sport) assistant professor; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

ORCID: https://orcid.org/0000-0002-5030-5318

E-mail: oksanakan71@gmail.com

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IMPACT OF CROSSFIT EXERCISES ON THE LEVEL OF PHYSICAL PREPAREDNESS OF HIGH SCHOOL-AGE PUPILS

Anhelina Petrova

Kharkiv State Academy of Physical Culture,
Kharkiv, Ukraine

Purpose: to determine the degree of change in the level of physical fitness of the 10^{th}–11^{th} grade pupils under the influence of CrossFit exercises.

Material and methods: theoretical analysis and generalization of scientific-methodological literature; pedagogical testing, pedagogical experiment, and methods of mathematical statistics. The tests were used to determine the level of physical fitness of the 10^{th}–11^{th} grade pupils: raising straight legs in a hanging (number of times); running in place with the intensity of 70% from maximum to pronounced fatigue (s); "shuttle" run 4–9 m (s); run 60 m (s) and cross split (cm). The studied results were compared to norms and evaluated with a certain number of points. Statistical analysis: the study materials were processed using the licensed program Excel. The research involved 113 pupils of the 10^{th}–11^{th} grades.

Results: at the beginning of the school year, the stating research was carried out, according to which the "average" level (3 points) of physical fitness among 16–17-year-old pupils was established. According to the results of the primary research, pupils were divided into main and control groups for conducting the formative experiment. Pupils of the control groups were engaged by the generally accepted state program on physical education for 10–11 grades of general secondary education institutions, and the educational process on physical education of pupils of the main groups was supplemented by the variable module "CrossFit". According to researches obtained after the pedagogical experiment, it was established that the level

of physical fitness increased to “above the average” (4 points) in pupils of the main groups, and changes weren’t found on the assessment scale in the researched control groups. In the age aspect, there is mainly the improvement in results with age, both in main and control groups ($p>0,05$). The reliable prevarication of the data of boys, over the indicators of girls, was revealed, mainly, in the article ($p<0,05–0,001$).

Conclusions: the positive impact of CrossFit exercises on the level of physical fitness of the 10^{th}–11^{th} grade pupils of main groups was revealed.

Keywords: variable module, CrossFit, high school pupils, physical fitness, physical culture lessons, motor activity.

Introduction

Nowadays the problem of reducing the level of physical preparedness, and as a result of the health of young students, remains urgent. Several leading specialists [2, 6, 10, 11] note that, according to statistics, nearly 60% of older school-aged children have health abnormalities and low levels of physical preparedness. The main reasons for this problem are the peculiarities of education in a modern school, namely: an increase in the volume of educational information, intensification of the passage of material, modernization, and complication of educational programs. All this leads to an increase in mental load and a decrease in motor activity of children [5].

Physical culture is an effective means of compensating for the lack of motor activity of a modern pupil [2]. However, according to the results of several authors [1, 3, 15, 19, 22, 24] today, acting lessons are ineffective, uniform, insufficiently stimulating the curiosity of pupils for physical education and sports activities. Therefore, the problem requires the search for new interesting forms, innovative means, methods, and principles of improving the physical education system, increasing the volume and diversity of types of motor activity [1, 2, 4, 10].

The number of scientists pay considerable attention to optimizing the content of physical culture lessons [2, 11, 20, 21, 23, 25]. Numerous researches determined the positive impact of innovative types of motor activity on the physical preparedness of pupils of different age periods. So, N. Bazylevych, O. Tonkonoh (2017) found an

improvement in the level of physical preparedness of younger pupils under the influence of fitball aerobics; T. M. Bala, I. P. Masliak (2014) established a positive dynamics of indicators of the level of speed development under the influence of cheerleading exercises in the 5^{th}-6^{th} grade pupils; T. I. Suvorova, M. S. Moroz, A. H. Karabanov (2011) found that a tendency is reflected to improve physical preparedness data in high school-age pupils under the influence of athletic gymnastics classes. It should be noted that the analysis of literary sources showed the absence of scientific works that would raise the issue of the impact of CrossFit exercises on the level of physical preparedness of high school pupils. Thus, the above indicates the relevance and usefulness of the research.

The purpose of the research is to determine the degree of change in the level of physical preparedness of the 10^{th}–11^{th} grade pupils under the influence of CrossFit exercises.

Connection of the work with scientific programs, plans, topics. The research was carried out by the Thematic Plan of the research work of Kharkiv State Academy of Physical Culture for 2015–2020 on the topic "The improvement of the process of physical education in educational institutions of various profiles" (the state registration number is 0115U006754) and for 2020–2026. "The improvement of the process of physical education of various segments of the population" (the state registration number is 0120U101110).

Material and Methods of research

The following *methods* were used during the experiment: theoretical analysis and synthesis of scientific-methodological literature; pedagogical testing, pedagogical experiment, and methods of mathematical statistics.

The tests presented by L.P. Serhiienko [13; 14] and V. A. Romanenko [12] were used, namely: hanging straight leg raises (number of times); running in place with the intensity of 70% from maximum to pronounced fatigue (s); "shuttle" run 4x9 m (s); run at 60 m (s) and cross split (cm).

Statistical analysis: the study materials were processed using a licensed program Excel. Calculated: the arithmetic mean of the variation series ($\overline{X}$) – for the

characteristic of the population according to individual parameters; representativeness mistake (m) for determining the deviation of the arithmetic mean from the corresponding parameters of the general population; reliability of differences (p) – was calculated to establish the homogeneity of control and main groups, the degree of differences in indicators in the age aspect and changing the average values of the studied parameters in the main and control groups after the experiment with the help of Student's parametric criteria (t) with a significance level not lower than 0,05.

The research was carried out based on the secondary schools No. 146 and No. 57 of Kharkiv during the 2017–2018 school years. It was attended by 113 pupils of 16–17 years old, of which 2 main and 2 control groups were formed. The main groups included 59 pupils: the first group – 16-year-old boys and girls (n = 27), the second group – 17-year-old boys and girls (n = 32); control groups included 54 pupils: the first group - 16-year-old boys and girls (n = 21) and the second group – 17-year-old boys and girls (n = 33). All children who took part in the research were almost healthy and were under the supervision of a school doctor.

During the research, the preparedness of the control groups was engaged only in the generally accepted state program on physical culture for the 10^{th}–11^{th} grades of general secondary education institutions, and the educational process on physical education of pupils of the main groups was supplemented by the CrossFit variant module developed by us. CrossFit classes were held twice a week, according to the school schedule. The content of which included theoretical information, special physical training (elements of gymnastics, athletics and weightlifting, kettlebell, general development exercises), and technical training (specially picked up CrossFit exercises "Burpee", "Box Jump", "Farmer's Walk", "Good morning", "Bear crawl", "Floor wipers", "Burpee bench jump"., etc.). At the end of studying the CrossFit module, the pupils carried out a set of exercises in the facilitated conditions which consisted of special and technical elements of CrossFit, for the minimum period and with the specified quantity of rounds ("Cindy", "Annie", "Fran", etc.) [16].

During the classes, the age, sex, and anatomical-physiological features of the pupils were taken into account. The load and dosage increased gradually, taking into account the individual capabilities of pupils. CrossFit exercises were also included in the preparatory part of the lesson of other variable modules, in the system of organized breaks, and were given in the form of homework.

Results of the research

Considering the investigated indicators, reliable differences between the investigated data weren't found ($p>0,05$).

In the age aspect, it is determined mainly the improvement in results with age, both in main and control groups ($p>0,05$).

Comparing the results of the article, a reliable prevarication of the data of boys, over the indicators of girls are revealed, mainly ($p<0,05–0,001$), except the results of a cross split, where there is an opposite trend, that is, the indicators of girls are better than the data of boys and these changes are mainly reliable ($p<0,05–0,01$).

Determining the level of physical preparedness of pupils of senior school age, it was revealed that the results of the stating experiment indicate that in pupils of the study groups it corresponds to a score of 3 points, which indicates the "average" level. So, according to the level of force development, on average, there is a score – 2 points ("below the average" level); endurance – 3 points ("below the average" level); agility – 3 points ("average" level); speed abilities – 2 points ("below the average" level); flexibility – 3 points ("average" level).

After the introduction of the experimental technique, a significant improvement was revealed in all the investigated indicators, both in boys and in girls of the main groups (Table 1), and these differences are statistically significant ($p<0,05–0,001$). So, the increase in results reflecting the level of force development in the 10^{th}-grade boys was – 24,5%, the 11^{th}-grade – 23,7%; girls, 55,3 percent and 43,3 percent respectively; endurance – in the 10^{th}grade boys is 7,8%, in the 11^{th} grade – 6,4%; 25,6 percent and 21,4 percent respectively; dexterity - in the 10^{th}-grade boys is 3,1%, in the 11^{th}-grade – 8,0%; girls had 3,0 percent and 3,5 percent respectively; speed abilities – in the 10^{th}-grade boys is 3,1%, in the 11^{th}-grade – 2,1%; girls 9,5 percent

and 3,0 percent respectively; flexibility – for the 10th-grade boys is 10,6%, for the 11th-grade – 10,2%; for girls, 24,2% and 13,4%, respectively.

Table 1

Indicators of physical preparedness of main group pupils before and after the experiment

Grades / Sex		Groups			t	p
		n	***Before the experiment***	***After the experiment***		
			Indicators $\bar{x}$ ±m			
Hanging straight leg raises (number of times)						
10 grade	Boys	17	14,35±1,74	17,88±2,11	4,07	<0,001
	Girls	12	7,83±1,93	12,17±2,06	6,39	<0,001
11 grade	Boys	10	16,00±2,35	19,80±1,53	2,03	>0,05
	Girls	22	9,86±0,99	14,14±0,93	7,98	<0,001
Running in place with intensity of 70% from maximum to pronounced fatigue (s)						
10 grade	Boys	17	116,08±2,79	125,20±1,00	4,79	<0,001
	Girls	12	34,14±1,98	42,90±1,21	8,89	<0,001
11 grade	Boys	10	131,16±1,83	139,59±0,66	4,90	<0,001
	Girls	22	33,09±1,31	40,17±2,29	4,48	<0,001
"Shuttle" run 4-9 m (s)						
10 grade	Boys	17	9,91±0,19	9,60±0,20	3,43	<0,01
	Girls	12	11,38±0,14	11,03±0,14	3,79	<0,01
11 grade	Boys	10	9,81±0,16	9,02±0,07	5,21	<0,001
	Girls	22	11,14±0,17	10,75±0,20	3,29	<0,01
Run 60 m (s)						
10 grade	Boys	17	9,12±0,10	8,83±0,06	3,97	<0,01
	Girls	12	11,18±0,26	10,12±0,21	8,18	<0,001
11 grade	Boys	10	9,09±0,12	8,90±0,10	3,05	<0,05
	Girls	22	11,00±0,26	10,67±0,23	3,70	<0,001
Cross split (cm)						
10 grade	Boys	17	29,71±2,44	26,53±2,60	2,81	<0,05
	Girls	12	22,33±3,65	16,92±2,89	6,13	<0,001
11 grade	Boys	10	31,10±3,04	27,90±3,14	4,95	<0,001
	Girls	22	20,32±2,23	17,59±1,94	2,47	<0,05

Analyzing the studied indicators in the age and sex aspects obtained after the use of CrossFit exercises, it was found that the trend of differences remained unchanged compared to the initial data in pupils of the main groups, mainly.

Examining the performance of the control group pupils after the experiment, it was found that they also improved slightly, but these changes are not significant and aren't reliable (p>0,05). Thus, the increase in results ranged from 0,3% to 9,4%. It should be noted that there weren't changes from the original data by age and article.

When comparing the repeated data of main and control groups pupils (Table 2), significant primacy of results of main groups over control groups was

established. It should be noted that reliable differences are observed in the indicators of hanging straight leg raises of the 11th-grade pupils (p<0,05); running on the place with the intensity of 70% from maximum to pronounced fatigue of the 10th–11th-grade pupils (p<0,05; 0,001); "shuttle" run 4x9 m of the 11th-grade boys (p<0,001); run 60 m of the 10th-grade girls (p<0,01) and cross split of the 11th-grade girls (p<0,05).

Table 2

Comparison of physical preparedness indicators of pupils of main and control groups after the experiment

Grades	Sex	Groups				t	p
		n	***Main***	n	***Control***		
		Indicators $\bar{x}$ ±m					
Hanging straight leg raises (number of times)							
10 grade	Boys	17	17,88±2,11	10	13,70±1,34	1,67	>0,05
	Girls	12	12,17±2,06	11	7,91±1,31	1,74	>0,05
11 grade	Boys	10	19,80±1,53	17	15,12±0,86	2,67	<0,05
	Girls	22	14,14±0,93	16	10,19±1,25	2,54	<0,05
Running in place with intensity of 70% from maximum to pronounced fatigue (s)							
10 grade	Boys	17	125,20±1,00	10	121,04±1,57	2,23	<0,05
	Girls	12	42,90±1,21	11	33,85±1,24	5,22	<0,001
11 grade	Boys	10	139,59±0,66	17	131,24±1,53	5,01	<0,001
	Girls	22	40,17±2,29	16	34,31±1,70	2,05	<0,05
"Shuttle" run 4-9 m (s)							
10 grade	Boys	17	9,60±0,20	10	9,98±0,11	1,68	>0,05
	Girls	12	11,03±0,14	11	11,31±0,23	1,07	>0,05
11 grade	Boys	10	9,02±0,07	17	9,81±0,12	5,49	<0,001
	Girls	22	10,75±0,20	16	11,29±0,24	1,76	>0,05
Run 60 m (s)							
10 grade	Boys	17	8,83±0,06	10	9,01±0,12	1,35	>0,05
	Girls	12	10,12±0,21	11	11,35±0,37	2,92	<0,01
11 grade	Boys	10	8,90±0,10	17	9,13±0,15	1,30	>0,05
	Girls	22	10,67±0,23	16	11,16±0,34	1,22	>0,05
Cross split (cm)							
10 grade	Boys	17	26,53±2,60	10	28,80±4,72	0,42	>0,05
	Girls	12	16,92±2,89	11	20,55±3,87	0,75	>0,05
11 grade	Boys	10	27,90±3,14	17	31,35±2,92	0,81	>0,05
	Girls	22	17,59±1,94	16	23,38±1,96	2,09	<0,05

Determining the level of physical preparedness of older pupils, after the introduction of the variable module CrossFit into the physical education process, it was revealed that against the background of a significant and reliable improvement in the results, it increased by 1 point and became equal to a score of 4 points, which indicates the "above average" level. So, indicators of the level of development of force, endurance, dexterity, and flexibility on average correspond to a score of 4

points (“above the average” level), speed abilities – 3 points (“average” level). It should be noted that in the study control groups, the indicators remained unchanged, that is, changes weren’t observed on the assessment scale.

Thus, the results of the research indicate positive dynamics in the physical preparedness indicators of 16–17-year-old pupils of main groups, influenced by CrossFit exercises.

Conclusions / Discussion

According to the results of the research, it was established that CrossFit exercises in the process of physical education of the 10^{th}–11^{th} grade pupils contributed to improving the level of physical preparedness. Thus, considering the changes in the level of development of the maximum dynamic muscle strength of the abdominal press, the established mainly significant improvement both in boys and girls of the main groups, and these differences are statistically significant ($p<0,001$). The above is confirmed by the data of I. I. Zemtsova (2019) according to which it was revealed that muscle hypertrophy occurs during physical exertion of the force direction, as a result of adaptation-trophic exposure, characterized by an increase in thickness and a tighter packaging of contractile elements of muscle tissue. So, scientists T. M. Kravchuk, T. V. Karpunets, I. V. Stepanenko (2019), indicate that the introduction of functional exercises into the main part of the lesson contributed to a significant improvement in force abilities of high school pupils.

Analyzing the indicators of the level of endurance development obtained after the use of the variable module CrossFit, it was determined that the data improved significantly and are reliable in nature of differences ($p<0,001$) in pupils of the main groups. So, according to O. M. Khudoliy (2008), this is because the oxygen modes of the body under physical exertion become more economical at the studied age, the ability of the body to work “in debt” significantly increases, that is, anaerobic productivity increases.

Considering the indicators of coordination of movements obtained after the pedagogical experiment, it was revealed that they improved significantly and are reliable in nature of differences in pupils of senior school age in main groups

(p<0,01; 0,001). The above is confirmed by the data of I. I. Zemtsova (2019), according to which it is determined that the improvement of motor coordination to the level of adults continues, and the differentiation of muscle forces reaches the maximum level in 16-17 years. So, according to V. A. Berezovskyi (2016), it was established that under the influence of physical culture lessons with elements of sports orientation, the indicators of agility of high school pupils improved significantly.

Analyzing the level of development of the frequency of movements obtained after the introduction of CrossFit exercises, a significant and reliable improvement in data in pupils of the main groups was revealed (p<0,05–0,001). So, scientists Zh. K. Kholodov, V. S. Kuznetsov (2008) claim that classes in various sports affect positively the development of high-speed abilities.

Analyzing the indicators of the level of motor development in pelvis joints obtained after the experiment, it was determined that, they improved significantly and have a reliable nature of differences in pupils of the main groups (p<0,05; 0,001). According to I. I. Zemtsova (2019), it was determined that ossification of the skeleton hasn't been completed at this age yet, which provides a sufficiently high level of mobility and significant reserves available to improve flexibility, especially under the influence of systematic, dosed physical activity. Thus, our data are consistent with the indicators of V.U. Krendeleva (2015), according to which positive changes in the level of flexibility development in high school boys and girls are observed, under the influence of wellness fitness.

Thus, the conducted researches indicate the positive impact of CrossFit exercises proposed by us on the level of physical preparedness of the 10^{th}–11^{th} grade pupils.

Prospects for further research in this direction can be carried out by determining the level of physical health of high school pupils under the influence of CrossFit exercises.

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Information about the Authors

Anhelina Petrova: teacher of the department of theory and methods of physical education; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.
ORCID: https://orcid.org/0000-0001-6400-8624
E-mail: petrovaangelina@ukr.net

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PROFESSIOGRAM OF CONSTRUCTION SPECIALISTS AND THE STATE OF HEALTH OF STUDENTS MAJORING IN "CONSTRUCTION AND CIVIL ENGINEERING"

Tetiana Dereka

Serhii Melnyk

Sumy State Pedagogical University named after A. S. Makarenko,

Sumy, Ukraine

Purpose: to determine the professional profile of construction specialists and the state of health of students majoring in "construction and civil engineering".

Material and methods: theoretical analysis and generalization of scientific and methodical literature, questionnaire. The survey involved 24 teachers of construction specialties and 183 students majoring in "Construction and Civil Engineering" Sumy Construction College, Kharkiv College of Construction, Architecture and Design and Mariupol Construction College.

Results: the study identified the main means of recovery after work for construction professionals, such as: exercise, massage, baths, saunas.

Conclusions: it is established that professional and applied physical training helps in the effective development of professionally important physical qualities, prevention of injuries and occupational diseases.

Keywords: pre-higher education, student, teacher, health status, applied professional physical training, builder.

Introduction

Solving the problem of increasing interest and desire of students to exercise on a systematic basis and the development of their professionally important qualities is an important task today [2, 10, 12, 13, 16]. Vocational and applied physical training helps to solve this problem. The results of the analysis of special literature show that students do not have sufficient knowledge about the importance of health for everyday life and professionally important physical qualities necessary for their future work [3]. We note that during theoretical and practical classes on professional and applied physical training students form a positive attitude to their own health and increase the desire to regularly engage in physical culture and physical activity [1, 6, 14].

For rational selection of forms, methods and means of professional and applied physical training of future specialists of construction specialties of institutions of professional higher education it is necessary to take into account data of professional researches and level of health and psychophysical readiness of students [5, 9, 11].

In this regard, the study of important professional qualities of construction specialists, as well as the state of health of future professionals becomes especially relevant [7, 15].

Connection of the study with scientific programs, plans, topics. The work was performed in accordance with the consolidated plan of research work of the Department of Theory and Methods of Physical Culture of Sumy State Pedagogical University named after A.S. Makarenko for 2016-2020 on the topic "Theoretical and methodological foundations of physical education of different groups" (state registration number 0116U000900)

The purpose of study: to determine the professional profile of construction specialists and health status of students majoring in «Construction and Civil Engineering».

Material and Methods of research

Theoretical analysis and generalization of scientific and methodical literature, questionnaire. The survey involved 24 teachers of construction specialties and 183

students majoring in: «Construction and Civil Engineering», Sumy Construction College, Kharkiv College of Construction, Architecture and Design and Mariupol Construction College.

Research methods: theoretical analysis and generalization of scientific and scientific-methodical literature, questionnaire.

Organization of the research: a questionnaire survey of teachers and students of professional higher education institutions was conducted. Questionnaires by S. M. Kharchenko [8] and A. I. Kubatko [4] were used, adapted to the construction specialties of institutions of professional higher education. The questionnaire for teachers included 12 questions, for students 28 questions.

Results of the research

Teachers were asked to answer the questions of the questionnaire to determine the professional profile of construction professionals. As a result of the questionnaire of teachers, results were obtained on the means to be used to maintain high physical and mental performance and speed up the recovery process, most teachers believe that it is necessary to perform physical exercises (79,1%), 33% teachers are convinced that you need to attend a massage; 29,1% offer to sleep; to visit a bath, a sauna, consider it necessary – 25%; drink strong coffee – 12,5%; teachers do not recommend taking medicines without extreme necessity and without a doctor's permission. The predominant working posture of construction specialists is defined as standing work (83,3%), 41,7% attach importance to work in motion, and standing bent, and 33,3% allocate sitting position while working. According to the questionnaire, the fatigue of construction professionals is manifested by: apathy (50%), drowsiness and decreased concentration (20,8%), decreased coordination of movements and irritability (16,7%), low mood (54,2%), eye pain (12,5%), weakness and decreased attention (25%), headache (54,5%). The first reason for fatigue of construction professionals is nervous and emotional stress, the next reason is work in stress, and in third place was identified a great responsibility, which is followed by difficult working conditions and adverse weather conditions. According to teachers, the greatest load during the performance of production operations by specialists in

construction specialties falls on the muscles of the back. 66.7% of respondents think so, 50% of respondents believe that the muscles of the shoulder girdle take the maximum load together with the muscles of the back, 41.7% of teachers preferred the muscles of the lower extremities, and a large load falls on the muscles of the neck and eyes (33,3%).

Both teachers and students were asked to identify important physical and psychophysiological qualities for the professional activities of construction professionals. The results of a survey of teachers showed that such physical qualities as endurance and strength are important for the professional activities of construction professionals in first and second place, respectively. The following are coordination and flexibility. The least important teachers determine the speed. The results of a survey of students that the importance of physical qualities in the first and second place are respectively endurance and strength, following the importance of physical qualities in descending order of importance are as follows: coordination; speed; flexibility. In the questionnaire, it was proposed to determine the importance of each physical quality, where "1" was defined as the most important, and "5" the least significant physical quality for construction professionals (Table 1).

Table 1

Distribution of physical qualities by levels of importance for specialists in construction specialties (in points)

Physical qualities	*Teachers (n = 24)*	*Students (n = 183)*
Endurance	1	1
Strength	2	2
Coordination	3	3
Speed	5	4
Flexibility	4	5

Along with physical qualities, it is necessary to know and understand the important psychophysiological qualities necessary for the professional activity of construction specialists. First of all, according to the results of the questionnaire, operational thinking, attention and concentration are highlighted, the next most important teachers are emotional stability, logical thinking, distribution and switching

of attention, and the final ones are less important: balance and memory. In this questionnaire, respondents were also asked to determine the importance of each psychophysical quality, where "1" was defined as the most important quality, and "8" the least significant psychophysical quality for construction professionals (Table 2).

Table 2

Distribution of psychophysiological qualities by levels of importance for specialists in construction specialties (in points)

Psychophysiological qualities	*Teachers (n = 24)*	*Students (n = 183)*
Operational thinking	1	5
Attention	2	1
Concentration	2	3
Emotional stability	3	6
Logic of thinking	4	4
Distribution and switching of attention	5	7
Balance	6	8
Memory	6	2

In order to perform their professional duties at a high level, professionals must have good professional qualities, among which teachers attach the highest importance to organization. (83,3%), a little less, but also very important are: responsibility (79,2%), emotional stability (70,8%), attention (concentration, switching attention, volume and accuracy) – 66,7%, the ability to maintain multiple and diverse connections in the process (58,3%), ability to manage people (50%), verbal abilities (12,5%). Students among the important psychophysiological qualities put attention in the first place. The following qualities in descending order of importance are as follows: memory; concentration; logic of thinking; operational thinking; emotional stability; distribution and switching of attention; balance.

In the last question of the questionnaire, teachers were asked to answer the question of what helps professional-applied physical training (PAPT), and 80% of teachers surveyed believe that PAPT helps in the effective development of professionally important physical qualities, 70.8% believe that PAPT significantly helps in the prevention of injuries and occupational diseases. Respondents attach less

importance to the help of PPFP in the formation and development of abilities (organizational, communicative, etc.) – 33,3%, and in mastering the professional activity (29,2%).

According to the results of a questionnaire survey of students majoring in "Construction and Civil Engineering" established the following. First, in 33,3% of students of institutions of professional higher education in construction specialties, the state of health has recently deteriorated, at the same time it was found that the state of health remains unchanged in 47,1%, and only 19,6% feel improvement. students. Secondly, only 11,8% of the surveyed students consider their own health to be excellent, however, it was recorded that 39,2% consider their health to be good, 48,4% feel satisfactory, and 7,8% students who consider their own health unsatisfactory. Third, the survey showed that 51% of students get sick 1-2 times a year, 33,3% of respondents get sick 3-4 times a year there are even those students who get sick 5-6 times a year (7,8%), or even those who replied that they were not ill at all (5,9%). The surveyed students suffer from various diseases of which 72,5% have colds, 17,6% have diseases of infectious origin and rheumatic (5,9%) and production (7,8%) disease. Chronic diseases also occur in construction students mostly related to the respiratory system dominated by asthma.

Obviously, the health of students depends on their physical activity, including morning gymnastics and exercise during the day. But only 7,7% of students are constantly engaged in morning gymnastics and 21,1% spend physical education. Students who sometimes do morning gymnastics were also found (49%). 7,9% do not consider it necessary to do morning gymnastics and physical training, and 35,3% of respondents do not want to, other 25,5% do not do it due to fatigue. Some students (5,9%) do not have sufficient knowledge and skills for morning gymnastics and physical education. The results of the survey also showed that only 26% of respondents are constantly engaged in exercise, where at the same time 45,1% believe that it would be desirable to do but you can do without it and 11,8% of respondents are convinced that their health enough to do without physical culture at all, although 17.6% lead an active lifestyle (walking, hiking, etc.). The study also

showed that 31,4% of students know about the means of effective recovery, and some do not know at all (39,2%) or do not know enough (29,4%). Regarding the working posture during the day, it was found that 52,9% of students are sedentary, 41,2% of surveyed students identify their working posture standing, 11,8% of respondents are dominant standing, bending and 27,5% defined their working pose during the day - "in motion".

The results of the study show that students cover different distances from one kilometer to fifteen or more during the day, which is determined by their lifestyle. The vast majority of students walk from 5 to 10 km (45,1%), from 10 to 15 km pass 31,4%. At the same time, students who pass the least, from 1 to 5 km make 19,6% and those who pass the most, more than 15 km – 3,9%. It should be noted that students mostly have a medium (56,9%) and large (23,5%) degree of fatigue, and only a small number have a mild (17,6%). Also, a small number of students answered that they do not feel tired (2%). According to the results of the questionnaire, it was found that during the school day students usually feel tired at the end (41,2%), or after 4-6 hours from its beginning (37,3%), or even within one hour after (11,8%). Students of pre-higher education institutions in construction specialties experience the greatest fatigue on Monday (25,5%) and Thursday (23,5%) followed by Wednesday (17,6%) Friday (13,7%) and Tuesday (11,8%). When asked how fatigue manifests itself in students, the answers were different. Most respondents experience drowsiness (68,6%), eye pain (9,7%), as well as weakness (45,1%), headache (41,2%), irritability (39,2%), decreased mood (33,3%), concentration (25,5%), attention (23,5%), coordination of movements (9,8%). The reasons for their fatigue are mostly nervous and emotional stress (60,8%) and difficult working conditions (39,2%), a quarter of respondents feel tired due to work under stress (25,5%).

The results of the study showed that students when performing production operations experience the greatest load on the muscles of the back (58,8%), and slightly less experience the load on other muscles of the body: eye muscles (27,5%), neck 23,5%), lower extremities 19,6%) and shoulder girdle (17,6%). According to them, professional and applied physical training helps in the effective development of

professionally important qualities (43,1%); in the prevention of injuries and occupational diseases (33,3%); in the formation and development of abilities required by the leader (organizational, communicative, etc.) – 25,5%; in mastering professional activity (21,6%). It should be noted that the surveyed students attend physical education classes because it is an important component of their education in the educational institution, 39,2% are convinced of this, as well as to maintain their general physical fitness (35,3%) or because of the desire to strengthen their health (33,2%), physical shape and physique (33,4%). There are also students who come to physical education classes to: relax from other classes (17,6%); to participate in sports competitions (15,7%); relieve nervous tension, mental overload, negative emotions, stress (13,7%).

Conclusions / Discussion

The analysis of the questionnaire survey of teachers allowed to determine the important professional, physical and psychophysiological qualities of specialists in construction specialties. The most important are: organization as a professional quality; endurance and strength as physical qualities; operational thinking, attention and concentration as psychophysiological qualities.

The questionnaire survey of students allowed to determine that students have a mostly sedentary lifestyle. A large number of students have frequent and chronic diseases, mainly with the respiratory system. A large percentage (33,3%) of students surveyed experience a deterioration in their own health due to frequent fatigue, which is manifested mostly by drowsiness and general weakness. It was also found that students are not sufficiently aware of the means of effective recovery after work.

The results of the study show that most graduates of vocational higher education institutions have a low level of psychophysical readiness for work.

Prospects for further research: consist in the development of the author's experimental curriculum, professional and applied physical training, students of construction specialties of institutions of professional higher education.

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Information about the Authors

Tetiana Dereka: Doctor of Sciences (Pedagogical), Associate Professor; Sumy State Pedagogical University named after A. S. Makarenko: Sumy, Romenskaya str. 87, 40002, Ukraine.
ORCID: https://orcid.org/0000-0003-0998-1821
E-mail: 24tetiana01@ukr.net

Serhii Melnyk: graduate student; Sumy State Pedagogical University named after A.S. Makarenko: Sumy, Romenskaya str. 87, 40002, Ukraine.
ORCID: https://orcid.org/0000-0002-7742-0690
E-mail: sergeymelnick2016@gmail.com

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Svetlana STADNYK

Publication of Kharkiv State Academy of Physical Culture

Kharkiv State Academy of Physical Culture
Ukraine, 61058, Kharkiv, 99 Klochkivska Street
+38 (057) 705-23-01
slobozhanskyi.nsv@khdafk.com