ISSN (English ed. Online) 2311-6374
ISSN (Ukrainian ed. Print) 1991-0177
ISSN (Ukrainian ed. Online) 1999-818X

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
KHARKIV STATE ACADEMY OF PHYSICAL CULTURE

SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

Scientific and theoretical journal

Published 6 times in a year
English ed. Online published in October 2013

№ 4(60)

Kharkiv
Kharkiv State Academy of Physical Culture
2017

P 48
UDC 796.011(055)”540.3”

Slobozhanskyi herald of science and sport : [scientific and theoretical journal]. – Kharkiv : KSAPC, 2017. – № 4(60). – 106 p.

English version of the journal “**SLOBOZANS`KIJ NAUKOVO-SPORTIVNIJ VISNIK**”

The journal includes articles which are reflecting the materials of modern scientific researches in the field of physical culture and sports.
The journal is intended for teachers, coaches, athletes, postgraduates, doctoral students research workers and other industry experts.

Contents Themes:

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Publication of Kharkiv State Academy of Physical Culture
Publication language – English.

The journal is included in the list of professional publications in Ukraine, which may publish results of dissertations (Decree of Presidium of SCADT Ukraine:
№3–05/11 from 10.11.1999.
№1–05/34 from 14.10. 2009.
Order Ministry of Education and Science of Ukraine №1081 from 29.09.2014.
Certificate of State Registration – КВ №12221-1105Р from 17.01.2007).

ISSN (English ed. Online) 2311-6374
ISSN (Ukrainian ed. Print) 1991-0177
ISSN (Ukrainian ed. Online) 1999-818X
Key title: Slobozhanskyi herald of science and sport
Abbreviated key title: Slobozhanskyi her. sci. sport

SLOBOZANS'KIJ NAUKOVO-SPORTIVNIJ VISNIK

scientific and theoretical journal №4(60), 2017

CONTENT

SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 796.012.13:797.12

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 5-13

Swiftness movement evaluation criteria in women's rowing

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Purpose: *to develop criteria for assessing the speed capabilities of the rate of movement, time and speed of one movement, the frequency of movements that ensure the performance of motor actions in certain conditions of a specific period of time.*

Material & Methods: *the girls, students of the Higher School of Physical Culture and university students, specializing in rowing, various age groups and sports qualification were surveyed, all 73 athletes. According to the method of measuring the effect of the training action developed by us, we studied the speed capabilities that characterize the manifestation of the quality of swiftness. On a special stand athletes made hand movements from the target to target. In the first period of the test, with a duration of 15 seconds, the athletes were to gain maximum speed; in the second period, with a duration of 60 s, it was necessary to maintain the achieved speed – distance velocity was investigated; in the third period – 15 seconds, speed endurance was determined – the athletes were supposed to perform the motor task with the maximum speed. The rate, time and speed of single movement, the frequency of movements were determined, and sensorimotor responses to sound and light stimuli were studied in modeling the conditions of training and competitive activity.*

Result: *formation and improvement of motor abilities in specific age ranges is caused by high rates of development of morphological and functional indicators in sensitive periods. Obtained results characterize the individual psycho-physiological characteristics of the athlete's body in the context of modeling sports activities, show a different reaction in the observed age groups, a different level of sports qualification, which makes it possible to make adjustments in improving the speed abilities and effectively manage the training process.*

Conclusion: *based on a comparative analysis of the studies that carried out, criteria were developed for assessing the physical quality of swiftness and its components (rate, time and speed of single movement, the frequency of movements). The proposed technique for investigating the effect of a training action can be applied for the purposeful study and development of physical quality of swiftness in the training process, as well as to determine the prospects of athletes and use as one of the constituent parts of the selection methodology at various stages of improving sports training and perfecting the level of sports qualifications.*

Keywords: *rate, time and speed of one movement, the frequency of movements, time of sensorimotor reactions to sound and light stimuli.*

Introduction

The effectiveness of work aimed at the development of various high-speed qualities depends not only on the methodology and organization of the pedagogical process, but also on the individual rates of development of this quality. With the directed development of high-speed quality in the period of accelerated development, the pedagogical effect is much higher than in the period of slow growth. Therefore, it is expedient to carry out directed development of speed abilities in children in those age periods when their most intensive growth is observed [4; 6].

Swiftness is a complex physical quality of a person – it is the ability of a person to perform a motor action in the minimum period for these conditions with a certain frequency and impetuosity. The physiological basis of swiftness is the lability of the neuromuscular apparatus, and the importance of the swiftness of mobility of the nervous processes [9].

Swiftness – physical quality, which is very diverse and specific manifested in various motor actions of person. The swiftness of the motor reaction is expressed, which is expressed by the time from the moment when the person saw the light or heard the sound signal, before the movement, and also – swiftness of movement, that is speed with which there is a signal switching off. Between these forms there is no close relationship: a person can have a very fast reaction and at the same time a relatively slow speed of movements and vice versa [5].

The swiftness of movement is primarily determined by the appropriate nervous activity, causing tension and relaxation of the muscles, directing and coordinating movements. It largely depends on the perfection of sports equipment, strength and elasticity of muscles, mobility in the joints, consistency of the activity of muscle-antagonists at the maximum frequency of alternation of processes of excitation and inhibition, the degree of possession of technical methods, and in continuous work – from the athlete's endurance [7; 8].

Swiftness is manifested in the ability to overcome a certain distance in the shortest period of time, as well as in the impul-

siveness, sharpness of single or repeated movements. Between these forms of manifestation of speed there is a connection, but there is no direct dependence.

Speed abilities are individual features that determine the level of motor abilities of a person associated with the success of any motor activity. Ability – it is a function with a peculiar form of manifestation, with different for each individual makings, one of which are genetically conditioned typological features of the manifestation of the properties of the nervous system, very little and with great difficulty changing under the influence of living and working conditions. At the same time, such individual characteristics as maximum oxygen consumption, high mobility of nervous processes, and speed of thinking or trunk length are reflected in the resultant side of activity. At certain age periods, especially favorable for the development of certain motor qualities, it is necessary to carry out work aimed at the development of high-speed qualities, strength, speed, endurance and other motor abilities of children, which gives the most visible effect [1; 8].

The use of high-speed and speed-strength exercises in school age is determined by indicators of morphofunctional development of children, which characterize the sufficiently high capabilities of their body, the close relationship between the formation of functional systems and physical preparedness [2; 9].

Improving the swiftness of movement, increasing the speed of implementation of integral motor acts are closely related to the enhancement of the functional capabilities of the athlete's organism, which determine the speed characteristics in various forms of motor activity [4; 7].

The physiological mechanism of manifestation of swiftness, associated with the speed characteristics of the nervous processes, is realized as a multifunctional property of the central nervous system and peripheral neuromuscular apparatus [8; 9].

Purpose of the study: to develop criteria for assessing the speed capabilities of the rate of movement, time and speed of one movement, the frequency of movements that ensure the performance of motor actions in certain conditions of a specific period of time.

Material and Methods of the research

Surveyed women of different ages, students of the Higher School of Physical Education and students of universities specializing in rowing. First group (young) – age 13–14 years, 27 people, 2 sports category; Second group (medium) – 15–16 years, 25 people, 2 and 1 sports category; third group (senior) – 17–18 years, 21 people, first-rank sportsmen and candidates for master of sports. According to the method of measuring the effect of the training action developed by us, we studied the speed capabilities that characterize the manifestation of swiftness quality. On a special stand athletes made hand movements from the target to the target. in the first period of the test, with a duration of 15 s, the athletes were to gain maximum speed; in the second period, with a duration of 60 s, it was necessary to maintain the achieved speed – distance velocity was investigated; in the third period – 15 s, speed endurance was studied – the athletes were supposed to perform the motor task with the maximum speed. Sensory motor responses to sound and light stimuli were also studied. In detail, the research methodology was published in the "Slobozhanskyi herald of science and sport", 2015, No. 4(48), pp. 15–20 [3].

Results of the research and their discussion

The conducted observations (Table 1) showed that the time of sensorimotor reaction to a sound stimulus in athletes aged 13–14 years was more by 0,012 s or 6,06% compared to 15–16-year-olds and 0,024 s or 11,43%, compared to 17–18-year-olds; sensorimotor response time to the light stimulus in the younger group was greater by 0,042 s or 19,35% than in the middle group and by 0,056 s or 27,59% than in the older group. The time of sensorimotor reactions decreased, therefore, the response to sound and light stimuli improved with increasing age and sports qualification.

When determining the effect of the training action in the first period of 13–14 years, the rate was less by 3,7 movements (16,59%) than at 15–16 years, and by 4,7 movements (21,08%) than at the age of 17–18 years; last group showed an increase in the tempo from the previous one by one movement (3,85%). The difference in the deviation from the average was 13–14 years at the most 3.7 movements (16,59%) and minimally 4,3 movements (23,89%); in 15–16 years the best result is more for 11 movements – 42,31% and the worst – for 7 movements less – 36,84%; in 17–18 years the indicator is more than the average for 4 movements – 14.81% and less for 5 movements – 22,72%. The number of movements from the youngest to the older age group increases, however, deviations from the average are noted, more pronounced in 15–16 years, the difference was 79,15%, and at 13–14 years – 40,48% and 17–18 years – 37,53%. These results characterize the unequal reaction of athletes of all ages, especially at the age of 15–16, as well as a different level of athletic preparedness for all athletes, especially at 13–14 and 17–18 years.

The time of one movement in girls aged 13–14 was greater by 0,096 s (16,67%) than at 15–16 years, and by 0.117 s (21,08%) than at 17–18 years. The difference between the senior and middle groups was 0,021 s (3,78%). Deviation in the younger group from the average was in the direction of improving the result – by 0,095 s (16,46%) and deterioration - by 0,161 s (23,96%), at 15–16 years the best result was 0,171 s (42,22%) And the worst – on 0,129 s (22,39%), in 17–18 years the best result was at 0,072 s (14,91%) and the worst result – by 0,126 s (22,70%). The time of one movement from the younger age group to the older one decreases, which characterizes the improvement of one of the speed indicators. Deviations from the average indicator are more pronounced in 15–16 years, the difference was 65,61%, at 13–14 years – 40,42%, at 17–18 years – 37,61%.

The speed of one movement in the first group was less than in the second group by 0,074 $m \cdot s^{-1}$ (16,59%) and by 0,094 $m \cdot s^{-1}$ (21,07%) than in the third group, in the second group compared to third less on 0,020 $m \cdot s^{-1}$ (3,85%). At 13–14 years, the maximum speed was observed at 0,074 $m \cdot s^{-1}$ (16,59%) more than the average, the minimum speed is less than the average for 0,086 $m \cdot s^{-1}$ (23,89%). The best result of the first group was the same with the average of the second group. In athletes aged 15–16 years, the highest speed exceeded the average by 0,221 $m \cdot s^{-1}$ (42,5%), minimum speed was less

Table 1

Indicators of physical quality of swiftness (women's, rowing)

Indicators			Age								
			13–14 year-olds			15–16 year-olds			17–18 year-olds		
			M±m	M_{max}	M_{min}	M±m	M_{max}	M_{min}	M±m	M_{max}	M_{min}
Effect of training action	First period	rate (number of movements)	22,3±0,99	26	18	26,0±1,25	37	19	27,0±1,26	31	22
		time of one movement (s)	0,672	0,577	0,833	0,576	0,405	0,705	0,555	0,483	0,681
		speed of one movement ($m \cdot s^{-1}$)	0,446	0,520	0,360	0,520	0,741	0,425	0,540	0,621	0,441
		frequency of movement	1,48	1,73	1,20	1,73	2,47	1,27	1,80	2,07	1,47
	Second period	rate (number of movements)	102,5±5,82 (25,5±1,45)	135 (33,75)	88 (22)	116,0±2,23 (29,0±0,55)	128 (32)	92 (23)	120,0±6,73 (30±1,68)	148 (37)	100 (25)
		time of one movement (s)	0,585	0,445	0,682	0,517	0,469	0,652	0,500	0,405	0,600
		speed of one movement ($m \cdot s^{-1}$)	0,512	0,674	0,439	0,580	0,639	0,475	0,600	0,741	0,500
		frequency of movement	1,71	2,25	1,47	1,93	2,13	1,53	2,0	2,47	1,67
	Third period	rate (number of movements)	27,4±0,61	35	22	30,5±1,39	44	24	31,8±1,26	36	27
		time of one movement (s)	0,547	0,429	0,682	0,491	0,341	0,625	0,471	0,417	0,556
		speed of one movement ($m \cdot s^{-1}$)	0,548	0,699	0,439	0,610	0,879	0,480	0,636	0,719	0,559
		frequency of movement	1,82	2,33	1,47	2,03	2,93	1,6	2,12	2,4	1,80
	Summary	rate (number of movements)	152,0±3,06 (25,3±1,01)	196 (32,6)	131 (21,8)	172,0±7,52 (28,6±1,25)	244 (40,6)	136 (22,6)	178±6,17 (29,6±1,02)	217 (35,8)	173 (24,8)
		time of one movement (s)	0,592	0,460	0,687	0,523	0,369	0,662	0,505	0,415	0,612
		speed of one movement ($m \cdot s^{-1}$)	0,506	0,652	0,437	0,573	0,753	0,453	0,594	0,723	0,500
		frequency of movement	1,69	2,17	1,45	1,91	2,51	1,51	1,97	2,41	1,65
Time of sensorimotor reaction											
	Sound		0,210±0,044	0,199	0,222	0,198±0,006	0,152	0,239	0,186±0,005	0,159	0,198
	Light		0,259±0,017	0,200	0,340	0,217±0,005	0,167	0,247	0,203±0,011	0,165	0,248

than the average speed by 0,095 $m \cdot s^{-1}$ (22,35%). For rowers at 17–18 years, the maximum speed was greater than the average by 0,081 $m \cdot s^{-1}$ (15,01%), and minimum speed is less than the average speed 0,99 $m \cdot s^{-1}$ (22,45%). Deviations from the average index of the highest 64,85% in 15–16 years, significantly less in 17–18 years, which amounted to 37,46% and slightly less than 40,22% in 13–14 years.

The frequency of movement of the surveyed athletes increased with age. In the 15–16 years was more by 0,25 Hz (16,89%), and at 17–18 years by 0,32 Hz (21,62%) than at 13–14 years, at 17–18 years of age this figure was higher than in 15–16 years 0,07 Hz (4,05%). In the younger group, the maximum frequency of movements was greater than the average value by 0,25 Hz (16,89%), the minimum – less than the average 0,28 Hz (23,33%). In the middle group, the highest frequency of movements at 0,74 Hz (42,77%) exceeded the average, the smallest frequency of movement at 0,46 Hz (36,22%) was less than the average value. In the senior group, the best indicator was greater than the average value by 0,27 Hz (15,01%), and the worst – less than the average 0,33 Hz (22,45%). Deviations from the average indicator were 40,22% in the first group, 78,99% in the second group, and in the third group – 37,46%.

In the second period of the study of the effect of training action, the rate of athletes at 13–14 years was less than in 15–16 years for 3,5 movements (13,73%) and even less than in 17–18 years – 4,5 movements (17,65%). In the older group, the rate was greater than in the middle group, for one movement (3,45%). The deviation from the average of 13–14 years was according to the maximum indicator – 8,25 movements (35,35%), the minimum indicator – 3,5 movements (15,91%); in 15–16 years for the best result – 3 movements (10,34%), for the worst – 6 movements (26,09%); in 17–18 years, according to the highest score – 7 movements (23,33%), at the lowest – 5 movements (20%). The difference in the rate between the maximum and minimum values compared with the average results was observed in 13–14 years – 48,26%, in 15–16 years – 36,43%, in 17–18 years – 43,33%.

The time of one movement in the first group was greater than

in the second group by 0,068 s (13,15%) and more than in the third, by 0,085 s (17%), and in the second group more than in the third group by 0,017 s (3,4%). In the first group, the best result differed from the average by 0,14 s (31,46%), the worst – by 0,097 s (16,58%). In the second group, the best time was less than the average for 0,048 s (10,23%) and the worst time is more than the average for 0,135 s (26,11%). In the third group, the best time for one movement is less than the average for 0,095 s (23,46%), the worst time is more than the average for 0,100 s (20%). The difference in the time index of one movement between the maximum and minimum values was in 13–14 years 48,04%, 15–16 years – 36,34%, 17–18 years – 43,46%.

The average speed of one movement in the group of female athletes aged 17–18 was more by 0,020 $m \cdot s^{-1}$ (3,45%) than in 15–16-year-olds, and by 0,088 $m \cdot s^{-1}$ (17,19%), than in 13–14-year-olds. In the younger age group, the maximum speed was greater than the average by 0,162 $m \cdot s^{-1}$ (31,64%), and the minimum speed was less by 0.073 $m \cdot s^{-1}$ (16,63%); in the middle group, the maximum speed exceeded the average by 0,059 $m \cdot s^{-1}$ (10,23%), and the minimum was less than the average on 0,105 $m \cdot s^{-1}$ (22,11%); In the older group, the maximum speed was determined more than the average speed by 0,141 $m \cdot s^{-1}$ (23.5%), and the minimum – less than the average 0,100 $m \cdot s^{-1}$ (20%). The difference in the rate of one movement between the maximum and minimum results was in 13–14 years – 48,27%, 15–16 years – 32,34%, in 17–18 years – 43,5%.

The frequency of movements in 13–14 years was compared with a 15–16-year less at 0,22 Hz (12,87%) and 17–18-year 0,29 Hz (16,96%), the last group by this indicator exceeds previous on 0,07 Hz (3,63%). In the first group, the maximum frequency of movements was determined more than the average value by 0,54 Hz (31.58%), the minimum – less than the average 0,24 Hz (16,32%). In the second group, the best result was greater than the average of 0,2 Hz (10,36%) and the worst – less than the average 0,4 Hz (26,14%). In the third group, the maximum indicator was greater than the average value by 0,47 Hz (23,5%), the minimum - less than the average by 0,33 Hz (19,76%). Fluctuations between the best and worst indicators were in 13–14 years – 47,9%, in 15–16 years – 36,5%, in 17–18 years – 43,26%.

In the third period of the test of determining the effect of the training action, when comparing the three age groups, the lowest rate was observed at 13–14 years, at 15–16 years it was increased by 3,1 movements (11,31%), in 17–18 – on 4,4 movements (16,06%) and compared with 15–16-year-olds – on 1,3 movements (4,26%). The maximum rate of 13–14 years was above the average by 7,6 movements (27,74%), and the minimum - less than the average by 5,4 movements (24,55%). In the 15–16 years the best indicator was determined above the average by 13,5 movements (44,26%), the worst – below the average by 6,5 movements (27,08%). In 17–18 years the maximum index exceeded the average by 4,2 movements (13,21%), and the minimum was below the average by 4,8 movements (17,78%). There was a difference in the fluctuations s between the maximum and minimum values in 13–14 years – 52,29%, in 15–16 years – 71,34%, in 17–18 years – 30,99%.

The time of one movement was 13–14 years more than at 15–16 years by 0,56 s (11.41%), at 17–18 years – by 0,076 years (16,14%), in the older group compared to average this indicator decreased by 0,02 s (4,25%). In the first group, the best result differed from the average by 0,118 s (27,51%) and the worst by 0,135 s (24,68%), in the second group the difference in the best time from the mean was 0,15 s (43,99%) and the worst – 0,134 s (27,29%), in the third group, respectively – 0,054 s (12,95%) and 0,085 (18,05%). The difference in the time index of one movement between the maximum and minimum results was noted in 13–14 years – 52,19%, in 15–16 years – 71,28%, in 17–18 years – 31,0%.

Speed of one movement in the 13–14 years was less than in the 15–16 years by 0,062 $m \cdot s^{-1}$ (11,31%) and less than in the 17–18 years by 0,088 $m \cdot s^{-1}$ (16,09 %), and in the middle group it is less than in the senior group on 0,026 $m \cdot s^{-1}$ (4,26%). In the first group, the maximum speed exceeded the average by 0,15 $m \cdot s^{-1}$ (27,55%), and the minimum was less than the average 0,109 $m \cdot s^{-1}$ (24,83%). In the second group, the fastest speed was 0,269 $m \cdot s^{-1}$ (44,09%) above the average and the lowest – below the average by 0,13 $m \cdot s^{-1}$ (27,08%). In the third group, the best speed is greater than the average by 0,083 $m \cdot s^{-1}$ (13,05%) and the worst speed is less than the average on 0,077 $m \cdot s^{-1}$ (13,77%).

Frequency of movement in female athletes in 13–14 years was less than in 15–16 years at 0,21 Hz (11,54%), at 17–18 years – at 0,30 Hz (16,48%), and in 15–16 years less than in the 17–18 years, on 0,09 Hz (4,43%).

In the first group, the maximum frequency of movements was greater than the average value by 0,51 Hz (28,02%) and the minimum frequency was less than the average by 0,35 Hz (23,81%); in the second group, respectively – by 0,90 Hz (44,33%) and 0,43 Hz (26,87%), in the third group the best result is more than the average for 0,28 Hz (13,21%) and worst – was less than the average on 0,32 Hz (17,79%). Differences between the maximum and minimum results for the frequency of movements were in 13–14 years 51,83%, in 15–16 years – 71,20%, in 17–18 years – 31,0%.

On the total score of the test for determining the effect of the training action, the following data were obtained. At 13–14 years, the rate was less than 15–16 years, 3,3 movements (13,04%), and less than in the 17–18 years by 4,3 movements (6,99%), and in 15–16 years less than in 17–18 years, for 1 movement (3,49%). In the first group, the best result was above the average by 7,3 movements (28,85%) and the worst – below the average by 3,5 movements (16,06%); in the second group the maximum index is more than the average for 12 movements (41,96%) and the minimum – less than the average for 6 movements (26,55%); in the third group, the highest result exceeded the average by 6,2 movements (20,95%) and the smallest was less than the average by 4,8 movements (19,35%). Difference in the total result of the rate between the maximum and minimum values in comparison with the average indicator was determined in 13–14 years – 44,91%, in 15–16 years – 68,51%, in 17–18 years – 40,3%.

The time of one movement in the first group was more than in the second group by 0,069 s (13,19%) and than in the third by 0,087 s (17,23%), and in the second one more than in the third – на 0,018 s (3,56%). At 13–14 years, deviations from the average value were for the better, i.e., the decrease in the time of one movement by 0,132 s (28,69%) and the increase in time by 0,095 s (16,05%), at 15–16 years The best

result differed from the average – by 0,154 s (41,73%) and the worst – by 0,139 s (26,58%), at 17–18 years respectively – by 0,009 s (21,69%) and 0,107% s (21,19%). The difference in the time of one movement from the mean value over the maximum and minimum indicators was noted in 13–14 years 44,74% in 15–16 years – 68,31%, in 17–18 years – 42,88%.

The speed of one movement among female athletes in 13–14 years less than in 15–16 years, by 0,067 $m \cdot s^{-1}$ (13,24%) and, by 17–18 years – by 0,088 $m \cdot s^{-1}$ (17,39%), and 15–16 years less than in the 17–18 years, on 0,021 $m \cdot s^{-1}$ (3,67%). In the younger age group, the total maximum speed is greater than the average by 0,126 $m \cdot s^{-1}$ (28,85%), the minimum is less by 0,069 $m \cdot s^{-1}$ (15,79%); in the middle group, respectively – 0,244 $m \cdot s^{-1}$ (42,58%) and 0,120 (26.49%); in the senior group the best result is greater than the average by 0,129 $m \cdot s^{-1}$ (21,72%), the worst – 0,094 $m \cdot s^{-1}$ (18,81%). The deviation of the speed of one movement in total for the best and the worst indicator was in 13–14 years – 44,64%, in 15–16 years – 69,07%, in 17–18 years – 40,53%.

The frequency of movements in the sum of the three stages of the test was 13–14 years less than at 15–16 years, 0,22 Hz (13,01%) and, at 17–18 years, at 0,28 Hz (16,57%), and 15–16 years less than in the 17–18 years, on 0,06 Hz (3,14%). In the first group, the maximum indicator is 0,48 Hz higher than the average (28,41%), minimum indicator is less by 0,24 Hz (16,55%);in the second group, the best result exceeds the average by 0,80 Hz (41,88%), worst – less than the average by 0,40 Hz (26,49%); in the third group, the indicators studied were correspondingly – 0,44 Hz (22,34 %) and 0,32 Hz (19,39%). Deviations from the average value are determined in total in 13–14 years – 44,96%, in 15–16 years – 68,37%, in 17–18 years – 41,73%.

The obtained results characterize the individual characteristics of female athletes in the simulation of sports activities; show a different reaction in the observed age groups and, consequently, a different level of sports qualification.

Based on a comparative analysis of the studies, criteria were developed for assessing the physical quality of the speed and its components (the rate, time and speed of a one movement, the frequency of movements) to determine the prospects of athletes and use as part of the selection methodology at various stages of improving sports training and improving the level of sports qualifications.

Table 2 presents the criteria for assessing the physical quality of the swiftness of female athletes aged 13–14 years engaged in rowing. Obtained results of the conducted researches characterize the level of the functional and physical state of the examined female athletes. The average time of sensorimotor reaction to sound is determined by the evaluation "good", the best time is almost "excellent" (less than 0,001 s), in the light of the average time – "satisfactory", the best figure – somewhat higher (0,008 s) parameters "excellent" assessment, worst is less by 0,055 s from the "satisfactory".

In the test of measuring the effect of the training action in the first period, the tempo by the average indicator is rated "good", but at the lower level of the evaluation, the maximum is "excellent", the minimum is lower (for one movement). The time of one movement is marked at the level – on the average "good", the best indicator is "excellent", the worst – "satisfactory". The speed of one movement was on the average at the level of "good", the maximum speed – "excellent", the minimum – "satisfactory", but only 0,01 $m \cdot s^{-1}$ exceeded the lower limit. The frequency of movements was assessed as an average "good", the best result was "excellent", and the worst was

Table 2

Criteria for assessing the physical quality of swiftness (girls 13–14 years old, rowing)

Indicators		Evaluation	Rate (Number of movements)	Time (s)	Speed ($m \cdot s^{-1}$)	Frequency (Hz)
Effect of training action	First period	satisfactory	19–21	0,850–0,750	0,350–0,430	1,20–1,45
		good	22–24	0,749–0,650	0,431–0,510	1,46–1,71
		excellent	25–27	0,649–0,550	0,511–0,590	1,72–1,97
	Second period	satisfactory	80–90 (20–22,5)	0,750–0,650	0,430–0,510	1,45–1,70
		good	91–101 (22,75–25,25)	0,649–0,550	0,511–0,590	1,71–1,96
		excellent	102–112 (25,5–28)	0,549–0,450	0,591–0,670	1,97–2,22
	Third period	satisfactory	22–24	0,650–0,550	0,435–0,515	1,50–1,75
		good	25–27	0,549–0,450	0,516–0,595	1,76–2,01
		excellent	28–30	0,449–0,350	0,596–0,675	2,02–2,27
	Summary	satisfactory	140–150 (23,3–25)	0,700–0,600	0,400–0,480	1,40–1,65
		good	151–162 (25,2–27)	0,599–0,500	0,481–0,560	1,66–1,91
		excellent	163–174 (27,1–29)	0,499–0,400	0,561–0,640	1,92–2,17

Time of sensorimotor reaction		
Evaluation	Sound (s)	Light (s)
satisfactory	0,230–0,215	0,255–0,240
good	0,214–0,199	0,239–0,224
excellent	0,198–0,183	0,223–0,208

"satisfactory" at the lower boundary level.

In the second period of the test, female athletes maintain an average rate of movement on "excellent", maximum – more than the best estimate for 5,75 movements (20,54%), minimum – "satisfactory". The time of one movement is determined by the "good" rating, the best result is 0,005 (1,12%) higher than the "excellent" rating, the worst is "satisfactory". The speed of one movement is on average "good", the maximum result is "excellent", the minimum is "satisfactory". The frequency of movements is on the average "good", the best result is "excellent", the worst is "satisfactory".

In the third test period, the rate of 0,4 movement (1,48%) exceeded the rating "good", maximum for 5 movements (16,67%) more parameters – "excellent", minimum – "satisfactory". The time of one movement was determined on the average by "good", the best figure is "excellent", the worst result is less "satisfactory" by 0,032 s (24,68%). The average speed of one movement is "good", the maximum is 0,024 $m \cdot s^{-1}$ (3,56%) is more "excellent", the minimum is "satisfactory". The average frequency of movements is a "good" estimate, the maximum is 0,006 Hz (2,64%) higher than the rating parameters "excellent", the minimum frequency is 0,03 Hz (3,81%) less than the lower "satisfactory".

According to the total indicator of the study of the effect of training action in female athletes aged 13–14 years, the rate of movement on average – the score is "good", maximum – 3,6 movements (12,41%) more than "excellent", at least 1,5 movement (6,89%) is less than the lower level of the assessment "satisfactory". Time of one movement is "good", the best is "excellent", worst is "satisfactory". Speed of one movement was, on the average, evaluated as "good", the maximum indicator for 0,012 $m \cdot s^{-1}$ (1,88%) Above the proposed assessment boundary is "excellent", the minimum is "satisfactory". Average frequency of movements is at the level of "good", the maximum – "excellent", the minimum – "satisfactory".

The obtained research results characterize, on the average, a sufficiently high level of development of swiftness physical quality; however, large differences between the maximum and minimum indices indicate the heterogeneous composition of the group for special and general physical readiness.

The obtained results of the research of female athletes 15–16 age years engaged in rowing, made it possible to develop criteria for assessing the physical quality of the swiftness and some of its components, which are presented in the Table 3.

Following assessments were made in our studies: the time of sensorimotor reaction to sound is "good" on the average, the best result is 0,028 s (18,42%) higher than the upper bound of the rating "excellent", the worst is 0,014 s (6,22%) less than the lower boundaries of the assessment are "satisfactory"; sensorimotor response time to light is "good" on the average, the best result is 0,021 s (12,57%) higher than the rating parameters "excellent", the worst indicator is less than the "satisfactory" score for 0,012 s (5,11%).

In the test of the effect of the training action in the first period, the evaluation criteria were determined: the average rate is "good", the maximum result is greater than the "excellent" score for 7 movements (23,33%), minimum – lower assessment "satisfactory" 3 movement (15,79%); time of one movement – on average the score is "good", the best result is "excellent", the worst is "satisfactory"; The speed of one movement on average is "good", the maximum result is more "excellent" 0,071 $m \cdot s^{-1}$ (10,59%), minimum – slightly less than "satisfactory"; frequency of movements is on the aver-

Table 3

Criteria for assessing the physical quality of swiftness (girls 15–16 years old, rowing)

Indicators		Evaluation	Rate (Number of movements)	Time (s)	Speed ($m \cdot s^{-1}$)	Frequency (Hz)
Effect of training action	First period	satisfactory	22–24	0,750–0,650	0,430–0,510	1,30–1,55
		good	25–27	0,649–0,550	0,511–0,590	1,56–1,81
		excellent	28–30	0,549–0,450	0,591–0,670	1,82–2,07
	Second period	satisfactory	90–100 (22,5–25)	0,700–0,600	0,435–0,515	1,50–1,75
		good	101–111 (25,25–27,75)	0,599–0,500	0,516–0,595	1,76–2,01
		excellent	112–122 (28–30,5)	0,499–0,400	0,596–0,675	2,02–2,27
	Third period	satisfactory	25–27	0,650–0,550	0,450–0,530	1,55–1,80
		good	28–30	0,549–0,450	0,531–0,610	1,81–2,06
		excellent	31–33	0,449–0,350	0,611–0,690	2,07–2,32
	Summary	satisfactory	150–160 (25–26,7)	0,700–0,600	0,440–0,520	1,50–1,75
		good	161–172 (26,8–28,7)	0,599–0,500	0,521–0,600	1,76–2,01
		excellent	173–184 28,2–30,7	0,499–0,400	0,601–0,680	2,02–2,27

	Time of sensorimotor reaction	
Evaluation	Sound (s)	Light (s)
satisfactory	0,225–0,210	0,235–0,220
good	0,211–0,196	0,219–0,204
excellent	0,195–0,180	0,203–0,188

age "good", the best result exceeds the rating "excellent" by 0,4 Hz (19,32%), the worst one – by 0,03 Hz (2,36%) less than the "satisfactory".

In the second period of the test the average rate was at the level of "excellent", maximum – 1,5 movement (4,91%) more "excellent", the minimum – "satisfactory"; time of one movement is on the average "good", the best indicator is "excellent", the worst is "satisfactory"; speed of one movement was estimated on average as "good", maximum – "excellent", minimum – "satisfactory"; frequency of movements was on the average – "good", the best result – "excellent", the worst – "satisfactory". In the third period of the test, the tempo of the movements was noted at the level of the upper bound of the "good" score, the maximum – by 11 movements (33,33%) higher than the "excellent" score, the minimum – "satisfactory"; time of one movement was estimated on the average – "good", the best figure – exceeds "excellent" by 0,059 s (17.30%), speed of one movement – on average, the score is "excellent", maximum – more "excellent" for 0,199 $m \cdot s^{-1}$ (29,26%), minimum – "satisfactory"; frequency of movements is on the average "good", the best indicator exceeds the rating "excellent" by 0,61 Hz (26,29%), the minimum – "satisfactory".

Total indicator of the measurement of the effect of the training action of female athletes 15–16 years age, specializing in rowing, characterized the following results: the rate of movements – "good", maximum – more than "excellent" for 9,9 movements (32,25%); time of one movement is on the average "good", the best indicator is more than "excellent" at 0,031 s (8,4%), the worst – "satisfactory"; speed of one movement – on the average "good", maximum – exceeds the rating "excellent" on 0,073 $m \cdot s^{-1}$ (10,74%), minimum – "satisfactory"; frequency of movements is on the average "good", the best result is more than "excellent" at 0,60 Hz (31,41%), the worst is "satisfactory".

Based on the conducted research, it was noted that there are large differences between the mean values and the maximum and minimum indices, which determines the unequal level of physical and functional preparedness of the female athletes of this group, with a general average level determined by the "good".

These criteria for assessing the physical quality of the swiftness of female athletes 17–18 years age, specializing in rowing, are presented in Table 4. In our studies in the first period of the measurement of the effect of a training action, the rate of movement was determined on the average by the evaluation "good", the maximum – "excellent", the minimum – for one movement (4,55%) smaller evaluation as "satisfactory"; time of one movement on the average – "good", the best indicator – "excellent", the worst – "satisfactory"; speed of one movement on the average is "good"; maximum – "excellent", minimal – on 0,009 $m \cdot s^{-1}$ (2,04%) smaller evaluation as "satisfactory"; Frequency of movements – on the average "good", best indicator – "excellent", worst – "satisfactory". In the second period following evaluation test were observed: the average rate – "good", the maximum – up to 4 motion (12,12%) "excellent", the minimum – at least one movement (4,0%) than the "satisfactory"; time of one movement on the average – "good", the best – "excellent", the worst – "satisfactory"; The speed of one movement on average is "good", the maximum on 0,046 $m \cdot s^{-1}$ (6,62%) is greater than "excellent", minimum is "satisfactory"; frequency of movements on the average is "good", the best indicator is 0,10 Hz (4,22%) more than "excellent", the worst – "satisfactory". In the third period of the test, the indices were estimated: the rate of movement was 0,2% slower (0,63%) than "excellent", maximum – 2 movements (5,89%) higher than "excellent", minimum – "sat-

Table 4

Criteria for assessing the physical quality of swiftness (girls 15–16 years old, rowing)

Indicators		Evaluation	Rate (Number of movements)	Time (s)	Speed ($m \cdot s^{-1}$)	Frequency (Hz)
Effect of training action	First period	satisfactory	23–25	0,730–0,630	0,450–0,530	1,40–1,65
		good	26–28	0,689–0,530	0,531–0,610	1,66–1,91
		excellent	29–31	0,529–0,430	0,611–0,790	1,92–2,15
	Second period	satisfactory	100–110 (25–27,5)	0,680–0,580	0,455–0,535	1,60–1,85
		good	111–121 (27,75–30,25)	0,579–0,480	0,536–0,615	1,86–2,11
		excellent	122–132 (30,5–33)	0,479–0,380	0,616–0,695	2,12–2,37
	Third period	satisfactory	26–28	0,630–0,530	0,470–0,550	1,65–1,90
		good	29–31	0,529–0,430	0,551–0,630	1,91–2,16
		excellent	32–34	0,429–0,330	0,631–0,710	2,17–2,42
	Summary	satisfactory	155–165 (25,8–27,5)	0,680–0,580	0,460–0,540	1,55–1,80
		good	166–176 (27,7–29,3)	0,579–0,480	0,541–0,620	1,81–2,06
		excellent	177–187 (29,5–31,2)	0,479–0,380	0,621–0,700	2,07–2,32

Time of sensorimotor reaction		
Evaluation	Sound (s)	Light (s)
satisfactory	0,125–0,200	0,230–0,215
good	0,199–0,184	0,214–0,199
excellent	0,183–0,168	0,198–0,183

isfactorily"; time of one movement is on the average "good", the best time is "excellent", the worst is "satisfactory"; speed of one movement on the average is "good", the maximum is "excellent"; frequency of movements on average – "good", maximum – "excellent", minimal – "satisfactory". Totally, for three periods, the average rate was rated "excellent", the maximum rate for 4,6 movements (14,74%) exceeded the score "excellent", the minimum for one movement (4,03%) was less than "satisfactory"; time of one movement on the average – "good", the best indicator – "excellent", the worst – "satisfactory"; speed of one movement on average is "good", the maximum on 0,023 $m \cdot s^{-1}$ (3,29%) is greater than "excellent", minimum is "satisfactory"; frequency of movements on the average is "good", the best score is 0,09 Hz (3,88%), higher than the upper bound of the rating "excellent", the worst is "satisfactory".

Results of the research determine a fairly uniform level of female athletes of this group in terms of indicators that characterize the physical quality of swiftness.

Increase in the speed of voluntary movements is due to the training of swiftness in the overall movement, as well as the analytical improvement of the factors determining the maximum speed of movement during the performance of exercises. Common tendency is the desire to exceed the maximum speed when performing exercises.

A simple motor reaction is determined by its two main components: latent (delayed), due to delays accumulating at all levels of organization of motor actions in the central nervous system (latent time of a simple motor reaction practically does not lend itself to training, it is not connected with sporting skill and can not be taken as a characteristic of the speed of a person); motor, due to the improvement of which, basically, and the reduction of the response time.

Conclusions

To improve the motor qualities and form the speed of movements, the most favorable conditions have studied age periods. Under the influence of training, there are changes in the tempo, time, speed, frequency of movements, the time of sensorimotor reactions to sound and light stimuli.

Indicators of the physical quality of the swiftness characterize the individual psycho-physiological characteristics of the athlete's body, which makes it possible to make adjustments in improving the speed abilities and effectively manage the training process.

Based on a comparative analysis of the studies, criteria were developed for assessing the physical quality of the swiftness and its components (rate, time and speed of a single movement, frequency of movements) to determine the prospects of athletes and use as part of the selection methodology at various stages of improving sports training and improving the level of sports qualifications.

Prospects for further research. This work is a logical continuation of a series of studies related to the study of the functional state and physical qualities of rowers, differing in gender, age, sports qualification and specialization in order to create an effective integrated methodology for assessing the prospects and selection of rowing and other sports.

It is proposed to identify other functional and psycho-physiological indicators along with the study of traditional features in predicting sports abilities, which can significantly change under the influence of training.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 29.06.2017.
Published: 31.08.2017.

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UDK 615.825:616.12-008.46

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 14-17

An influence of physical rehabilitation on living standards of children with chronic heart failure

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Purpose: *to determine the impact of the developed program of physical rehabilitation on the quality of life of school-age children with chronic heart failure (CHF) I–IIA stages.*

Material & Methods: *analysis, generalization of scientific and methodological literature, Internet, survey method, methods of mathematical statistics. The study was conducted on the basis of the West-Ukrainian specialized children's medical center (Lviv). The experiment involved 34 school-age children with CHF I–IIA stages.*

Result: *the evaluation of the quality of life of school age children with EH with CHF I–IIA stages showed a significant improvement in the four blocks. The physical functioning according to the parents' information had the greatest improvement. Despite the increase in the indicator of the functioning of the child in school, it remains low. Improving emotional and social functioning contributes to the social adaptation of children in society. The positive and negative dynamics of QoL of children of CHF for block indicators is not reliably confirmed.*

Conclusion: *quality of life in children with CHF is an important integral indicator.*

Keywords: *physical rehabilitation, quality of life, children with chronic heart failure.*

Introduction

Given the unsatisfactory prediction of long-term survival of patients with chronic heart failure (CHF), maintaining their acceptable quality of life (QOL) at an acceptable level are important clinical tasks [9]. Decrease of QOL in patients with CHF is associated not only with physical discomfort accompanied by a sustained decrease in functional capacity, is a consequence of the clinical severity of the disease, the severity of subjective symptoms of CHF, low fraction of the ejection of the left ventricle, but also with psychoemotional discomfort, caused by both social maladjustment and mental depression, anxiety, depression associated with the perception of their illness, sleep disturbance, etc. [3].

QOL study in medicine allowed changing the traditional view on the problem of the disease and the patient [2]. Quality of life is considered as a health-related integral characteristic of the physical, psychological and social functioning of a healthy or sick person, based on his subjective perception [1; 2].

Control over the state of health and its treatment is impossible without the definition of QOL, as a criterion for the effectiveness of ongoing treatment and rehabilitation activities in modern medicine [4; 7]. Since the ultimate goal of any therapy is to increase life expectancy and improve its quality, that is why scientists pay significant attention to such research and development of effective methods of physical rehabilitation [8].

Support for quality of life is one of the important components of healthcare worldwide and its research is presented in many works: D. A. Klatchoian and others. (2010), J. Varni (2007, 2013), K. Kobayashi, K. Kamibeppu (2010), E. Pristupa, N. Kurish (2010), Y. Pavlova (2015), and others. Questions about the impact of physical rehabilitation on children's QOL were studied by scientists: N. A. Ivasik (children of school age with acute broncho-pulmonary diseases, 2016). V. Vitomskaya (children with functional single ventricle of the heart, 2016), etc.

We see it necessary to determine the quality of life of children with CHF as a criterion for the effectiveness of the developed program of physical rehabilitation.

Relationship of research with scientific programs, plans, themes. The work is carried out on the theme of research work of Lviv State University of Physical Culture for 2016–2020. "Theoretical and methodical foundations of physical rehabilitation of disabled people with disruption of the musculoskeletal system and respiratory system" (Minutes No. 8 of 19.04.2016).

Purpose of the study: to determine the impact of the developed program of physical rehabilitation on the quality of life of school-age children with chronic heart failure (CHF) I–IIA stages.

Material and Methods of the research

Study was conducted on the basis of the West-Ukrainian specialized children's medical center (Lviv). Experiment involved 34 school-age children with CHF I–II A stages. Distribution of children on experimental (16 children) and control group (18 children) conducted randomly and statistically set them equal effectiveness at the beginning of the experiment ($p>0,05$). Statistical processing of the results was performed using a nonparametric Mann-Whitney test to estimate the difference between two unrelated samples and the non-parametric Wilcoxon test to estimate the difference between two related samples.

Experimental group (EG) was engaged in the developed program of physical rehabilitation [6], which provided for practical

and theoretical parts. Practical part was aimed at improving both the functional and psycho-emotional state of children, and improving the quality of life and social adaptation. Theoretical studies were aimed at obtaining new knowledge, on the formation of patients 'and their parents' attitudes toward self-control, the modification of the motor regime of the day, the way of life, etc.

Research methods: analysis, generalization of scientific and methodological literature, Internet, survey method, methods of mathematical statistics.

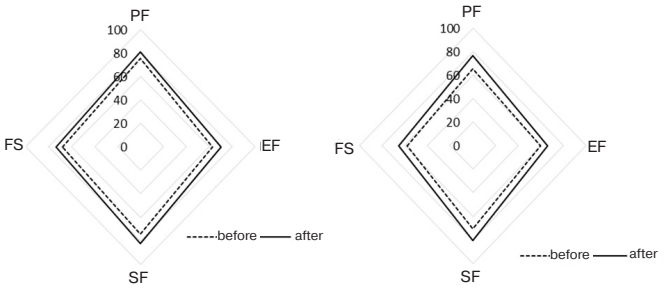
Results of the research and their discussion

Since QOL is considered a full-fledged criterion of the effectiveness of the therapy, it is equivalent in its significance to clinical criteria (V. V. Selivanov, A. S. Mikhailova in co-workers, 2011). A high level of quality of life is an unconditional criterion for the harmonious functioning of the individual and her psychological health [5].

When considering QOL patients, it is necessary to evaluate the pleasure of those aspects of life that are affected by the disease and its treatment [4]. That is why in our study we used the questionnaire PedsQL 4.0 – Pйdiatrie Quality of Life Questionnaire that translated into 22 languages and adapted for children and adolescents aged 2 to 18 years [11]. This questionnaire contains questionnaires for children of different age groups (2–4 years, 5–7 years, 8–12 years and 13–18 years) and their parents. School-age children with CHF I–II A of the stages participating in our study responded to 23 questionnaires that were divided into 4 blocks relating to the physical, emotional, social functioning and functioning of the child in school. Similar blocks of questions were also raised by parents in the questionnaire QOL about their child. The results of the questionnaire survey are presented in scores from 0 to 100 both for each block and in general.

Questioning was conducted twice: before the beginning of the experiment and after the lessons on the developed program of physical rehabilitation. Results of the survey on the blocks of information (report) from children and their parents before and after the experiment are presented in Table 1.

As you can see, all the changes that are established in children of the EG have a statistically significant improvement. Dynamics of indicators (improvement and deterioration), held among children of CG, is not reliably confirmed, as well as information from parents on the QOL of their children. According to the report of the children of the EG, their physical functioning improved by 6,05±1,52 points, and according to their parents – on 11,33±4,32 points. It is the physical functioning according to the parents' information that has the greatest improvement, graphically depicted in Figure 1. This block of the questionnaire indicates how much the state of health limits its physical activity and the performance of various physical activities (self-service, walking, running, carrying weight, etc.).



а) child result б) parents result

Fig. 1. Results of the questionnaire on the quality of life *(on the report of children (a) and information from parents (b)): PF – physical functioning, EF – emotional functioning, SF – social functioning, FS – functioning in school.*

On the emotional and social functioning of EG children, it was they who had more improvement in the children's report, where the increase was 7,81±3,23 points in each block. Parents noted an increase of 6,25±1,91 and 9,69±3,11 points, respectively, of the QOL questionnaire of their child. This indicates an improvement in the social adaptation of children in society, in particular among peers.

However, despite an increase of 7,5±2,7 points on the questionnaire of the parents of children in the EG in the unit of functioning in the school, this indicator remains low. This is due to missing the school for the poor health of the children, visiting the doctor during the lessons, etc.

Analyzing the level of QOL (end result), we can observe its

Table 1

Dynamics of indicators of quality of life of children with CHF I-II A stages, points

	Indicators	Experimental group (n=16)		Control group (n=18)	
		before	after	before	after
		$\bar{X}$±m			
child report	physical functioning	75,2±2,76	81,25±2,92*	70,83±2,02	72,4±2,28
	emotional functioning	62,81±4,96	70,63±5,14*	67,22±3,06	66,67±3,1
	social functioning	74,38±4,78	82,19±3,62*	78,33±3,13	80,83±2,81
	functioning in school	67,81±3,71	73,75±3,67*	61,67±2,68	65±2,68
	QOL result	70,72±2,98	77,51±2,64**	69,69±1,66	71,38±1,93
parents report	physical functioning	65,43±5,58	76,76±3,87**	63,72±3,24	63,89±2,92
	emotional functioning	60±3,48	66,25±3,55**	58,89±2,9	58,33±2,32
	social functioning	70,63±4,23	80,31±3,97**	71,39±3,72	72,5±3,34
	functioning in school	58,13±4,67	65,65±3,56*	63,06±3,08	63,89±3,17
	QOL result	63,79±3,64	72,83±2,98**	64,19±2,34	64,55±2,06

Note. ** – p<0,05, ** – p<0,01 when comparing the final parameters of the experimental group and the control group.*

growth by 6,79±1,4 points according to the opinion of the children of EG and by 9,04±2,18 points according to information from parents. It should also be noted that the fathers estimated the QOL of their children with less points both before and after the experiment. According to research by Y. Pavlova (2015) [10], quality of life of healthy Ukrainian schoolchildren is 78,9±14, points, and in children of the EG after training in the developed program of physical rehabilitation, QOL has grown to 77,51±2,64 points, which is close to the value of healthy peers (Figure 2).

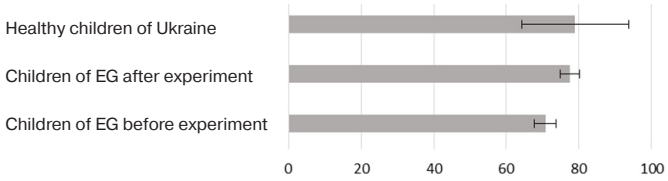


Fig. 2. Quality of life of healthy children and children EG with CHF

So, one of the criteria for the effectiveness of the implemented physical rehabilitation program for school-age children with CHF I–IIA stages is the quality of life.

Conclusions

1. Quality of life in children with CHF is an important integral indicator and an objective criterion of the effectiveness of the therapy.

2. Evaluating the quality of life of school-age children with a CHF of I–IIA stages showed a significant improvement in four blocks. Physical functioning in the opinion of children improved from 75,2 to 81,25 points, and according to their parents – from 65,43 to 76,76 points. It is the physical functioning according to the parents' information that has had the greatest improvement. Emotional functioning improved according to the data of the children of the EG and, according to their parents, from 62,81 to 70,63 and from 60 to 66,25, respectively. Social functioning is also a little positive effect on 74,38 to 82,19 points according to the data of the children's EG report and from 70,63 to 80,31 points according to information from parents. This indicates an improvement in the social adaptation of children in society, in particular among peers. Functioning of the child in the school from 67,81 points increased to 73,75 points in the children of the EG, and according to the parents of growth there was from 58,13 to 65,65 points. Despite the increase, this indicator remains low. This is due to missing the school for the poor health of the children, visiting the doctor during the lessons, etc.

3. Positive and negative dynamics of QOL children of CG for block indicators is not reliably confirmed.

A prospect for further research is to check the effectiveness of the developed PR program on other criteria, as well as to monitor the dynamics of the quality of life of children with CHF.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization

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Received: 12.07.2017.
Published: 31.08.2017.

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ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 18-21

An improvement of competitive exercises performing on the rings by 10–12 year old gymnasts using special physical training

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Purpose: *to reveal the influence of the level of special physical readiness of gymnasts of 10–12 years on the technique of performing exercises on rings.*

Material & Methods: *for the task of testing the level of special physical and technical preparedness were carried out gymnasts of 10–12 years, who are trained on the basis of Sports School of high sportsmanship Kharkov.*

Result: *based on the results of the study, the dynamics of qualitative and quantitative indicators of the level of special physical preparedness of gymnasts aged 10–12 years and its influence on the technique of performing a competition program on rings.*

Conclusion: *results of the experiment confirm the effectiveness and significance of the use of special physical training that positively influence the technique of performing a competitive combination on the gymnasts' rings during the preliminary basic training.*

Keywords: *gymnasts 10–12 years, the level of special physical preparedness, level of technical preparedness, competitive program, testing, rings.*

Introduction

Gymnastics is a complex coordinated sport with the performance of competitive combinations on gymnastic apparatus. Qualitative performance of gymnastic all-round exercises is due to the corresponding level of special physical preparedness of athletes. According to experts in gymnastics, the technical training of athletes is carried out on the basis of advancing development of special physical qualities, that is, there should be an outstripping development of physical qualities in relation to the technical training of gymnasts [1; 5; 8]. In modern competitive programs, the leading gymnasts show the highest technical skill with the maximum manifestation of physical qualities that merge into a single whole, reflected in original ties and combinations [7]. The effectiveness of the training process is directly dependent on the means used in the classes with athletes in accordance with physiological characteristics [4].

Rings – this is the only gymnastic projectile with a mobile support, determines the specifics of exercises of this kind, which combine a pronounced flaring dynamics, high demands on the accuracy of actions, balance in the stops and special power training of gymnasts [2; 3; 8]. When performing exercises on the mobile support, the gymnast experiences an abrupt increase in the shock-type load on the motor apparatus, which requires a high level of special physical readiness. Analysis of literary sources and video materials showed that since the beginning of the 1980s another leap occurred in the development of this type of all-around – forgotten strength exercises began to revive and combine with the flight, demanding from the gymnasts the development of muscle strength, speed-strength abilities, flexibility, orientation in space, a sense of balance, etc. [1–3; 5; 8]. Thus, particular relevance optimization special physical training of young gymnasts to improve their technical readiness

Purpose of the study: to reveal the influence of the level of special physical readiness of gymnasts of 10–12 years on the technique of performing exercises on rings.

Material and Methods of the research

Experiment, which was attended by eight gymnasts of 10–12 years, was held in Kharkov on the basis of the Sports School of high sportsmanship (SSHS) in artistic gymnastics. In the course of the study, at the beginning of the experiment, an assessment was made of the level of special physical preparedness of gymnasts and an assessment of the level of their technical preparedness in performing a competitive combination on rings. Main purpose of the study was to identify the dynamics of qualitative and quantitative indicators of the level of special physical preparedness and its influence on the technique of compulsory program execution on rings.

After the initial testing, the young athletes were trained according to the Curriculum for the Youth Sports School [6]. Means of sports training were physical exercises that directly or indirectly influenced the improvement of the skill of gymnasts. Gymnastic exercises were deliberately selected by the coach for solving the main tasks of the training process – training, education of physical qualities and perfection in the chosen sport. Volume of gymnastics used during the preliminary basic training was conventionally divided into four main groups. First group included competitive exercises on gymnastics, which were the subject of specialization and were performed in accordance with the conditions of the competition. Second group included general development exercises for the comprehensive physical development of gymnasts. In the third group preparatory special exercises designed for training and development of physical qualities. To the fourth group exercise of other sports. According to the program for the Youth Sports School of gymnastics, the training process for children aged 10–12 years during the study was based on

general, special physical, special-motor and sports-technical training, the ratio of which was approximately 1:3 training time. Preservation of the specific weight of general, special physical and special-motor training was associated with the growing demands on the level of development of physical qualities and the special-motor preparedness of gymnasts of this age [6].

Methods of research: theoretical analysis and generalization of literary sources; pedagogical observations; testing; pedagogical experiment; methods of mathematical statistics.

Results of the research and their discussion

To summarize the results of the experiment, a comparative analysis of the level of special physical and technical preparedness of young gymnasts for the study period was made (Table 1).

When performing the "Run on 20 m" (s) test, which characterizes the level of development of speed, the young gymnasts showed a average group result of 4,1 s at the beginning of the study and 3,9 s at the end. According to the Student's test, the difference between the average results shown by the athletes in this test is statistically unreliable because t_c less t_{gr}. (Table 1). To assess the level of development of speed-strength readiness of gymnasts of 10–12 years used the test «Standing long jump». Results of the study showed that in September 2016 they performed this exercise with a average group result of 155,4 cm, and in March 2017 – 158,9 cm. Difference between these indicators is not statistically significant, since t_c=0,83<t_{gr}=2,15. When performing exercises "Rope climbing" (rate of force development) boys, who are engaged in gymnastics, showed an average result of 7,9 s at the beginning of the study and 7,0 s at the end. A comparison of these results by the Student's test shows that the difference between the mean group values is statistically significant (p<0,05). This indicates that the conduct of the training process for six months contributed to an improvement in the mean group result in the study group (Table 1). As can be seen from the materials presented, in the test for the development of the force "Lifting by force on rings", the children of the study group showed an initial average result of 4,8 times and a repeat average of 6,1 times. Difference between these indicators is statistically significant, since t_c=2,85>t_{gr}=2,15. This means that at the end of the study the results improved objectively. Results of the study indicate that during the "Horizontal suspension back on rings" exercises gymnasts aged 10–12 years showed results of 9,4 s and 11,1 s for initial and repeated testing, respectively (Table 1). Difference between the mean group results from this test is statistically significant, since p <0,05. Results of the children in this test allow us to confirm the effectiveness of training sessions. During the next test to determine the level of development of the athletes' strength readiness "Stance by force on uneven bars", the initial result was 5,8 times, and the repeated result – 7,0 times. According to the Student's test, the difference between the average results in this test is statistically reliable, since t_c more t_{gr}. (Table 1). This indicates that training in the studied group of gymnasts contributed to an improvement in the group's average result for this test. In the process of comparative analysis of indicators of development of flexibility in the "Twisting gymnastic sticks" test, revealed no significant improvement of results in the group of gymnasts (p>0,05).

During the period of the study, in the group of gymnasts, the indicators of the development of their technical readiness have undergone significant changes, they have been studied according to the indicators of the combination on rings (obligatory program for I class): from the visibility on the rings by twisting in the shoulder joints, the transition to the viscous bending, unbending the forwards forward on the bent hands, swinging forward, hastening, backwards; swing forward, jump off in full swing backwards (quality of performance of a combination in points is evaluated. Penalties for errors) (Figure 1) [6].

These changes (Table 1) can be explained by the fact that work with gymnasts to improve the quality of performing a competitive combination on the rings for the I category was carried out simultaneously in two directions: improving the strength and speed-strength qualities of gymnasts, necessary to perform a competitive combination on the rings, and individual work on technical mistakes made by gymnasts when performing a combination on rings. According to the results of the individual performance of the competitive combination on the rings during the study (Figure 1), it should be noted that the improvement of the combination is observed in all gymnasts of the study group.

Gymnasts who occupied the leading positions on the basis of the initial performance of the competitive combination (gymnasts No. 4 and No. 8), and remained the leaders. Group's outsiders on the basis of the primary testing (gymnastics No. 2, 3 and 5) also improved their results, but failed to catch up with the leaders of the group. Maximum increase in marks

Table 1

Level of development of special physical and technical readiness of gymnasts 10–12 years according to the results of the research (n=8)

No. i/o	Test	$\bar{X}$±m		t_c	t_{gr}	p
		Primary results	Repeated results			
1.	Run on 20 m (s)	4,1±0,08	3,9±0,08	1,36	2,15	>0,05
2.	Standing long jump (cm)	155,4±3,06	158,9±2,94	0,83	2,15	>0,05
3.	Rope climbing (s)	7,9±0,26	7,0±0,23	2,53	2,15	<0,05
4.	Lifting by force on rings (times)	4,8±0,40	6,1±0,28	2,85	2,15	<0,05
5.	Horizontal suspension back on rings (s)	9,4±0,46	11,1±0,35	3,00	2,15	<0,05
6.	Stance by force on uneven bars (times)	5,8±0,26	7,0±0,30	3,16	2,15	<0,05
7.	Twisting gymnastic sticks (cm)	14,1±0,70	13,0±0,66	1,17	2,15	>0,05
8.	Competitive combination (points)	7,7±0,10	8,1±0,07	3,03	2,15	<0,05

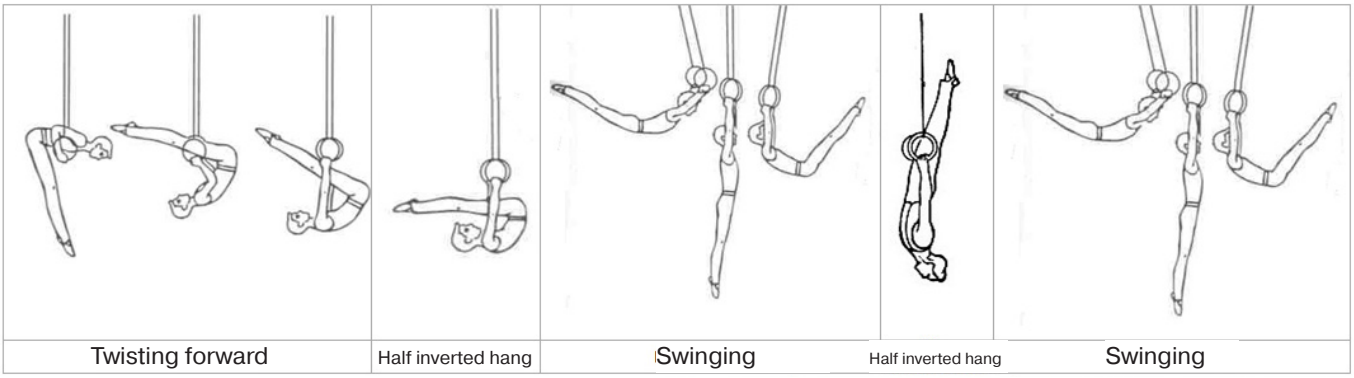

Fig. 1. Combination on rings (obligatory program for I class)

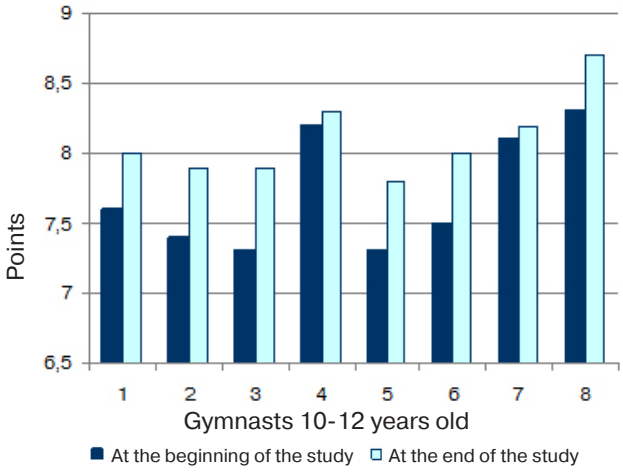

Fig. 2. Evaluation for the performance of a competitive combination on the rings at the beginning and at the end of the study

(0,6 points) for the combination is observed in gymnast No. 3; Minimum (0,1 points) – for gymnasts No. 4 and No. 7.

Thus, the results of the competitive combination of the I category indicate the effectiveness of the training process and the use of an individual approach to work with gymnasts, as well as the complex work carried out to improve the performance of exercises on the rings.

Conclusions

Analysis showed that during the study of the training process gymnasts at the stage of preliminary basic training, there were positive changes in the test tasks that characterize the level of special physical and technical preparedness. At the end of the study, for most test tasks, statistically significant differences were recorded based on the results of primary and repeated testing, except for tests – run on 20 m; standing long jump; twisting gymnastic sticks. So, following the results of the training process during the study, the group of gymnasts managed to achieve a statistically significant growth of only strength qualities. This fact suggests that the means and methods used by the coach during this period worked better for the development of the strength of the gymnasts than speed-strength and flexibility. The training process in the study group as a whole provided a comprehensive impact on improving the physical qualities of gymnasts and improving the quality of their training combination. Increase in the level of special physical preparedness positively influenced the technique of fulfilling the obligatory combination on the rings (in particular, the average score for the completion of the training combination increased from 7,7 to 8,1 points).

Prospects for further research. In the future, it is planned to assess the effect of the level of special physical training of young gymnasts on the technique of performing exercises in other gymnastic apparatus.

Conflict of interests. The author declares that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization

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Received: 16.07.2017.
Published: 31.08.2017.

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ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 22-26

Influence of bodybuilding training on changes in the anthropometric indicators of skilled female athletes in different phases of a specific biological cycle

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Purpose: *to carry out research on the influence of the activities of female athletes engaged in bodybuilding on changes in anthropometric indicators in different phases of the ovarian-menstrual cycle (OMC).*

Material & Methods: *studies were conducted in the fitness clubs of Kharkiv "Pheromone", "City", "King" with qualified athletes who are engaged in bodybuilding for 3 months of the preparatory period in the amount of 22 people. As research methods used: analysis of literature sources and testing of the level of motor qualities in individual phases of the OMC.*

Result: *presented analysis of the condition of the female athletes taking into account the features of the OMC phases and the testing of body weight and anthropometric indicators in different phases of a specific biological cycle in qualified female athletes engaged in bodybuilding.*

Conclusion: *Obtained results indicate that the anthropometric indicators of qualified female athletes engaged in bodybuilding are not the same in the phases of the ovarian-menstrual cycle. It was revealed that during the OMC period the body is able to retain water, which leads to fluctuations in the body weight of female athletes from 0,5 to 2,5 kg, while on the 3rd–6th day and on the 25–26th there is an increase in body weight, and on the 7th and 16th – its decrease. According to the results of the study, in the first phase, the decrease in anthropometry and body weight, this is due to the rejection of the mucous membrane of the uterus and menstrual bleeding.*

Keywords: *testing, OMC phases, body weight, anthropometric indicators, bodybuilding, female athletes.*

Introduction

One of the most significant differences of the female body from the male is the structure and functioning of the reproductive system and its hormonal regulation [6; 16]. Therefore, the recommendations of any health systems should be based on taking into account the characteristics of their effects on women in different phases of the ovarian-menstrual cycle. First of all, it should be borne in mind that these changes during the cycle occur not only in the female's reproductive system but extend to a number of other systems and organs (nervous, cardiovascular, endocrine, respiratory, immune, etc.) [18; 19; 20].

There are two main points of view on the relationship between the ovulatory-menstrual cycle and performance. Some experts deny the dependence of performance on the phases of OMC in female athletes [2]. Other scientists [1, 4, 17] believe that the different concentration of sex hormones in the body during the ovulatory-menstrual cycle, changes the functional state of the vital systems of the body, can not but be reflected in the level of efficiency of female athletes. Meanwhile, it is proved that not in all phases of the biological cycle female athletes are able to perform training and competitive loads.

For example, Ukrainian researchers [5, 12; 14; 16; 17], dealing with the problem of women's sports for many years, came to the conclusion that in all women the level of manifestation of different motor abilities during the ovulatory-menstrual cycle does not remain constant and varies in accordance with the phases of the cycle.

At the same time, the researchers, not denying the influence of the menstrual function on the ability to work, pay attention to the individuality of its dynamics in separate phases in different female athletes [11; 15].

Researchers who studied the muscular activity of women, found that, depending on the nature of the course of the ovarian-menstrual cycle and the dynamics of performance of all athletes can be divided into categories. Thus allocate such group of women at which stability of working capacity during an ovarian-menstrual cycle is observed, and group of sportswomen in whom there is a sharp decrease in working capacity in a menstrual phase. Other groups identified by scientists are different: these are the female athletes who have reached the menstrual phase of maximum performance, and female athletes who show the highest level of performance during ovulation [17].

In the work of L. G. Shakhlina, the classifications of women according to the results of subjective self-evaluation of health in the menstrual phase are presented [17]:

1 group – female athletes with a good state of health and good objective condition. Sports results are independent of the phases of the ovarian-menstrual cycle.

2 group – female athletes, complain of drowsiness, weakness, reluctance to exercise; they usually have low blood pressure.

3 group – female athletes who have headaches such as migraines, pain in the lower abdomen and in the lower back, increased arterial blood pressure in them is often increased, and the pulse is increased.

4 group – female athletes, who have symptoms of poisoning: loss of appetite, nausea, joint pain, aching, restless sleep,

sometimes increased heart rate, breathing, lowering blood pressure, fever.

G. Erdeby study shown that in those sports where female athletes receive high physical loads (ski races, different kinds of rowing), they have deep violations of menstrual function (amenorrhea, hypomenorrhea, dysmenorrhea, etc.). Moreover, the author notes that during the period of reduction of both physical and mental load in their normalization observed occurrence of ovarian-menstrual cycle [18]. Negative effect of intensive physical exertion on the course of this cycle in female athletes is reported in a number of works [3; 7; 8; 9; 10; 13].

Studying the question of changes in other systems of the female athlete's body in connection with the comparison of the different phases of their menstrual cycle, the authors determined, firstly, their presence, and secondly, the dependence of the depth of functional metabolic changes in organs and tissues from the phase of the ovarian-menstrual cycle.

There are studies whose authors are sure that female athletes can continue training and compete during the entire ovarian-menstrual cycle [9]. At the same time, authors who hold such an opinion, note that with the participation of female athletes in competitions in the premenstrual and menstrual phases of their ovarian-menstrual cycle, the results and achievements deteriorate substantially.

Above analysis of the literature data shows that the majority of authors dealing with this problem express unanimous opinion about the high level of manifestation of the basic physical qualities (except flexibility) in the postmenstrual and postovulatory phases and about the decrease in menstruation, ovulation and premenstrual period. However, the question of the minimum level of manifestation of a specific motor quality during the ovarian-menstrual cycle remains open. Also conducted studies in various sports do not fully reflect the specifics of sports activities of a force character, which includes bodybuilding, which requires the conduct of research.

Relationship of research with scientific programs, plans, themes. The scientific research was carried out on the theme of the Consolidated Plan of Research Work in the Sphere of Physical Culture and Sport for 2011–2015. On topic 3.7 "Methodological and organizational-methodological basis for determining the individual rate of a person's physical condition" (state registration number 0111U000192).

Purpose of the study: to carry out research on the influence of the activities of female athletes engaged in bodybuilding on changes in anthropometric indicators in different phases of the ovarian-menstrual cycle.

Material and Methods of the research

Research was carried out in sports fitness clubs of the city of Kharkov "Pheromone", "City", "King" with skilled female athletes engaged in bodybuilding, for 3 months of the preparatory period in the number of 22 people. As research methods used: analysis of literature sources and testing of the level of motor qualities in individual phases of the OMC.

Results of the research and their discussion

When planning the training process of female athletes engaged in bodybuilding, it is important to distribute anthropometric indicators taking into account the performance in different phases of the OMC. Therefore, we conducted studies during 3 mesocycles of the preparatory period with the determination of the influence of individual phases of OMC on the manifestation of changes in anthropometric indicators, the results of which are presented in Table 1.

As evidenced by the results, the highest changes in anthropometric indicators were obtained in the premenstrual phase, since the fertilization of the egg did not occur; the yellow body degenerates 2–3 days before the onset of menstruation. Concentration in the blood of progesterone and estrogen decreases, reducing the body's functionality.

During OMC observed pronounced hormonal changes in blood composition, strength performance, muscle tone, water-electrolyte metabolism. Ability of the body to retain water also changes, which leads to fluctuations in the body weight of athletes from 0,5 to 2,5 kg, while on the 3–6th day and on the 25–26th there is an increase in body weight, and by 7 and 16th – its decrease. As the results indicate, in the first phase, the decrease in anthropometry and body weight, this is due to the rejection of the mucous membrane of the uterus and menstrual bleeding. During this period there is a sharp drop in the level of metabolism, including the exchange of proteins. In the cerebral cortex disturbs the processes of attention. The sensitivity of the visual, tactile and other sensory systems decreases. Increased irritability, emotional imbalance. Slows respiration rate and heartbeat. In connection with the loss of blood (usually 150–200 ml), the number of erythrocytes, hemoglobin, leukocytes and platelets decreases. Thus, in the second phase, the follicle develops in the ovary until it ripens and ruptures (this phase is also called follicular or pre-ovulatory). During this period, the content of the female sex hormone

Table 1

Dynamics of anthropometric indicators in different phases of the ovarian-menstrual cycle in skilled athletes engaged in bodybuilding (n=22)

Indicators	Phase OMC				
	I	II	III	IV	V
Body weight, kg	63,5±1,21	61,5±1,10	62,7±1,12	63,6±1,51	65,5±1,09
Circumference of chest (inhalation), cm	93,2±0,77	91,4±0,97	93,0±0,92	94,3±0,80	97,5±0,93
Circumference of chest (exhalation), cm	88,4±0,82	86,7±0,95	88,9±0,98	89,5±0,88	92,8±0,95
Circumference of the shoulder, cm	33,4±0,68	32,8±0,67	33,6±0,60	34,6±0,72	35,7±0,77
Waist circumference, cm	72,1±0,59	70,2±0,60	71,0±0,65	71,2±0,75	73,7±0,53
Thigh circumference, cm	51,3±0,68	49,1±0,55	50,0±0,47	50,3±0,56	54,2±0,64
Shin circumference, cm	34,3±0,48	33,5±0,47	34,6±0,40	35,6±0,52	36,9±0,57

Note. *Phase OMC: I – menstrual; II – postmenstrual; III – ovulatory; IV – postovulatory; V – premenstrual.*

Table 2

Matrix of reliability of the difference in the body weight in different phases of the OMC in skilled female athletes engaged in bodybuilding (n=22)

Phase OMC	II	III	IV	V
I	t=1,22; >0,05	t=0,49; >0,05	t=0,05; >0,05	t=1,23; >0,05
II		t=0,76; >0,05	t=1,12; >0,05	t=2,58; <0,05
III			t=0,48; >0,05	t=1,79; >0,05
IV				t=1,02; >0,05
V				

estrogen in the blood increases, and the development of the mucous uterus. The body weight in this phase can decrease by 2 kg, and in the third phase, the egg follicle (ovulation) exits and falls into the fallopian tubes and further into the uterus. In phase IV, the follicle remains a yellow body, which becomes a new gland of internal secretion and begins to release the hormone progesterone, in this regard; this phase is considered the most workable.

Thus, the highest body weight indices are shown (Table 2) by female athletes in the V and II phases in relation to other phases of the OMC.

At the same time, the indices in the body weight in the V phase are significantly ($p < 0.05$) higher in comparison with other phases of the OMC.

It should be noted about the high rates of female athletes in the chest circumference on the inspiration and the chest circumference on exhalation (Table 3). Thus, the lowest of them are shown in post-menstrual (91,4±0,97 cm and 86,7±0,95 cm) and ovulatory (93,0±0,92 cm and 89,5±0,88 cm), which reliably lower results in the II and IV phases of the OMC ($p<0,001$).

Changes in the circumference of the shoulder and waist circumference (Table 4) have significantly higher ($p<0,001$) results in the V and I phases of the OMC, which fully coincides

Table 3

Matrix of reliability of the difference in the circumference of chest (inhalation) and circumference of chest (exhalation) in different phases of the OMC in skilled female athletes engaged in bodybuilding (n=22)

Phase OMC	II	III	IV	V
I	t=1,45; >0,05 t=1,35; >0,05	t=0,17; >0,05 t=0,39; >0,05	t=0,99; >0,05 t=0,91; >0,05	t=3,56; <0,001 t=3,44; <0,001
II		t=1,20; >0,05 t=1,61; >0,05	t=2,31; <0,05 t=2,16; <0,05	t=4,54; <0,001 t=4,47; <0,001
III			t=1,07; >0,05 t=0,46; >0,05	t=3,44; <0,01 t=2,81; <0,05
IV				t=2,61; <0,05 t=2,51; <0,05
V				

Note. *Top line – chest circumference (inspiration); bottom line – chest circumference (exhalation).*

Table 4

Matrix of reliability of the difference in the circumference of the shoulder and waist circumference in different phases of the OMC in skilled female athletes engaged in bodybuilding (n=22)

Phase OMC	II	III	IV	V
I	t=0,63; >0,05 t=2,26; <0,05	t=0,22; >0,05 t=1,25; >0,05	t=1,21; >0,05 t=0,94; >0,05	t=2,24; <0,05 t=2,02; <0,05
II		t=0,89; >0,05 t=0,90; >0,05	t=1,83; >0,05 t=1,04 >0,05	t=2,84; <0,01 t=4,37; <0,001
III			t=1,07; >0,05 t=0,20; >0,05	t=2,15; <0,05 t=3,22; <0,05
IV				t=1,04; >0,05 t=2,72; <0,05
V				

Note. *Top line – circumference of the shoulder; bottom line – waist circumference.*

Table 5

Matrix of reliability of the difference in the thigh circumference and shin circumference in different phases of the OMC in skilled female athletes engaged in bodybuilding (n=22)

Phase OMC	II	III	IV	V
I	t=2,52; <0,05 t=1,19; >0,05	t=1,57; >0,05 t=0,48; >0,05	t=1,14; >0,05 t=1,84; >0,05	t=3,11; <0,01 t=3,49; <0,01
II		t=1,24; >0,05 t=1,78; >0,05	t=1,53; >0,05 t=3,00; <0,01	t=6,04; <0,001 t=4,60; <0,001
III			t=1,52; >0,05 t=0,20; >0,05	t=5,29; <0,001 t=3,30; <0,01
IV				t=4,59; <0,001 t=1,68; >0,05
V				

Note. *Top line – thigh circumference; bottom line – shin circumference.*

with the results in the measurements given earlier in Table 1. It should be noted that the indicators of female athletes in the thigh circumference (Table 5) have significantly higher ($p<0,001$) results in the V phase of the OMC (54,2±0,64 cm). Indicators of female athletes in the shin circumference had no significant difference ($p>0,05$) in the phases OMC (36,9±0,57 cm).

Conclusions

Results show that the anthropometric indicators of skilled athletes engaged in bodybuilding are not the same in the phases of the ovarian-menstrual cycle. It was revealed that during the OMC period the body is able to retain water, which leads to fluctuations in the body weight of athletes from 0,5 to 2,5 kg, while on the 3–6th day and on the 25–26th there is an increase in body weight, and on the 7th and 16th – its decrease. As the results indicate, in the first phase, the decrease in anthropometry and body weight, this is due to the rejection of the mucous membrane of the uterus and menstrual bleeding.

Prospects for further research provide for determining the influence of bodybuilding training on the functional state and psychophysical characteristics of female athletes in different phases of the ovarian-menstrual cycle.

Conflict of interests. The author declares that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 15.07.2017.
Published: 31.08.2017.

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SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 796+612.821

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 27-32

Influence of psychoemotional stress on the functional state of the neuromuscular system and the efficiency of sensorimotor activity of highly skilled athletes

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Purpose: *assessment of the influence of the level of psychoemotional stress and the effectiveness of mental self-regulation on the functional state of the neuromuscular system and the effectiveness of the sensorimotor activity of highly skilled athletes specializing in complex co-ordination sports (on the example of diving).*

Material & Methods: *study involved 14 high-class athletes (master of sport, international master of sport, honored master of sports) at the age of 15–30 years. To determine the psychophysiological properties of the nervous system of athletes, the diagnostic complex "Diagnost-1" are used. Electroneuromyography was performed on the neurodiagnostic complex "Nicolet Viking Select". For a differentiated assessment of the level of stress, the emotional state of the respondents and also for assessing the effectiveness of mental self-regulation, a technique to select colors was used.*

Result: *interrelation between the effectiveness of mental self-regulation and adaptability, the intensity of existing stress, emotional stability and vegetative balance with electroneuromyographic characteristics, strength and functional mobility of nervous processes, the accuracy of reaction to a moving object and the ratio of the reactions of lead and lag, the efficiency of sensorimotor activity are identified.*

Conclusion: *revealed interrelation of the effectiveness of mental self-regulation and adaptability, intensity of existing stress, emotional stability and vegetative balance with typological properties of the higher parts of the central nervous system and electroneuromyographic characteristics of athletes can have prognostic value and be used to optimize the sports development of promising young people.*

Keywords: *efficiency of sensorimotor activity, electroneuromyography, highly skilled athletes, diving.*

Introduction

A special place in the formation of reliability and effectiveness in sports belongs to the adaptive capabilities of the athlete. Degree of expression of adaptive reactions to the action of external stimuli is one of the main criteria of physical and mental health of an athlete [22] and depends both on the functional reserves of the organism, and on the preliminary adaptation of the athlete's organism to the acting stimulus. Adaptability determines the ability of an athlete to maintain the necessary performance for a long period of time with high efficiency and rapid recovery, which ensures the reliability of achieving high results in sports [8; 29; 30].

It is well known that the formation of a long-term adaptation of the athlete's body to physical loads of different directions leads primarily to improving the effectiveness of sports activities. Physiological adaptation is specific for different types of training loads, typical for different sports. In order to achieve a specific physiological adaptation, the training program must ensure the workload of precisely those physiological systems that are crucial for achieving optimal results in this sport [24; 27].

As the factors determining the psychological adaptability and success of athletes' performances regardless of sports specialization, some authors singled out: high motivation for achievement, adaptive abilities, an internal locus of control, organization, commitment, perseverance [3; 4; 11; 35]. Their severity differs among representatives of different sports. For example, in artistic sports the most important psychological qualities that determine adaptation to competition are: plasticity, emotionality, mobility of nervous processes, emotional stability, low internality in the field of failures. In martial arts positively affect the adaptation to the competition: the power of excitement, aggressiveness in combination with mental stability, the desire for «struggle» and domination [11]. It is known that the unique variants of adaptation in the sport of higher achievements are best overcome by individuals with a mosaic type of functional asymmetry of the brain [12].

Thus, the problem of adapting to strained physical loads with different types of energy supply depending on the individual characteristics of athletes remains one of the topical problems of biology and medicine, psychology and physiology of sports [20; 21; 26].

One of the methods for predicting the reliability and success of sports activities is to monitor the functional state of the central nervous system of athletes in conjunction with their individual and typological characteristics [6; 14; 18; 31]. To evaluate the functional state of the neuromuscular apparatus of athletes, the application of electroneuromographic (ENMG) study with determination of parameters of the H-reflex, which is a monosynaptic reflex response that is diverted from the muscle (in this case soleus muscle of the leg) under conditions of electri-

cal stimulation of its low-threshold sensitive fibers that make up the mixed nerve [1; 9; 10].

Relationship of research with scientific programs, plans, themes. In carrying out complex biological research with the participation of athletes in accordance with the principles of bioethics, the theory and methodology of sports training and reserve capabilities of athletes developed by the Research Institute NUPESU "Programs for a comprehensive biological study of the features of athletes' functional capabilities," as well as the health care legislation of Ukraine and the Helsinki Declaration of 2000, the European Society Directive 86/609 on the participation of people in biomedical research [32].

The work was carried out in accordance with the state budget research theme 2.2п «Technology prediction of the economic development in the instants of the resettlement» (State Registration No. 0117U002385) of the Ministry of Education and Science of Ukraine.

Purpose of the study: assessment of the influence of the level of psychoemotional stress and the effectiveness of mental self-regulation on the functional state of the neuromuscular system and the effectiveness of the sensorimotor activity of highly skilled athletes specializing in complex co-ordination sports (on the example of diving).

Material and Methods of the research

The study involved 14 high-class athletes (MS, MSIG, HMS) at the age of 15–30 years (sport – diving). To determine the psycho-physiological properties of the nervous system of athletes, the diagnostic complex "Diagnost-1" [14; 17; 19; 20; 31]. Electroneuromyographic study was performed on the neurodiagnostic complex Nicolet Viking Select (USA-Germany). A technique was used to determine the rate of conduction of a nerve impulse along the motor fibers of various nerves of the upper and lower extremities, as well as the H-reflexometry [1; 9; 10].

When examining the upper extremities, tested athlete was in a sitting position; his arms were freely placed on the couch. Electrical stimulation of the median nerve (*n.medianus)* was performed in the wrist and elbow joint area with the registration of the M-response (direct muscle response to irritation of motor nerve fibers) from the muscle that leads the thumb (*m.abductor pollicis brevis)*; stimulation of the ulnar nerve (*n.ulnaris*) in the region of the wrist and elbow joint with the registration of M-responses from the muscle that leads the little finger (*m.abductor digiti minimi).*

When examining the lower limbs, the athlete was lying on his stomach, his feet freely hanging from the couch. H-reflex soleus muscle (*m.soleus*) was caused by bipolar percutaneous stimulation of the tibial nerve (*n.tibialis*) in the popliteal fossa. In determining the rate of nerve impulse conduction through the motor fibers of the tibial nerve (*n.tibialis*), stimulation was conducted in the popliteal fossa and the posterior region from the medial epicondyle and M-responses were recorded from the muscle of the short flexor of the fingers (*m.flexor hallucis brevis).* For recording electromyographic signals using a pair of standard surface electrodes with interelectrode distance 20 mm.

Following ENMG parameters were analyzed: P_H and P_M (thresholds for the appearance of the H-response and the M-response), P_H/P_M (ratio of the thresholds for the occurrence of H- and M-responses), H_{maks} and M_{maks} (amplitude of the maximum H-response and maximum M-response), H_{maks}/M_{maks} (ratio of the amplitudes of the maximum H- and M-responses in %). Values of impulse conduction velocities were also obtained (ICV) of motor fibers of the tibial, median and ulnar nerves. Indicators for the right limb (RC) and left limb (LC).

To determine the level of existing stress in athletes, M. Luscher's test was used [2; 5; 23; 28]. Stress level indicator (SL) in the range 0–4 points was characterized by low SL, 5–8 points – average and 9–12 points – high level of stress [15; 16]. Integrative index of emotional stability by the M. Lusher test (ES) was calculated by the method proposed in the methods of investigating the functional state of operators [16]. So, 3 points were assigned to the athlete if he is emotionally stable, 2 points – in case of lack of emotional stability and 1 point – when there is an alarm, signs of emotional instability. Valnefer coefficient (VC) – an index of the total deviation from the autologous norm, was used to assess the harmony and internal optimality of the neuropsychic state of athletes [16]. Minimum values of VC are an indicator of adaptability, well-developed mechanisms of self-regulation, lack of signs of fatigue, emotional tension and intrapersonal conflicts. Based on the values of VC, the contingent of the subjects was divided into individuals with a high level of self-regulation and adaptability (VC is 1–10 c.u.), with an average level of self-regulation and adaptability (VC is 11–20 c.u.), with signs of fatigue and a decrease in the level of self-regulation and adaptability (VC more 20 c.u.).

Lusher's test also allowed us to indirectly judge the sympathetic or parasympathetic dominance of activity in the autonomic nervous system of the subjects [16; 34]. For this purpose, the coefficient of vegetative balance of K. Shipos (KS). Value of KS>1 is interpreted as ergotropic dominance (sympathotonia), KS<1 as trophotropic dominance (vagotonia), KS=1 – as vegetative balance, respectively.

Statistical processing of data was carried out using nonparametric statistics. The results were processed by statistical analysis using the computer program STATISTICA 6.0.

Results of the research and their discussion

Of particular interest are studies of the psychophysiological reliability of the athlete, based on the ideas of B. F. Lomov [13] that characterizes the reliability, above all, the potential reserves of the person, and the effectiveness of professional activity – mainly the presence of certain properties [29, 30].

In this study, an attempt was made to identify the criteria for assessing the potential reserves of athletes in complex coordinated sports by analyzing the interrelationships between the effectiveness of mental self-regulation and adaptability of athletes, as well as the relationship between the level of existing stress, emotional stability, vegetative regulation with electroneuromyographic and psychophysiological characteristics.

Overall, 78,57% of athletes with high (21,43%) and medium (57,14%) levels of self-regulation and adaptability were identified among the surveyed sportsmen (Valnefer coef-

ficient from 1 to 20 c.u.), which indicates that most of the athletes – surveyed are sthenic, balanced, have no signs of fatigue, emotional tension and intrapersonal conflicts. At the same time, 21,43% of athletes were identified (Valnefer coefficient more than 20 c.u.) with a low level of self-regulation and adaptability, signs of fatigue and heightened emotional tension.

As you know, a special place in the formation of reliability in sports belongs to the nonspecific reaction of the body to various stress factors: cold, hunger, fatigue, rapid movement, lack of oxygen, blood loss, pain, uncertainty of the situation, and extreme significance of events for the individual – that is, resistance to stress. On the impact of stress factors, the body responds not only with the appropriate protective reaction, but also with a universal process – an adaptation syndrome, that is, mobilization of the organism's capabilities [3; 5; 7; 29; 33; 35].

According to the results of M. Lusher's test, it was revealed that the level of existing stress was low or absent – in 64,29% of the surveyed athletes, average LS – in 28,57% of athletes, high LS – in 7,14% of athletes. Authors admit that it is the athletes with a high level of existing stress that can primarily constitute a risk group for the development of occupational stress [33].

According to the results of the studies, 71.43% of the surveyed athletes had a high (28,57%) and average (42,86%) emotional stability, while 28,57% of the athletes were emotionally unstable.

In addition, the Lusher test allowed indirectly to judge the sympathetic or parasympathetic dominance in the autonomic nervous system of the examined athletes [16; 23]. According to the results of the conducted studies, 57,14% of the examined athletes demonstrated the predominance of sympathetic regulation (sympathotonia), 28,57% – the predominance of parasympathetic regulation and 14,29% – were normotonics. Thus, the surveyed athletes had more pronounced ergotrope dominance.

Correlation analysis of the obtained data showed that the Valnefer coefficient in the examined athletes was not related to age and sports experience. Ratio of the vegetative balance of Shipos criterionwas significantly correlated according to the Spearman criterion with sports experience (respectively r_s=0,55, p<0,05). Same criterion establishes an inverse correlation between the age of athletes and the coefficient of assessing the intensity of existing stress(r_s=–0,68, p<0,05), as well as a direct correlation – between age and the indicator of emotional stability (r_s=0,80, p<0,05). Thus, the increase in sports experience (and, therefore, for athletes of high class – improving sports skills) was associated with an increase in the dominance of sympathetic regulation in the autonomic nervous system. With age, in the examined observed athletes decrease in the level of stress, increased stress resistance and increased emotional stability.

Correlation analysis showed the existence of interrelations between the effectiveness of mental self-regulation and adaptability, the intensity of existing stress, emotional stability and vegetative balance with electroneuromyographic characteristics – speed of conduction of the nerve impulse along the motor fibers of the ulnar nerve and the threshold of the occurrence of the H-response (Table 1). Evealed interrelations of the measured parameters can testify to the mutual influence of the functional state of the neuromuscular apparatus and the neuropsychic state of the athletes. The obtained results confirm the well-known paradigm (postulate) that reactivity (including nonspecific reactivity), as well as individual-typological features of the nervous system, temperament, significantly influences the components of mental health and can contribute to the corresponding disorders of the psyche and personality behavior – affective, neurotic, psychosomatic disorders [7; 25; 35].

Table 1

Correlation links (according to Spearman) psychological characteristics of athletes with electroneuromyographic characteristics (n=14), r_s

Indicators	Correlation links, r_s
Valnefer coefficient – speed of the impulse along the ulnar nerve (right arm), $m \cdot s^{-1}$	0,58*
Indicator of the level of stress – speed of the impulse along the ulnar nerve (right arm), $m \cdot s^{-1}$	0,61*
Indicator of emotional stability – speed of the impulse along the ulnar nerve (right arm), $m \cdot s^{-1}$	–0,56*
Coefficient of the vegetative balance of K. Shiposh – the threshold of occurrence of the H-response (right leg), mA	0,54*

Note. ** – p<0,05.*

Predominance of sympathetic dominance in the functioning of the autonomic nervous system of athletes was associated with large values of thresholds for the appearance of the H-response (values of the stimulatory current needed to obtain the minimal H-response). And such ENMG parameters as the thresholds for the appearance of the M-response, the ratio of the thresholds for the occurrence of H- and M-responses, the amplitude of the maximum H- and M-responses, and the ratio of the amplitudes of the maximum H- and M-responses were not associated with the measured psychological characteristics of athletes.

Correlation analysis of the obtained data revealed the existence of interrelations between the effectiveness of mental self-regulation and adaptability in the examined athletes with the indices of strength and functional mobility of the nervous processes (Table 2), the accuracy of the reaction to the moving object and the ratio of the lead and lag reactions (Table 3). Athletes with the optimal neuropsychic state had a higher functional mobility of the nervous processes, greater strength of the nervous processes and a greater prevalence of advanced reactions in the RMO on the results of three trials.

Coefficient of the intensity of existing stress was related to the indices of the strength of the nervous processes and the efficiency of the sensorimotor activity (see Table 2) and the accuracy of the reaction to the moving object (see Table 3). Stress-resistance of athletes was associated with greater strength of the nervous processes and efficiency of sensorimotor activity, a greater predominance of advanced reactions in the RMO and a smaller number of delayed responses.

Higher the emotional stability of the examined athletes, the greater the effectiveness of sensorimotor activity, determined by the time of minimum exposure of signals in the feedback

Table 2

Correlation (according to Spearman) psychological and psychophysiological characteristics (in feedback and imposed rhythm) among athletes (n=14), r_s

Indicators	Correlation links, r_s
Valnefer coefficient – is an indicator of the functional mobility of the nervous processes (test 5 min)	0,62*
Valnefer coefficient – indicator of the strength of the nervous processes (test 5 min), the number of processed signals in the range of 30–60 s	–0,68**
Valnefer coefficient – indicator of the strength of the nervous processes (test 5 min), number of processed signals in the range of 90–120 s	–0,54*
Stress level indicator - minimum exposure time of signals (test 5 min), ms	0,56*
Stress level indicator – indicator of the strength of the nervous processes (test 5 min), the number of processed signals in the range of 30–60 s	–0,55*
Stress level indicator – показатель силы нервных процессов (тест 5 мин), the number of processed signals in the range of 210–240 s	–0,58*
Indicator of emotional stability – minimum exposure time of signals (test 5 min), ms	–0,54*
Coefficient of vegetative balance of K. Shipos – indicator of the strength of the nervous processes (test 5 min), number of processed signals in the range of 90–120 s	0,56*

Note. ** – p<0,05; ** – p<0,01.*

Table 3

Correlation links (according to Spearman) of psychological and psychophysiological characteristics (reaction to a moving object by the leading hand) among athletes (n=14), r_S

Indicators	Correlation links, r_s	
	by results of the best samples	by results of the three samples
Valnefer coefficient – total number of the leading reaction	–	–0,71**
Valnefer coefficient – ratio of the total number of lead and lag	–	–0,60*
Valnefer coefficient – ratio of total lead and lag	–	–0,58*
Stress level indicator – number of lag reactions	0,54*	–
Stress level indicator – ratio of the total number of lead and lag	–0,54*	–
Stress level indicator – total number of the leading reaction	–	–0,60*
Coefficient of vegetative balance of K. Shipos – total deviation	–0,68**	–
Coefficient of vegetative balance of K. Shipos – average deviation	–0,69**	–
Coefficient of vegetative balance of K. Shipos – average lead	–0,61*	–
Coefficient of vegetative balance of K. Shipos – average lag	–0,54*	–
Coefficient of vegetative balance of K. Shipos – total deviation	–	–0,62*
Coefficient of vegetative balance of K. Shipos – average deviation	–	–0,62*
Coefficient of vegetative balance of K. Shipos – average lead	–	–0,63*
Coefficient of vegetative balance of K. Shipos – average lag	–	–0,63*

Note. ** – p<0,05, ** – p<0,01.*

mode (see Table 2). The predominance of sympathetic dominance in the functioning of the autonomic nervous system of athletes was associated with large values of the strength of the nervous processes (see Table 2) and smaller values of the deviation (lead/lag) in the reaction to the moving object based on the results of the best sample and the results of three samples (see Table 3).

Thus, the specific psychophysiological markers of adaptability can be considered an indicator of the functional mobility of nervous processes, and stress resistance and emotional stability – the effectiveness of sensorimotor activity.

Revealed interrelationships between the effectiveness of mental self-regulation and adaptability, the intensity of existing stress, emotional stability and vegetative balance with the typological properties of the higher sections of the central nervous system and the electroneuromyographic characteristics of athletes may have prognostic value and used for optimization of sports perfection promising young people in this sport.

Conclusions

1. The interrelationships between the effectiveness of mental self-regulation and adaptability, the intensity of existing stress, emotional stability and vegetative balance with electroneuromyographic characteristics – the speed of the nerve impulse along the motor fibers of the ulnar nerve and the threshold of the occurrence of the H-response.

2. It was revealed that the effectiveness of mental self-regulation and adaptability in the examined athletes was associated with the strength and functional mobility of the nervous processes, the accuracy of the reaction to the moving object and the ratio of the lead/lag reactions.

3. Intensity of the existing stress in the studied group of athletes was associated with the indicators of the strength of the nervous processes, the efficiency of the sensorimotor activity and the accuracy of the reaction to the moving object.

4. Emotionally stable athletes demonstrated higher efficiency of sensorimotor activity.

5. Predominance of sympathetic dominance in the functioning of the autonomic nervous system of athletes was associated with greater strength of the nervous processes and smaller values of the deviations (lead/lag) in the reaction to the moving object.

6. Revealed interrelationships of the effectiveness of mental self-regulation and adaptability, the intensity of existing stress, emotional stability and vegetative balance with the typological properties of the higher parts of the central nervous system and electroneuromyographic characteristics of athletes can have prognostic value and be used to optimize the sports development of promising young people.

Prospects for further research in this direction. It is of interest to further study the influence of the level of psychoemotional stress and the effectiveness of mental self-regulation on the functional state of the neuromuscular apparatus and the effectiveness of sensorimotor activity of highly skilled athletes specializing in various sports, with the conduct of a comparative analysis of psychophysiological and electroneuromyographic characteristics.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization

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Received: 19.07.2017.
Published: 31.08.2017.

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SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 796.015.6

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 33-37

An interrelation of physical working capacity and body component composition indicators of amateur athletes

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Purpose: *determine the features of the body component composition and the level of physical performance, as well as the structure of the correlation between these indicators in amateur athletes.*

Material & Methods: *in conditions of the test with physical load with stepwise increasing power in the 71-st physically active person, the reaction of the cardio-respiratory system to physical activity. The body component composition was determined by the bioelectrical impedance method.*

Result: *in amateur athletes, the relative VO_{2max} and power ratings are positively correlated with the relative body water content and have a negative relationship with age, body weight, body mass index, fat content. Oxygen pulse with a high degree of probability positively correlated with body weight, body mass index, metabolic rate, fat-free mass, water content and predictable muscle mass in all body segments.*

Conclusion: *conducted studies indicate a sufficient level of aerobic capacity, overall performance, the efficiency of the cardiac cycle, the functioning of the O_2-transport system and skeletal muscles ability to absorb oxygen from the amateur athletes, and excess fat tissue negatively affects physical performance, overall endurance and achieving high sports results in sports on the endurance.*

Keywords: *physical working capacity, general endurance, body component composition*

Introduction

At the moment, despite the negative trends in the state of health of the population of Ukraine and the general lack of motor activity, increasing attention is paid to the creation of positive motivation for physical culture and health sports activities. It should be noted that in the modern Ukrainian society an understanding of the need to maintain a healthy lifestyle and preserve one's own health as the highest social value. Choice of methods for practicing physical exercises for the health-improving orientation of various groups of the population is mainly conditioned by real circumstances, opportunities, demands, and sometimes is a matter of individual taste and interest [7; 11]. At the same time, most people pursue broader purpose related to lifestyle, in particular, increase work capacity (endurance), increase motor activity, improve general health, correct posture, increase resistance to stress, etc. However, the healing effect is achieved only when the physical load is rationally balanced with the orientation of the individual capabilities of individuals. That is why more and more untrained persons who are just beginning to engage in sports, or physical culture, mainly at the age of 20 and older, pay attention to testing their physical and functional state. Quite often they participate in competitions by half marathon, marathon or triathlon, which requires maximum realization of aerobic capabilities of the body.

It is known that the level of maximum oxygen consumption (VO_{2max}) is an objective criterion for assessing the aerobic capacity (reserves) of the body and the overall physical performance of a person, which is widely used in the decision of issues of professional fitness, assessment of athletes training, diagnosis of the state of the cardiovascular and respiratory systems [1; 2]. And the determination of the maximum oxygen consumption in the test with a stepwise increase in load makes it possible to calculate the lowest operating power at which VO_{2max} reaches approximate to the maximum values. In addition, it has been shown that anthropometric characteristics and body composition are important factors that also affect the athletic result in many sports, in particular, in the triathlon and marathon [13; 14; 18; 19].

Relationship of research with scientific programs, plans, themes. The work was carried out in accordance with the state budget research topic "Technology of individualization of the training process on the basis of physiological criteria" (the number of state registration of the topic No. 0117U002388) of the Ministry of Education and Science of Ukraine.

Purpose of the study: determine the features of the body component composition and the level of physical performance, as well as the structure of the correlation between these indicators in amateur athletes.

Material and Methods of the research

Testing was conducted after a day of rest with a standardized food and drinking regimen. The persons, who were tested, were acquainted with the contents of the tests, measurement procedures and agreed to conduct them. The content of the maximum test loads and procedures for measuring physiological indicators corresponded to the International Rules and Requirements for Biomedical Research involving people. In conducting complex biological surveys with the participation of amateur athletes adhered to the Helsinki Declaration of the World Medical Association on Ethical Principles of Medical Research with the participation of a person as an object of

research [5].

71 physically active men who plan to practice triathlon and long-distance running along the highway took part in the testing. According to the data of the dispensary surveys, the entire study was practically healthy.

Body composition was studied using bioelectrical impedance analysis (Tanita-BC-418MA analyzer, Germany), which is available, non-invasive, fast and informative [15].

Reaction of the cardio respiratory system of the body to the physical loads of the aerobic and anaerobic nature of power supply was studied in standard laboratory conditions using the LE2000C treadmill and Oxicon Pro ergospirometric complex (Viasys Healthcare, USA-Germany). Taking into account that the measurements were carried out in an open system, the external respiration rates were brought to BTPS conditions, and gas exchange to STPD conditions. To assess physical performance, a test was used with a step-increasing load from the initial speed of 8 km·h^{-1} the speed (by 0,5 km h^{-1}) was increased every 2 minutes and the angle of the track(on 0,2%). Testing was carried out until the moment of "strong-willed fatigue" (arbitrary failure of the examinee from the continuation of work) or to the inability to maintain the specified speed within ±5%. Results of the test determined the level of maximum oxygen consumption (VO_{2max}), absolute and relative performance (W, W kg^{-1}) [1]. Heart rate (HR, beats · min^{-1}) was recorded by radiotelemetric pulsometry (Sport Tester Polar-810i, Finland). Level of hematocrit in the peripheral blood was determined by the impedance method (HTI MicroCC-20 Plus, USA).

Results of the competitive activities were studied according to the half-marathon competition protocols, for which we determined the average speed of overcoming the distance of 21 km.

Statistical processing of the results was carried out using the Statistica 6.0 application software package using nonparametric methods, regression and correlation analysis (according to Spearman) [10].

Results of the research and their discussion

Results of the analysis of the body component composition showed that among the amateur athletes aged 22–51 years, the fat content was varied from 4,9 to 25,3% (3,5–24,9 kg), body mass index (BMI) from 19 to 30,8, mass of fat-free tissue from 54,8 to 85,7 kg, water content in the range of 40,1–62,7 kg (54,7–69.7%). The significance of the median of these indicators and the parameters of segmental analysis of the body composition are presented in Tables 1.

Table 1

Body component composition in amateur athletes (Me [25%; 75%])

Indicators	Amateur athletes
Age, years	33 [30,0; 39,0]
Height, cm	180 [176; 184]
Body weight, kg	79,4 [73,1; 86,5]
Body mass index kg·m^{-2}	24,8 [23,5; 26,5]
Fat content %	16,5 [12,8; 20,5]
Fat weight kg	12,8 [9,1; 16,7]
Weight of fat-free tissue, kg	67,0 [62,6; 71,6]
Total amount of water, kg	49,0 [45,8; 52,4]
Water content %	61,2 [58,2; 64,3]
Segmental analysis of body composition	
Right leg	
Fat content, %	14,6 [11,4; 17,9]
Fat weight kg	2,0 [1,5; 2,4]
Weight of fat-free tissue, kg	11,4 [10,8; 12,1]
Estimated muscle mass, kg	10,8 [10,2; 11,5]
Left leg	
Fat content, %	15,1 [12,3; 17,3]
Fat weight kg	2,0 [1,5; 2,4]
Weight of fat-free tissue, kg	11,0 [10,5; 11,9]
Estimated muscle mass, kg	10,5 [10,0; 11,3]
Right arm	
Fat content, %	15,7 [13,3; 17,5]
Fat weight kg	0,7 [0,6; 0,9]
Weight of fat-free tissue, kg	3,9 [3,6; 4,2]
Estimated muscle mass, kg	3,7 [3,4; 4,0]
Left arm	
Fat content, %	16,2 [13,9; 18,0]
Fat weight kg	0,8 [0,6; 0,9]
Weight of fat-free tissue, kg	3,9 [3,7; 4,3]
Estimated muscle mass, kg	3,7 [3,4; 4,0]
Torso	
Fat content, %	18,1 [12,5; 21,3]
Fat weight kg	7,4 [5,4; 10,2]
Weight of fat-free tissue, kg	36,4 [34,1; 39,3]
Estimated muscle mass, kg	35,0 [32,8; 37,7]

According to WHO, the level of VO_{2max} is one of the most informative indicators of the functional state of the cardio respiratory system, aerobic capacity and human health level, so we conducted a test with a step-by-step load. Results of the research showed that VO_{2max} amateur athletes compiled 3,78 [3,44; 4,12] l·min^{-1}, or 46,8 [41,5; 50,6] ml·min^{-1}·kg^{-1}. This is generally consistent with the values proposed by WHO as one of the criteria for the level of health – 3,5 l·min^{-1}, or in terms of 1 kg mass – 45 ml·min^{-1}·kg^{-1} [9]. At the same time, other indicators of physical performance were as follows: absolute power – 281 [259; 319] W, relative power – 3,55 [3,27; 3,89] W·kg^{-1}, HR – 182 [175; 187] beats·min^{-1}, oxygen pulse – 20,5 [18,6; 22,4] ml·beats^{-1}, ventilation equivalent for O_2 – 33,5 [30,7; 35,3] standard unit. These data indicate generally a sufficient level of aerobic capacity, overall health, the effectiveness of the cardiac cycle and skeletal muscle's ability to absorb oxygen in amateur athletes.

Earlier, we showed that the level of physical performance of amateur athletes depends on the length of the sports training and the age at which the amateur began to systematically train [8]. Since according to literature sources, the factors that can affect the VO_{2max}, indicators are the body weight and its component composition [3; 6; 13]. We analyzed the structure of correlation links between the indices of the body's composition and physical performance. The results showed that amateur athletes relative indicators VO_{2max} and the power has a positive relationship with the relative content of water in the body and a negative relationship with age, body weight, BMI and fat content (Table 2). In addition, the absolute and relative fat content in individual body segments also have a negative relationship with the VO_{2max} level and exercise power. That is, the greater the fats content in both individual body segments, and in general for a beginner athlete, the lower his level of

overall physical performance. Our results are consistent with the data of other authors who obtained similar data on the negative relationship between fat content and the developed load power for other sports [16; 17].

It is known that during the operation of submaximal power, the greatest shifts occur in the activity of the cardiovascular and respiratory systems, therefore, it was expedient to investigate the structure of the correlation between the oxygen pulse, the ventilation equivalent of O_2 and the body component composition of amateur athletes. Results showed that the oxygen pulse with a high degree of probability positively correlated with the following parameters: body weight, BMI, metabolic rate, fat-free mass and water content (Table 2). In all segments of the body, this indicator should have a significant positive relationship with lean and predictable muscle mass. Such results are quite logical, since it is known that when submaximal power is operating, the largest consumer of oxygen is working muscles [4].

In addition, we conducted a correlation analysis of the interrelationships of the body component composition, indicators of physical performance and the main hematological parameters of peripheral blood. It was found that the hematocrit level correlated with body weight (r=0,3329; p<0,05), BMI (r=0,33653; p<0,05) and relative fat content (r=0,3341; p<0,05). An increase in body weight under physiological conditions requires an increased intake of oxygen, which is satisfied by the growth of the hematocrit, which indicates an increase in the oxygen capacity of the blood. It is likely that an increase in the level of hematocrit is necessary to ensure the oxygen demand of muscle mass [9].

In the analysis of the correlation between the ventilation equivalent of O_2 and the component body composition, no statistically significant results were found.

To determine the relationship between the indicators of physical performance of the men under study based on the

Table 2

Correlation relations (according to Spearman) between the indices of physical working capacity and the body component composition of amateur athletes

Indicators	Correlation relations, r_s		
	VO_{2max}, $ml \cdot min^{-1} \cdot kg^{-1}$	Power of work, $W \cdot kg^{-1}$	O_2/HR $ml \cdot beats^{-1}$
Age, years	–0,235*	–0,188	0,106
Height, cm	–0,109	0,064	0,347**
Body weight, kg	–0,338**	–0,222	0,437***
BMI, $kg \cdot m^{-2}$	–0,373**	–0,319**	0,232
Metabolism, kcal	–0,201	–0,028	0,514***
Fat content %	–0,297*	–0,479***	0,024
Fat weight kg	–0,339**	–0,462***	0,163
Fat-free mass, kg	–0,173	0,026	0,524***
Water, kg	–0,178	0,021	0,525***
Water content, %	0,304**	0,454***	0,009
Segment analysis			
Right leg			
Fat content, %	–0,293*	–0,455***	0,063
Fat weight, kg	–0,331**	–0,434***	0,185
Fat-free mass, kg	–0,185	–0,012	0,499***
EMM, kg	–0,180	–0,003	0,504***
Left leg			
Fat content, %	–0,318**	–0,459***	0,070
Fat weight kg	–0,338**	–0,425***	0,211
Fat-free mass, kg	–0,184	–0,049	0,496***
EMM, kg	–0,190	–0,051	0,521***
Right arm			
Fat content, %	–0,339**	–0,476***	0,017
Fat weight, kg	–0,397***	–0,404***	0,179
Fat-free mass, kg	–0,111	0,017	0,563***
EMM, kg	–0,123	0,021	0,544***
Left arm			
Fat content, %	–0,289*	–0,469***	–0,007
Fat weight kg	–0,350**	–0,400***	0,221
Fat-free mass, kg	–0,152	0,032	0,521***
EMM, kg	–0,157	0,030	0,525***
Torso			
Fat content, %	–0,272*	–0,479***	0,011
Fat weight, kg	–0,310	–0,451***	0,138
Fat-free mass, kg	–0,191	0,052	0,494***
EMM, kg	–0,191	0,050	0,494***

Note. ** – p<0,05; ** – p<0,01; *** – p<0,001; EMM – estimated muscle mass.*

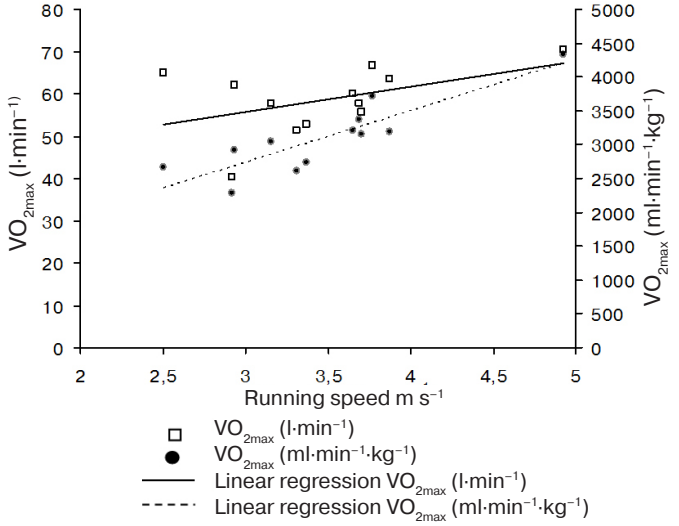

Fig. 1. Dependence of run speed on a distance of 21 km from indicators of physical working capacity in amateur athletes

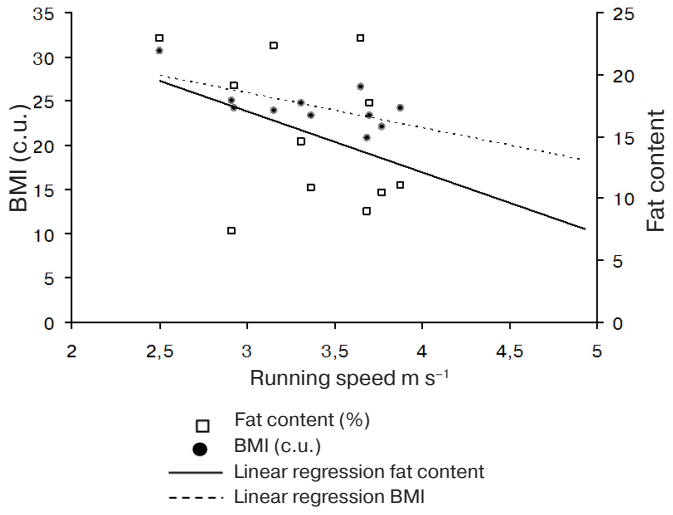

Fig. 2. Dependence of running speed on the distance of 21 km from the body composition indices of amateur athletes

results of laboratory tests and the average running speed at a distance of 21 km, which characterizes working capacity in conditions of competitive activity, we used linear regression models. Figure 1 shows the regression models illustrating the dependence of the average running speed of absolute and relative maximum oxygen consumption. Angle of inclination of the regression lines indicates that the relative level of VO_{2max} in low-training persons is a more objective indicator of achieving high physical performance than the absolute VO_{2max}.

Following regression models (Figure 2) illustrate the dependence of the average running speed on the body mass index and fat content in amateur athletes. The angle of inclination of regression lines indicates that the fat content of low-training persons is a more objective indicator, important for an amateur athlete to achieve high physical performance than the body mass index.

Conclusions

The results of the studies show that amateur athletes have a sufficient level of aerobic capacity, overall physical performance, cardiac cycle and the ability of skeletal muscles to absorb oxygen. At the same time, excess fat tissue negatively affects the level of physical working capacity, overall endurance and achievement of high sports results in sports for endurance. Created regression models confirm the dependence of speed running on relative oxygen consumption and fat content.

Prospects for further research consist in determining the age-specific performance trends for amateur athletes.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 19.07.2017.
Published: 31.08.2017.

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UDK 96.323.2+796.015.31

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 38-40

Increase the level of preparedness of qualified basketball players in the preparatory period

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Purpose: *to study the adaptation of basketball players of student teams to training loads during the preparatory period of the annual cycle of training on the parameters of motor qualities and functional readiness.*

Material & Methods: *conducted a survey of 12 basketball players on the team (Sumy, the highest league of the Ukrainian Basketball Championship). The following research methods were used: theoretical analysis of literary sources, methods of mathematical statistics, anthropometry and pedagogical control.*

Result: *dynamics of changes at the stage of preparation for the season is shown. It is established and observed that under the influence of training sessions in the examined basketball players, not only the optimization of the functional systems of their organism, but also the level of the functional state of the organism as a whole.*

Conclusion: *assessment of the functional condition of the athlete's body should play an important role in the overall system of medical and biological control in connection with significant additional information on the state of their body and the possibility of timely correction of physical activity and the provision of preventive measures. It is determined that during the preparatory period the level of motor qualities and functional readiness of the basketball players increased.*

Keywords: *basketball players, functional readiness, special working capacity, motor qualities, diagnostics.*

Introduction

Training of professional athletes from any sport is the choice of an effective training strategy, organizational form, appropriate training methodology and other. Vital orientation to professional sports requires additional organization of the athlete's life in connection with the laws of achieving professional sports results. Preparation of an athlete for successful performance at competitions is an improvement of the functioning systems of the athlete's body: muscular, cardiovascular, respiratory and nervous, taking into account his natural capabilities.

In connection with the increase in motor and gaming activity of basketball players in training and playing, which are characterized by a continuous change in the actions of players, an unusual alternation of the phases of load and rest, problem of developing the level of special working capacity of qualified basketball players and the means of controlling it becomes especially urgent. An important factor that affects the special performance of a basketball player is the level of development of the athlete's functional systems and his motor qualities.

In the preparatory period, the process of increasing the special working capacity of basketball players largely depends on the correct selection and distribution of means and methods of training. For this it is necessary to have objective data on the level of preparedness of each player at the individual stages of preparation.

Purpose of the study: to determine the level of development of motor qualities and functional training of qualified basketball players in the preparatory period.

Material and Methods of the research

Methods of research: theoretical analysis of literary sources, methods of mathematical statistics, anthropometry and pedagogical control.

12 basketball players of the team of the higher league of Sumy State University took part in the research. Role of players: center – three people, attackers – four, defenders – five people.

Athletes are examined regular check-ups, pedagogical tests, individual medical and pedagogical control.

Results of the research and their discussion

In modern basketball there is a tendency to increase in competitive and training loads [1; 2; 7]. Particular attention in the preparation of athletes, researchers and practitioners pay attention to the nature and content of the loads that are used in the training process [5].

In connection with this, the problem of optimizing all components of the training process arises sharply, the task of adequate functional training of players, capable of providing high special performance throughout the season. Solution of these issues only at the expense of increasing the volume and intensity of training loads is limited both by the biological capabilities of man and by social factors [9]. A feature of modern basketball is the growing intensity of the game and the tough athletic struggle on the entire court. These features are a consequence not only of rationalization of technology and tactics, but above all a higher level of special work ability of basketball players [6; 7].

According to V. N. Platonov, M. M. Bulatovoy, J. L. Kozina, L. V. Grin (2009), physical preparedness is characterized by the capabilities of the functional systems of the body of the athlete, providing effective competitive activity.

Preparatory period has its structure – stages, the work in which is aimed at improving general and special training, increasing the functionality of the basic systems of the body, development of physical abilities, the formation of technical, tactical and psychological preparedness, as well as to identify technical and tactical errors and their correction.

At each stage of the preparatory period, it is necessary to bring the basketball player's body to a new level and hold it for a certain period of time.

Preparatory period of the basketball team of Sumy State University (SSU) of the highest league of the championship of Ukraine began in August 2016. An important factor in the work of the coaching staff at the beginning of the preparatory period was the establishment of the level of functional preparedness of the players.

At the beginning of the study, the following parameters of athletes were determined: age (years), body length (cm), body weight (kg), body length with arms raised up (cm) and arm span (cm). Obtained resulting data are shown in Table 1.

During the pedagogical experiment, tests were conducted to measure the speed, strength and speed endurance of qualified team basketball players SSU.

Motor qualities of basketball players were determined with the help of tests: standing long jump, upward jump, a throw of a ball from a sitting position, a run on 30 m. Speed capabilities of basketball players were checked with the help of a tapping test for 10 seconds, a run on 30 meters from flying start, a run of 60 m. Speed endurance was assessed with the help of such tests: "shuttle run" 4x30 m, 200 m run.

Diagnosis of the level of preparedness and functional capabilities of the studied athletes revealed the weaknesses and strengths of each basketball player and this allowed the formation of individual training programs – a further training process required the inclusion of exercise complexes to increase the level of power, speed capabilities and speed endurance.

Obtained data results of the study are given in Table 2 [8].

Functional preparedness at the beginning and at the end of the preparatory period was determined using the PWC_{170} est with a measured physical load, Harvard step-test, Ruthier's test, Stange's and Genci's tests. Obtained data results of the study are given in Table 3 [8].

Table 1

Average values of age, body weight and anthropometric performance of a team of qualified basketball players SSU (n=12)

Indicators	$\bar{X}$	σ
Age	22,63	3,22
Body weight (kg)	82,25	8,72
Body length (cm)	192,25	7,13
Body length with arms raised upl (cm)	244,25	7,24
Arm span (cm)	194,58	7,86

Conclusions

As a result of pedagogical testing, the indicators of the physical and functional preparedness of the SSU basketball team were obtained and tracked for their change during the preparatory period. It is determined that during the preparatory period the state of physical preparedness and physical performance of athletes improved.

Physical readiness of the qualified basketball team of the SSU team at the beginning of the preparatory period corresponded to the average of 50% of basketball players had satisfactory physical preparedness, 50% – good and excellent.

Table 2

Correlation between the results of the motor performance indicators of a qualified basketball players team SSU (n=12), %

Name of test		Evaluation		
		"Satisfactory"	"Good"	"Good"
Standing long jump	At the beginning of PP	8	25	67
	At the end of PP	0	33	67
Upward jump	At the beginning of PP	0	33	67
	At the end of PP	0	25	75
Throw of a ball	At the beginning of PP	50	33	17
	At the end of PP	25	50	25
Run on 30 m	At the beginning of PP	25	42	33
	At the end of PP	8	50	42
Tapping test 10 s number of movements	At the beginning of PP	25	25	50
	At the end of PP	8	33	59
Run on 30 m from flying start	At the beginning of PP	33	42	25
	At the end of PP	17	50	33
Run on 60 m	At the beginning of PP	50	33	17
	At the end of PP	8	59	33
"Shuttle run" 4x30 m	At the beginning of PP	33	50	17
	At the end of PP	25	58	17
Run on 200 m	At the beginning of PP	25	42	33
	At the end of PP	17	50	33

Note. *PP – preparation period.*

Table 3

Evaluation of the functional readiness of a qualified basketball players team SSU (n=12)

Tests, samples	Beginning of the preparatory period		End of the preparatory period		$\bar{X}_2 - \bar{X}_1$	Evaluation at the end of PP
	$\bar{X}_1$	σ	$\bar{X}_2$	σ		
PWC170, c.u.	2089,2	378,39	2196,5	352,92	+107,3	High
IHST, c.u.	91,10	2,68	93,29	3,12	+2,19	High
Ruthier's test, c.u.	4,23	0,44	3,59	0,59	–0,69	High
Stange's test, c.u.	82,30	10,22	84,41	11,61	+2,11	Above average
Genci's tests, c.u.	57,87	2,05	58,91	2,87	+1,04	Above average

Correction of the training process allowed improving the state of physical and functional preparedness, as well as the state of physical performance. Physical preparedness of qualified basketball players at the end of the preparatory period revealed the following: 25% – satisfactory preparedness, 75% – good and excellent. Physical performance of athletes at the end of the preparatory period was assigned to the functional level of «good». It is determined that during the preparatory period the state of physical preparedness and physical performance of athletes improved.

Prospects for further research. In the future it is planned to develop model characteristics of the special preparedness of qualified basketball players in the annual macrocycle.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 20.07.2017.
Published: 31.08.2017.

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SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 373.5.015.311:613.8(477)

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 41-44

Physical education problems of 5–9 grade pupils in the context of health preservation

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Purpose: *determination of the causes of deterioration of health and related problems of physical education of 5–9 grade pupils.*

Material & Methods: *analysis of the causes and definition of the behavioral characteristics of pupils in relation to physical education was studied during 2012–2017 in one parallel class. In the experiment conducted in two stages, 52 pupils of the secondary school No. 1 of Melitopol took part. In the study used questionnaires, analytical, comparative, experimental and statistical methods.*

Result: *tendency of deterioration of pupils health during training in middle classes is proved; obtained data in accordance with the typology compiled reflect the awareness of some students health as a means of raising the status, as well as the failure to understand half the researched values of physical education in maintaining health and disinterest in physical education.*

Conclusion: *problems of school physical education are determined by the low level of the culture of health of the entire Ukrainian society.*

Keywords: *problems of pupils physical education, deterioration of health, behavioral characteristics.*

Introduction

Problems of physical education in the context of maintaining the health of the younger generation are directly related to the tendency of worsening of the somatic state – the development of chronic morbidity and functional disorders that limit the social capacity of the individual. The relevance of this relationship was first argued at the state level in 1974 in a document called "the report of Mark Lalonde". In the report, according to the Minister of Health of Canada, the main causes of the nation's ill health were identified as lack of physical activity and neglect of personal hygiene rules, reflecting the low level of physical education in the country [10, pp. 10–12].

Since the middle of the eighties of the last century, physicians began to register an increase in mental health disorders of European youth, directly related to physical illness and physical inadequacy, and as a consequence – the development of social ill health. Such facts indicate that the problems of the upbringing of a healthy generation in the late XX – early XXI centuries are becoming global, as evidenced by the findings of the WHO on accumulated and acquired diseases by the age of 13–15 [9, pp. 206].

Analysis of scientific works has shown that the leading countries of the world are actively developing theories and teaching practices in the field of physical education, physical education and a healthy lifestyle. Scientific works of such domestic and foreign scientists as Y. Bliznyuk, A. Golovchenko, V. Druz, B. Kram, T. Krutsevich, V. Lah, G. Allport, K. Rogers, E. Sutich, R. Schneider and others researchers are of undoubted practical interest in solving these issues. However, despite a large number of publications, the relevance of the problems of the effectiveness of physical education of pupils is preserved, since only 7% of Ukrainian children and adolescents have a satisfactory functional state of the body, which is caused both by objective and subjective reasons [5, pp. 110]. It is this context of the deterioration of health and the determination of the degree of personal interest of students in physical education and motivation for physical education and sports have become the reason for our study.

Purpose of the study: determination of the causes of deterioration of health and related problems of physical education of 5–9 grade pupils.

Material and Methods of the research

Analysis of the causes and the determination of behavioral characteristics of pupils for physical education were studied during 2012–2017 in one parallel of classes. Grades 5–9 of the school No. 1 of Melitopol took part. Study used questionnaires, analytical, comparative, experimental and statistical methods.

Results of the research and their discussion

Analysis of scientific works showed that the level of students' health often reflects the degree of efficiency of physical training. In order to find out the reasons for the increase in the incidence of pupils in this relationship, we conducted a study, the experimental part of which included two stages: study of the dynamics of deterioration of health and the elucidation of the value-motivational causes of different attitudes toward physical education, physical culture and health in general.

As the tools of the experiment, questionnaires, the analysis of school medical documents, interviews with the school physician and class teachers were used, focus groups were organized with children and their parents, data on general academic performance.

So, at the first stage, in order to determine the dynamics and trends in the deterioration of schoolchildren's health, we analyzed the state of health of 52 students who, at the beginning of the experiment in 2012, moved to the 5A and 5B classes

and at the end of it in 2017 finished 9 classes. All students were identified in the relevant health groups according to the "Instruction on the division of schoolchildren into groups for physical training" [3, add. 1]. Throughout the period under study, the health status of the schoolchildren under study was monitored, while the dynamics of its deterioration were recorded. Negative changes in the health of the groups studied were reflected in the Table 1.

Analysis of the results of this stage of the study showed that the composition of students in different health groups begins to change in the direction of its deterioration in the transition from class to class. At the same time, during the training period, the general health of students deteriorated from 81% in the 5th to 85% in the 9th grade.

Objective causes of negative dynamics are seen in the following:

1) transfer of students from primary to secondary schools has dramatically increased both the physical and psychological stress, which required special adaptive efforts, and with which the growing organism is not always able to cope without negative consequences;

2) most transfers to a weaker group of health occurred at the end of the second half of the year, which indicates the accumulated fatigue and distress in most students;

3) data reflected in Table 1 indicate a sharp change in the composition of groups in grade 7, which is explained by both physiological changes in the body of pupils, and with manifested pathologies.

Subjective reasons are presented in the analysis of personal representations: thus, a survey of pupils and their parents on the relationship between physical education, physical culture and health showed the following:

1) idea of the goals and objectives of physical education in the context of maintaining and promoting health is limited to the knowledge of the need for exercise, but does not include indicators such as the regime of the day, proper nutrition, psycho-hygiene and self-examination;

2) in most cases, respondents showed indifference or passivity in relation to physical education;

3) physical culture of the individual is determined by the majority of students as a temporary state, and not as a permanent style in life [1, pp. 87–93].

Requirements of the State Educational Standard of Ukraine in the section "Health and Physical Culture" determine the need for personal motivation for the conduct of a healthy image and physical training as systemic elements of the physical education of pupils [7, p. 95].

Therefore, in the second stage of the study, based on the method of E. Rakhimova, adapted to the conditions of the experiment, a classification was made of students according to the types of behavioral characteristics of the personal attitude to physical education and health [8, pp. 135–137]. This classification of ninth-graders, drawn up in 2017, was reflected in Table 2.

Results of this stage of the study, conducted in the 2016-2017 school year among students 9A and 9B classes of school № 1 in Melitopol, in accordance with this classification showed, that the attitude to health in the individual hierarchy of values reflects its place in the system of terminal values of the student. Thus, pupils of type IV as the main motive for physical training assume a struggle in the labor market, that is, health is a tool for achieving the goal. In types I, II and III, health stands in 2nd place, in V – by 3, and its recognition as a social value is in last place.

Place of health in the individual hierarchy of students' values is reflected as follows:

1) Pupils of II health type and physical development as a means of self-esteem are on the 1st place, and as practical value – on the latter, that is, for this type of health is not a means of achieving life goals in the future adulthood;

Table 1

Trends in the deterioration of student health during secondary school

Year of study	Class	Number of students	Division into health groups	Correspondence of pupils	
				amount	%
2012–2013	5	52	Basic	10	19
			Preparatory	30	58
			Special	12	23
2013–2014	6	52	Basic	10	19
			Preparatory	29	56
			Special	13	25
2014–2015	7	52	Basic	9	17
			Preparatory	25	48
			Special	18	35
2015–2016	8	52	Basic	9	17
			Preparatory	19	37
			Special	24	46
2016–2017	9	52	Basic	8	15
			Preparatory	19	37
			Special	25	48
In five years of study:				52	100

Table 2

Classification of behavioral characteristics of 9 classes pupils to training in health and physical culture

Type	Characteristics of types	Methods of physical education in the context of health	Correspondence of pupils	
			Amount	%
I	A conscious choice of physical training and sports at the level of mentality	Active physical exercise or sports, health systems are used	2	3,8
II	A healthy lifestyle and physical training are a habit	Regularly used exercise, common classes of street parkour and street workout	4	7,7
III	Physical education is influenced by the social environment	Regularly follow the rules of personal hygiene and often enough do exercise	7	13,5
IV	Pragmatic type, where health is a means of increasing social status	A positive attitude to physical culture, it is difficult to single out specifically applied exercises	13	25
V	Uninterested in maintaining health, passive to physical training	Do not lead a healthy lifestyle, rarely do physical exercises and hardening	26	50
Total students of 9 classes:			52	100

2) I, III and IV types showed high individual importance of health as a value and a high level of motivation to strengthen it by means of physical culture and sports;

3) V type of the 9th grade pupils showed a lack of understanding of the need for physical education and a healthy lifestyle, and the possibilities of the disease appear in the too distant future.

A comparative analysis of the value-motivational causes of insufficient health care has shown quite contradictory results:

– in types I and II there are no factors that make it difficult to take care of one's own health, engage in physical culture and sports;

– Pupils of type III motivate the irregularity of employment by the lack of free time and the presence of more important cases;

– IV type physical self-education is hampered by the lack of free time and conditions for physical training;

– pupils of the V type lead the maximum number of factors that allegedly prevent them from taking care of their own health and exercise, as follows: lack of will power, lack of time, like-minded people, appropriate conditions for physical exercises, and the need for greater material costs.

At the same time, the emotional block reflects the level of anxiety in relation to one's own health and the ability to enjoy them in all types – in case of well-being, positive emotions are experienced: calmness, inner contentment and lack of indifference and, conversely, with worsening of health – anxiety, fear, irritation and depression. Thus, the revealed differences allow us to assert that health for all pupils is a universal value.

Analysis of the obtained results of the conducted research makes it possible to identify universal and specific problems of physical education of Ukrainian pupils of grades 5-9. So, universal problems for all ages of students are a lack of understanding of the value of physical education in the context of health preservation, and specific ideas about the content and quantity of physical exercises depend on gender, age and personality characteristics.

Specific problems are those reflecting the specific conditions for the socialization of the student's personality, for example, in pupils of grades 5-6, formation of ideas about the need for physical education depends on intra-family relations, since even marginal behavior of parents is a role model for children [2, pp. 95].

Pupils of grades 7–8 demonstrate a relationship with respect to physical education and sports from the social environment and, accordingly, selected role models.

In the 9th grade, a lifestyle is consciously chosen that corresponds to the level of physical education of the individual: for some pupils, physical activity and a healthy lifestyle become the norm, and for another category of boys and girls – unhealthy lifestyle and associated bad habits are perceived as "normal good", without realizing the negative consequences for health in the future.

Thus, an analysis of the results of the study gives grounds for the following conclusions.

Conclusions

1. Deteriorating health of pupils is a persistent trend for all ages of education in the middle classes, with the seventh graders being the most vulnerable, which is caused both by accelerated physiological changes and provoked pathologies, and by a low level of physical education.

2. Main problem of physical education of pupils of grades 5–9 is a low level of culture, manifested in the insufficient representation of students and their parents about its value in maintaining health.

3. Level of the pupil's personal motivation for physical education, physical education and sports, the formation of a healthy lifestyle directly depend on the social environment. Accordingly, in the conditions of marginalization of Ukrainian society, the teacher of physical culture is often unable to independently correct the gaps of family physical education. So, even Plato, philosopher and Olympian noted that under normal conditions in the family "there is no need to seek help from doctors, since the need for them is evidence of poor upbringing and debauchery" [6, pp. 411].

Prospects for further research in this direction consist in modeling the process of competent physical education of pupils in the context of the preservation of health by all subjects of the educational process.

Conflict of interests. The author declares that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 02.06.2017.
Published: 31.08.2017.

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SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 796.525+796.015.5

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 45-48

Attention indicator dynamics of qualified climbers influenced by hypoxic training during the overcoming various altitude levels of Mount Elbrus

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Purpose: *to determine the effect of hypoxic training on the attention indicators at different altitudes when crossing the Mount Elbrus.*

Material & Methods: *the study of various attention indicators with the participation of control (n=16) and experimental (n=12) groups with the use of interval hypoxic training (IHT) in the 15–15 mode with breathing through the system into a confined space in the experimental group and using the methods of mathematical statistics are carried out.*

Result: *studies have made it possible to determine that the use of the regime of discontinuous hypoxia 15–15 in the training process of the pre-competitive period contribute to an increase in attention rates that affect adaptation to the load under hypoxia conditions.*

Conclusion: *results of the conducted studies indicate that the use of IHT in the 15–15 mode in the period before the ascent to Mount Elbrus allows to significantly increase the attention rates of qualified climbers at different altitude levels.*

Keywords: *climbers, hypoxic training, altitude level.*

Introduction

Many mountaineers note the difficulties in performing work in the highlands [4]. With muscle activity of high intensity, there is a discrepancy between the rate of oxygen delivery to the muscles and their increased metabolic needs. This leads to a mismatch in the oxygen delivery of the oxygen request of the tissue, the development of subcompensated and decompensated hypoxia [9].

Effectiveness of the oxygen regimes of the body – the ratio between the speed of the phased delivery of oxygen and the rate of its consumption – increases with exercise [1; 4; 6].

As the saturation of arterial and venous blood with oxygen decreases and the oxygen tension in the blood system decreases, one can assess the degree of hypoxemia, and the oxygen tension in tissues and mixed venous blood – the measure of tissue hypoxia [3; 5], which developed.

State of hypoxia (oxygen deficiency) occurs when the oxygen tension in the cells and tissues of the body becomes below the critical value, at which it is still possible to maintain the maximum rate of enzymatic oxidative reactions in the mitochondrial respiratory chain. Reasons that directly determine the occurrence and development of hypoxia state may be both external (changing gas composition environment, the rise in height, difficulty pulmonary respiration) and an internal character (functional insufficiency or pathological changes in vital organs, abrupt changes in metabolism accompanied by increased oxygen demand of tissues, action of poison and harmful metabolic products, etc.). Regardless of the causes that generate it, hypoxia exerts a pronounced effect on the course of metabolic and physiological processes in the body that determine the health and working capacity of a person [2].

Recently, artificial training of hypoxia is used as an additional training tool for traditional training to enhance the functionality of athletes: training in a hyperbaric chamber, use of various exercises with a delay in breathing, the method of return breathing with the use of masks and tubes with significant dead space, a method that allows breathing a mixture of hypoxia in real conditions of training. These methods allow to achieve a significant increase in the level of fitness of athletes of different levels of preparedness [7].

The effectiveness of hypoxic training depends on the effect of two interrelated factors of hypoxia, caused by a decrease in the partial pressure of oxygen in the inspired air, and hypoxia, is created by performing an exercise load. Each of these factors of hypoxia stimulates the action of another, but this only occurs when the rational choice of the training regime for hypoxia and establishing the correct ratio of loads of different directions [8].

Advantage of this method is that there is no stress stage as when climbing the mountains (normal acclimatization and re-acclimatization phenomena are not observed) normal atmospheric pressure; the possibility of variation and strict dosing of the stimulus of hypoxia, and the fact that IHT does not affect the planned process of sports training.

Purpose of the study: to determine the effect of hypoxic training on the attention indicators at different altitudes when crossing the Mount Elbrus.

Material and Methods of the research

Determination of the effectiveness of the level of preparation of the SP-I IHT method, introduced in the training process of climbers in the 15–15 mode with breathing through the system into a closed air with inhalable, simple, regulated air, was

conducted in the integrated training process in the competitive stage – in August 2015. Taking into account the peculiarities of ascent, technical difficulties are possible, as well as the degree of hypoxia influence on the central nervous system, for assessing the degree and quality of IHT influence on hypoxia tolerance and as a reflection – and cognitive functions of athletes, we, in the process of climbing climbers of the control and experimental groups at certain control points (CP), studied the ability to maintain a high level of mental processes in conditions of increasing physical fatigue – visual memory and attention.

Results of the research and their discussion

Taking into account the dynamics of climbing, we identified 5 control points for assessing the special preparedness of climbers, as well as their mental characteristics and sports activities: CP1 (2125 m), CP2 (3800 m), CP3 (4100 m), CP4 (4800 m), CP5 (2125 m).

It is known that the physiological basis of attention is the ratio of the processes of excitation and inhibition in the cerebral cortex. Excitation is due to the fact that the sensory organs are affected by the stimulus. By virtue of the law of negative induction, a zone of inhibition arises around the focus of objective excitability. The focus of optimal excitability provides the direction of mental activity on the object, the zone of inhibition is concentration (I. P. Pavlov, 1947). As evidenced by the results of studies of the attention of climbers of the experimental group, the IHT course caused a positive influence on the components of attention, which is of great importance during the ascent to the summit. Carrying out IHT in the 15–15 course with the increase in the time spent for inhalation of the gas mixture of hypoxia at regular intervals in an amount of 9 times in 6 weeks showed a significant improvement in the attention components at practically all control points in the athletes of the experimental group. Thus, at the 1st and 2nd control points, at the time of the first climbing of the climbers of both groups to a height of 2125 m and at the first acclimatization exit to the «Ice Base» – 3800 m, in assessing the overall performance of the test of the total number of viewed signs, there were no differences between the indices.

This indicates in favor of identical compensation of the process of fatigue in the period 1–4 days from the start of the ascent (Table 1).

In the future, when approaching the moment of conquest of the summit, which is associated with a set of altitude and voltage of the general operability at the 3 point of control, on the 8th day of entry at an altitude of 4100 m and at the 4 point of control, on the 10th day at an altitude of 4800 m ($p<0,05$) the differences between climbers of both groups. Thus, the total number of scanned characters in the experimental group on the 8th day of ascent was 461,2±10,4, significantly ($p<0,05$) differed from that in the control group – 429,2±10,7. On the 10th day of the ascent, the changes in the indicator of the total number of scanned characters were kept identical ($p<0,05$), which was 445,6±12,4 in the control and 488,6±12,1 in the experimental ($t=2.48$; $p<0,05$) groups. It should also be noted that there was a significant ($p<0,05$) tendency for the indicator to increase in the experimental group in time against the background of climb, in CP3 and CP4 which were 461,2±10,4 and 488,6±12,1, respectively. This is evidence in favor of rapid adaptation of the organism of climbers of the experimental group to a gradual increase in the level of hypoxia and a more pronounced tolerance for it under the influence of the IHT course in the pre-competition period in the 15–15 mode. Significant also information about the total number of scanned marks for athletes of both groups at the 5 point of control (2125 m), after the conquest of the summit. Thus, this index significantly ($p<0,05$) differs among climbers of the experimental group 493,3±12,7 in comparison with the control group 451,8±12,1 ($t=2,37$, $p<0,05$), which indicates a faster recovery in the experimental group.

When assessing the level of performance of the task in the indicator of the total number of correctly marked signs, significant changes ($p<0,05$) between the groups were investigated, were found starting from CP2 and the whole competition period was kept (Table 2).

Table 1

Attention indicators (the total number of characters viewed) of climbers of the control and experimental groups at different altitudinal levels in Mount Elbrus

Control points	Control group (n=16) $\bar{X}_1 \pm m_1$	Experimental group (n=12) $\bar{X}_2 \pm m_2$	Fidelity assessment t	p
CP1 (2125 m)	447,1±19,2	446,0±22,9	0,04	>0,05
CP2 (3800 m)	429,7±18,1	441,1±35,9	0,28	>0,05
CP3 (4100 m)	429,2±10,7	461,2±10,4	2,15	<0,05
CP4 (4800 m)	445,6±12,4	488,6±12,1	2,48	<0,05
CP5 (2125 m)	451,8±12,1	493,3±12,7	2,37	<0,05

Table 2

Attention indicators (the total number of correctly marked signs) of climbers of the control and experimental groups at different altitudinal levels Mount Elbrus

Control points	Control group (n=16) $\bar{X}_1 \pm m_1$	Experimental group (n=12) $\bar{X}_2 \pm m_2$	Fidelity assessment t	p
CP1 (2125 m)	219,6±4,8	222,6±5,2	0,42	>0,05
CP2 (3800 m)	210,5±4,6	238,4±5,7	3,81	<0,01
CP3 (4100 m)	215,4±5,5	235,2±6,2	2,39	<0,05
CP4 (4800 m)	216,2±6,8	234,9±5,8	2,09	<0,05
CP5 (2125 m)	214,4±6,2	236,5±7,9	2,20	<0,05

Thus, in CP2, the number of correctly marked signs in the control group was 210,5±4,6 and the experimental 238,4±5,7 group (t=3,81; p<0,01), in CP3 – 215,4±5,5 and 235,2±6,2 (t=2,39; p<0,05), in CP4 – 216,2±6,8 and 234,9±5,8 (t=2,09; p<0,05), in CP5 – 214,4±6,2 and 236,5±7,9 (t=2,20; p<0,05) respectively. At the same time, despite the tendency to increase the total number of correctly marked signs among the climbers of the experimental group, the authenticity of the entire ascent was not detected (p>0,05).

Identical reversible character changes were also determined in the total number of erroneously marked signs (Table 3).

Thus, in the experimental group, the error rate at all points of control was not significantly different in time. At the same time, in the control group on CP3 at an altitude of 4100 m, this figure was 2 times higher than the figures in the experimental group, 7,2±0,8 i 3,1±0,2 respectively (t=5,00; p<0,001). In CP3 (4100 m) and CP4 (4800 m) similar changes between groups were found, the total number of mistakenly marked signs was 7,2±0,8 and 3,1±0,2 that 4,3±0,3 and 2,1±0,3 respectively, in favor of the experimental group (t=5,00; 5,23; p<0,001). In CP5, there were no significant differences between these indicators. However, in the control group there was only a tendency to reduce errors at the control points 3, 4, 5 (from 8 to 12 days ascent) against the background of a consistently low number of errors in the climbers of the experimental group.

Analyzing the data of each group at separate altitude levels, their various indicators are also defined. So, in the control group, the most errors are defined in CP3 (4100 m), which are significantly lower in other altitude levels (p<0,05–0,001). At the same time, in the experimental group the errors in the marked signs were the largest in the KT3 (4100 m) and amounted to 3,1, significantly more than in the CP2 (3800 m), CP4 (4800 m) and CP5 (2125 m) (p<0,05–0,001).

In determining the dynamics of concentration of attention in athletes of the experimental group, beginning with CP2 (from the 4th day of ascent), there was a steady tendency to increase it with a significant difference (t=3,89, p<0,01) for 12 days in CP4 (4800 m) In relation to the control group (Table 4).

Upon returning to CP1, the concentration of attention in alpinists in the experimental group had significantly higher values (t=2,11, p<0,05). This suggests a more rapid adaptation of the central nervous system to changes in oxygen content in the inspired air and an active perception of the course of ascent, an analysis of the changes occurring and adaptation to them in the climbers of the experimental group.

At the same time, the rate of the test was reliable (p<0,05) differed in the experimental group, starting with CP3, CP4 and CP5, and amounted to 79,4±2,7; 81,9±2,7 and 82,2±1,8 (p<0,05), respectively, which indicates a greater tolerance to hypoxia in athletes of the experimental group (Table 5).

Table 3

Indicators of attention (mistakenly marked signs) of climbers of the control and experimental groups at different altitudinal levels in Mount Elbrus

Control points	Control group (n=16) $\bar{X}_1 \pm m_1$	Experimental group (n=12) $\bar{X}_2 \pm m_2$	Fidelity assessment t	p
CP1 (2125 m)	2,3±0,1	2,4±0,2	0,46	>0,05
CP2 (3800 m)	3,2±0,2	2,2±0,4	2,24	<0,05
CP3 (4100 m)	7,2±0,8	3,1±0,2	5,00	<0,001
CP4 (4800 m)	4,3±0,3	2,1±0,3	5,23	<0,001
CP5 (2125 m)	2,5±0,3	1,9±0,3	1,43	>0,05

Table 4

Attention (concentration) of climbers of the control and experimental groups at different altitudinal levels in Mount Elbrus, %

Control points	Control group (n=16) $\bar{X}_1 \pm m_1$	Experimental group (n=12) $\bar{X}_2 \pm m_2$	Fidelity assessment t	p
CP1 (2125 m)	98,3±0,8	98,3±0,5	0	>0,05
CP2 (3800 m)	97,2±1,2	98,6±0,8	0,97	>0,05
CP3 (4100 m)	97,5±1,2	98,8±0,6	0,97	>0,05
CP4 (4800 m)	98,2±0,3	99,6±0,2	3,89	<0,01
CP5 (2125 m)	98,6±0,4	99,8±0,4	2,11	<0,05

Table 5

Attention indicators (rate of performance) of climbers of the control and experimental groups at different altitudinal levels in Mount Elbrus, signs min^{-1}

Control points	Control group (n=16) $\bar{X}_1 \pm m_1$	Experimental group (n=12) $\bar{X}_2 \pm m_2$	Fidelity assessment t	p
CP1 (2125 m)	74,5±3,2	74,3±3,8	0,04	>0,05
CP2 (3800 m)	71,6±3,1	75,1±3,2	0,67	>0,05
CP3 (4100 m)	71,8±2,2	79,4±2,7	2,18	<0,05
CP4 (4800 m)	74,5±2,2	81,9±2,7	2,13	<0,05
CP5 (5642 m)	76,1±1,9	82,2±1,8	2,33	<0,05

Conclusions

1. The results of the conducted studies indicate that the use of IHT in the mode of 15–15 in the anterior period allows to significantly increase the attention rates of qualified climbers during the overcoming of altitudinal levels in the Mount Elbrus. So, starting with CP3 (4100 m), significantly higher indicators of the total number of characters seen by the climbers of the experimental group (CP3 – t=2,15; CP4 – t=2,48; CP5 – 2,37; p<0,05). In this case, the total number of correctly marked signs is much larger for the athletes of the experimental group starting from CP2 (t=3,81; p<0,001) and in the future – in CP3 (t=2,39; p<0,05), CP4 (t=2,09; p<0,05), CP5 (t=2,20; p<0,05) with a smaller number of mistakenly marked signs in CP2 (t=2,24; p<0,05), CP3 (t=5,00; p<0,001), CP4 (t=5,23; p<0,001). Level of concentration in the experimental group of climbers is significantly higher in CP4 (t=3,89; p<0,01) and CP5 (t=2,11; p<0,05).

2. This indicates that in the pre-competitive training of climbers, in addition to rational planning of the training process, the use of IHT is effective, which will promote hypoxic adaptation.

Prospect for further research is to determine the impact of IHT on HAM indicators.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 18.07.2017.
Published: 31.08.2017.

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SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 355.233.22

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 49-52

A set of professional working ability indicators of military operators

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Purpose: *determination of indicators of professional work capacity and their impact on the success of professional activity of military operators in the cycle of alert duty.*

Material & Methods: *indicators of the professional capacity of military operators were determined through theoretical analysis, systematization and generalization of data from scientific and methodological sources, medical-biological, psycho-diagnostic methods and mathematical methods of processing the results of the study.*

Result: *it is determined that the most informative indirect indicators of the professional capacity of military operators of the contract service of the Air Forces of the Armed Forces of Ukraine is: physical condition, psycho-emotional state, physical performance, aerobic endurance, static endurance of back muscles, neck and the abs, the speed of perception, memory, concentration and shifting attention. The correlation dependence of the level of professional preparedness of military operators on indirect indices of professional work capacity: physical fitness (r=0,58), psycho-emotional state (r=0,51), physical performance (r=0,34), aerobic endurance (r=0.59), static endurance of the muscles of the back and neck (r=0,52), static endurance of the abs muscles (r=0,48), simple sensorimotor reaction (r=0,44), short-term (operational) memory (r=0,40), concentration and attention switching (r=0,46).*

Conclusion: *a complex characteristic of the indicators of psycho-physiological functions of the body of a specialist can be used to assess the dynamics and prediction of the professional capacity of military operators of the Air Force in the cycle of alert duty.*

Keywords: *military operator, indicators of professional ability to work, professional preparedness.*

Introduction

Researchers of operators work (L. D. Veiner-Dubrovin, 1980, Yu K. Demyanenko, 1987, M. S. Korolchuk, 1997; Y. A. Borodin and others, 2008) indicate that military-operators perform the tasks of alert duty under the influence of negative factors of military professional activity [4]. During a 24-hour watch in the conditions of grounded command posts, there is a significant deterioration in the state of health against the background of fatigue, which leads to a decrease in the efficiency and reliability of performing professional tasks during combat alert duty [1; 3; 11].

According to M. S. Korolchuk, the efficiency and reliability of the activity of the specialists in the operator's field are closely related to the notion of professional work capacity [11]. It remains an open question of maintaining high professional capacity for work and ensuring the success of professional activities of Air Force servicemen in the cycle of alert duty, which confirms the relevance of the study that is carried out.

Relationship of research with scientific programs, plans, themes. The research is carried out in accordance with the plan of research works of the Air Force of the Armed Forces of Ukraine and is a composite research work "Theoretical and methodological foundations of the physical training system for servicemen of the Air Force of Ukraine", the cipher "Guidance-PI" with the state registration number 0101U001112.

Purpose of the study: determination of indicators of professional work capacity and their impact on the success of professional activity of military operators in the cycle of alert duty.

Material and Methods of the research

Study involved 86 military-operators, aged from 20 to 35 years, who were divided into two groups according to the level of professional preparedness. Study was conducted for eight months on the basis of the command post of the regiment A1451. General scientific methods (theoretical analysis, systematization and generalization of data) were used to study and analyze information from scientific and methodological sources on the issues of physical education, psychophysiology of labor and the specifics of the military professional activity of the specialists in the operator's profile. Problem of maintenance and preservation of working capacity is considered the main one in the physiology of labor. Efficiency of any work activity is provided on the basis of taking into account physiological and psychological patterns of human factor functioning. According to Y. V. Krushelnytska, human performance is the physiological basis of labor productivity. It determines professional performance as the maximum efficiency of human activity at a level of functional mobilization that does not cause a state of overstrains of the body of a specialist [6].

According to the researchers of the physiology of labor (M. S. Korolchuk, D. A. Oshanin, I. A. Sapov, A. S. Solodkov), work capacity is estimated by direct and indirect indicators. Direct indicators are: quality, reliability and the amount of labor, and the secondary indicators of the body's functions, that is, the psycho-physiological cost of effective and reliable activity [3; 8; 10]. These statements are acceptable and for the

military operators of the Air Force of Ukraine.

According to A. A. Navakaktiyan, V. V. Kryzhanovskiy, V. V. Kalnish, M. S. Korolchuk, under real alternation conditions, it is difficult to assess the performance with the use of criteria for the performance of professional duties by the operator [6]. Moreover, not always direct indicators (quality, reliability and quantity of labor) correspond to the real psycho-physiological price of labor [3; 10]. With this in mind, scientists (I. A. Sapov, V. S. Shchegolev, 1979; L. S. Solodkov, 1980; V. I. Osodlo 2001, V. M. Krasota 2007) it is offered to compare and predict changes in the level of professional work capacity with the help of a complex characteristic of psycho-physiological functions of the specialist body. General characteristics of psychophysiological functions in the process of military professional activity can be realized with the help of an integral evaluation of indirect indicators of the professional capacity of specialists of the operator profile [3; 5].

Solving the problem of assessing the success of carrier activity in the conditions of alert duty requires the consideration of a large number of direct and indirect indicators [3; 10]. Based on the analysis of scientific and methodological sources and the research conducted by us, it is determined that informative indirect indices of the professional capacity of servicemen-operators of the contract service of the Air Forces in the conditions of combat duty is: physical state, psycho-emotional state, physical working capacity, aerobic endurance, static endurance of back muscles, neck and abdominal muscles, information perception speed, memory, concentration and attention switching. With their help of a complex characteristic, it is possible to objectively predict the dynamics of the professional capacity of military servicemen at a particular stage of fulfilling their official duties [10].

Pedagogical methods, namely pedagogical observation, pedagogical testing, pedagogical experiment were used to determine the influence of the indicators of psycho-physiological functions on the success of military professional activities of military servicemen in the cycle of alert duty.

In order to study the issue of the connection between the levels of professional preparedness of military operators under the contract of the Air Force of Ukraine with informative indirect indicators of professional capacity for work, we conducted a study of the indices of representatives of two groups with different average assessment of professional preparedness.

Determination of the professional preparedness of the military-operators was carried out by studying and analyzing the assessments received for each alert on a four-point scale and assessments for the implementation of special training standards, with subsequent distribution of servicemen into two groups, according to their level of preparedness.

Physical condition of servicemen-operators was estimated by the method of A. A. Pirogova (physical state index).

Psycho-emotional state of servicemen-operators was determined by the HAM method (health, activity and mood) by questioning.

To assess the physical performance of military-operators, a simplified version of the classical step-test of Harvard University was used in the interpretation of the American test system YMCA (J. R. Morrow, 2000).

Aerobic endurance of military-operators was investigated for performing the exercise of running 3000 meters.

In order to assess the special physical qualities of military operators, on the basis of preliminary studies identified indicators:

Static strength endurance of the muscles of the back and neck – exercise the maintenance of the torso in a horizontal position [11];

static endurance of the abdominal muscles – an exercise angle in the abutment on the uneven bars [11].

Psychodiagnostic methods were used in our studies to assess the quality of mental work (memory, attention, sensorimotorics) as indirect indicators of the professional capacity of specialists in the operator's profile [3]. Study of the speed of information perception was carried out due to the definition of the latent period of a simple sensorimotor reaction. Coefficient of success of concentration and switching of attention was determined with the help of Krapevelin tables [3]. To assess the success of short-term memory, standard techniques for the study of auditory memory by numbers [2].

Methods of mathematical statistics (methods of mathematical processing of the results obtained) were used to characterize the groups studied and to reveal the difference in the values between the groups.

Results of the research and their discussion

The results of the study of informative indirect indicators of the professional capacity for work of two groups of servicemen with different levels of professional preparedness are presented in Table 1.

Analyzing the indirect indicators of the professional capacity for work of representatives of two groups with different levels of professional preparedness, we note the presence of reliably worse results among servicemen with "satisfactory" assessment of professional preparedness compared with representatives of the group on a "good" assessment (Table 1):

– Physical state index – on 4,7% at t=2,60;
– Evaluation of psycho-emotional state – on 8,5% at t =5,66;
– Physical performance – on 5,5% at t=2,76;
– Aerobic endurance – on 2,7% at t=2,97;
– Static strength endurance of the back and neck muscles – on 6,1% at t=2,09;
– Static endurance of the abdominal muscles – on 9,5% at t=2,28;
– Response time to external signal – on 4,8% at t=2,24;
– Coefficient of success of short-term memory – on 7,9% at t=2,86;
– Coefficient of attention success rate – on 10,2% at t=2,86.

For the purpose of confirming or refuting the experimental data on the dependence of the level of professional preparedness of military operators on the contract of the Air Forces of Ukraine on these indirect indicators of professional capacity for work we performed a correlation analysis of the results of combat duty and the results of determining the physical

Table 1

Indicators of professional capacity for military servicemen with different levels of professional preparedness

Indicators of professional capacity	Assessment of professional preparedness	$\bar{X}\pm m$	Significance level
Physical state index (c.u.)	Good (n=42) Satisfactory (n=44)	0,675±0,007 0,645±0,008	p<0,05
Psycho-emotional state (points)	Good (n=42) Satisfactory (n=44)	7,01±0,06 6,46±0,08	p<0,001
Physical performance (beat.·min^{-1})	Good (n=42) Satisfactory (n=44)	100,7±1,1 105,6±1,4	p<0,05
Aerobic endurance (s)	Good (n=42) Satisfactory (n=44)	825,36±4,51 848,43±6,36	p<0,05
Static strength endurance of the back and neck muscles (s)	Good (n=42) Satisfactory (n=44)	96,10±2,13 90,55±1,60	p<0,05
Static endurance of the abdominal muscles (s)	Good (n=42) Satisfactory (n=44)	47,17±1,36 43,07±1,18	p<0,05
Response time to external signal (ms)	Good (n=42) Satisfactory (n=44)	329,22±4,95 345,86±5,54	p<0,05
Coefficient of success of short-term memory (%)	Good (n=42) Satisfactory (n=44)	70,52±1,26 65,36±1,30	p<0,05
Coefficient of attention success rate (%)	Good (n=42) Satisfactory (n=44)	87,21±1,86 79,16±2,11	p<0,05

state index, evaluation the psycho-emotional state, assessing physical performance, aerobic endurance, static endurance of the back, neck and abdominal muscles, reaction time to the external signal, success rate of short-term memory and the success rate of attention in 86 military-operators (Table 2).

Obtained results of determining the correlation of the level of professional preparedness of military operators under the contract with indirect informative indicators of professional capacity for work demonstrated the presence (see Table 2):

– average correlation of the assessment of professional preparedness with the physical state index, the evaluation of the psycho-emotional state, static endurance of the back, neck and abdominal muscles, success rates of short-term memory and attention;

– weak correlation of the assessment of professional preparedness with physical capacity.

It should also be noted that there is a feedback of the assessment of professional preparedness with the time of the exercise of the control exercise for aerobic endurance and the response time to an external signal (see Table 2).

Conclusions

According to the results of the study, it is determined that the most informative indirect indices of the professional capacity of military operators of the Air Force of Ukraine are: physical condition, psycho-emotional state, physical working capacity, aerobic endurance, static endurance of the back, neck and abdominal muscles, speed of information perception, memory, concentration and attention switching.

Correlation dependence of the level of professional preparedness of military operators from indirect indices of professional work capacity: physical condition (r=0,58), psycho-emotional state (r=0,51), physical working capacity (r=0,34), aerobic endurance (r=0,59), static endurance of the back, neck muscles (r=0,52 static endurance of the abdominal muscles (r=0,48), simple sensorimotor reaction (r=0,44), short-term (operational) memory (r=0,40), concentration and attention switching (r=0,46).

This fact testifies to the possibility of applying a complex characteristic of the indicators of the physiological functions of the body of a specialist for assessing the dynamics and predicting the professional capacity of military operators of the Air Force in the cycle of alert duty.

Table 2

Correlation between the indicators of professional preparedness and indicators of the professional capacity of military-operators (n=86)

Indicators of professional capacity	Correlation relationship, r
Physical state index (c.u.)	0,58
Psycho-emotional state (points)	0,51
Physical performance (beat.·min^{-1})	0,34
Aerobic endurance (s)	–0,59
Static strength endurance of the back and neck muscles (s)	0,52
Static endurance of the abdominal muscles (s)	0,48
Response time to external signal (ms)	–0,44
Coefficient of success of short-term memory (%)	0,40
Coefficient of attention success rate (%)	0,46

In the **future**, we are aim research to use the integral assessment of professional work capacity to determine the effectiveness of the special physical training program for military operators of the Air Force of Ukraine in the cycle of alert duty.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 17.06.2017.
Published: 31.08.2017.

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SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 615.825/575:599.9

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 53-55

An algorithm of rehabilitation examination of persons with Charcot-Marie-Toot disease

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The Charcot-Marie-Toot disease is a hereditary demyelinated polyneuropathies, accompanied by a complex of physical and functional disorders from the musculoskeletal and nervous systems.

Purpose: *to develop an algorithm for the rehabilitation examination of persons with Charcot-Marie-Toot's disease.*

Material & Methods: *theoretical analysis and generalization of data from scientific and methodological literature and the worldwide Internet information network, classification.*

Result: *algorithm of rehabilitation examination is offered that will allow fully covering the existing violations and objectively assessing the physical and functional state of the patient for this disease is proposed.*

Conclusion: *carrying out a comprehensive rehabilitation survey and analyzing its results is the basis for an adequate selection of means and methods of physical rehabilitation and building a rehabilitation intervention plan.*

Keywords: *algorithm of examination, physical rehabilitation, Charcot-Marie-Toot disease.*

Introduction

Since, to date, medical treatment of this nosology does not lead to a slowing or stopping of the progression of this disease, most modern studies point to physical rehabilitation as a necessary means of treatment [4; 6; 8]. Presence of complex violations of the functional state of the musculoskeletal system in this disease, the progressivity of their passage and the decrease in the quality of life of persons with this disease determine the urgency of individualization of physical rehabilitation [3; 7]. Objective study of motor and functional disorders in the Charcot-Marie-Toot disease will allow to establish a rehabilitation diagnosis, which in future will be the basis for creating an individual rehabilitation program.

Relationship of research with scientific programs, plans, themes. The chosen direction of research corresponds to the theme of research work in the field of physical culture and sports for 2011–2015. Ministry of Ukraine for Family, Youth and Sports on theme 4.2. "Physical rehabilitation with disruption of the musculoskeletal system" (state registration number 0111U006471).

Charcot-Marie-Toot disease is the most common among hereditary neuropathies [9]. However, to date, therapeutic options for this disease are limited to symptomatic treatment, and the most effective treatment for this nosology is physical therapy [4; 5; 7].

Primary component of the activity of a physical rehabilitation specialist is a rehabilitation survey to identify existing violations on the part of various systems, which is necessary for establishing a rehabilitation diagnosis, planning and forecasting the process of physical rehabilitation [1].

Physical rehabilitation program must take into account all the functional and motor impairments that exist, the features of the initial physical condition and the concomitant diseases. A thorough examination of the patient and the establishment of his rehabilitation diagnosis is the basis for building a rehabilitation program [2; 8].

Existing research in the field of physical rehabilitation, in particular, the rehabilitation examination of people with Charcot-Marie-Toot's disease, does not fully cover this issue. However, it should be noted that the effectiveness of the rehabilitation program and the individual approach to selecting the means and methods of intervention primarily depends on an integrated and objective examination of the patient.

Purpose of the study: to develop an algorithm for the rehabilitation examination of persons with Charcot-Marie-Toot's disease.

Material and Methods of the research

Research methods: theoretical analysis and generalization of data from scientific and methodological literature and the world information network Internet; induction and classification.

Results of the research and their discussion

It is necessary to pay attention to the fact that in the clinical activity of the physical rehabilitation specialist, before starting the preparation and implementation of the rehabilitation program, it is necessary to establish a rehabilitation diagnosis; accordingly, for this he needs to conduct a survey [2].

In order for the rehabilitation survey to fully cover all existing disorders of the musculoskeletal system and be comprehensive and objective, it should include the following components: observations, objective evaluation and subjective evaluation [2].

When examining people with Charcot-Marie-Toot disease, taking into account the typical disorders of the disease, such as: hypotrophy of the muscles of the distal lower and upper

extremities, deformities of the hands and feet, disorders of walking and balance, and others, it is also necessary to include the above components [3; 5; 9]. That is why when examining people with this polyneuropathy, we suggest adhering to the algorithm developed by us (Figure).

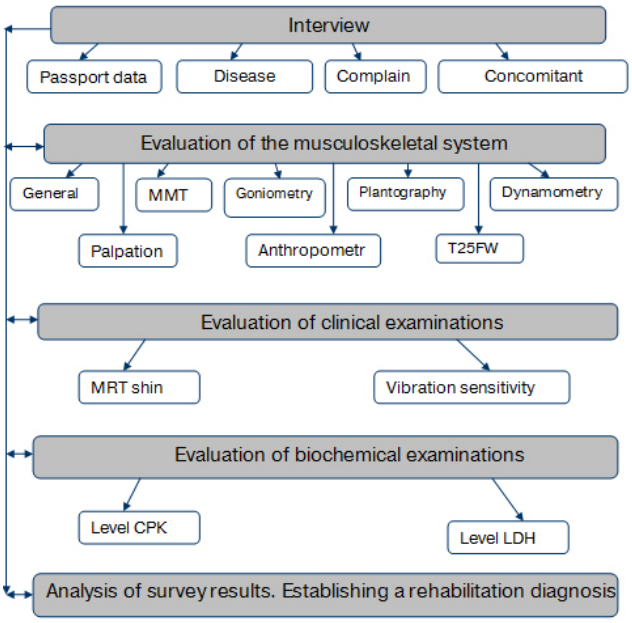

Fig. Algorithm of rehabilitation examination of people with Charcot-Marie-Toot disease:
MMT – manual muscle testing , MRT – magnetic resonance tomography, CPK – enzyme level creatine phosphokinase LDH – level lactic dehydrogenase, T25FW – timed 25-Foot Walking – walking test [10].

Algorithm of rehabilitation examination for people with Charcot-Marie-Toot's disease provides for the consistent application of such components of the survey as: survey, assessment of the musculoskeletal system, assessment of clinical examinations, assessment of biochemical examinations, the analysis of which will be the basis for establishing a rehabilitation diagnosis and compiling an individual and constructive program for physical rehabilitation.

Interview includes the patient's complaints, both basic and additional, the medical history, and presence of concomitant diseases. It is important to pay attention to the age of the individual, the date of diagnosis and the period of manifestation of the disease, which will allow us to analyze the rate of progression of polyneuropathy.

Evaluation of the musculoskeletal system include in itself:

– general surveying and palpation. During examination, attention should be paid to the condition of the skin, the deformation of the feet and hands and the state of their severity, the presence of distal muscular hypotrophy and body positions. When palpation, pay attention to the consistency of the muscles of the lower and upper extremities, especially the distal muscle groups.

– manual muscle testing – allows to establish the presence of weakness of the muscle or group of muscles, namely – flexors and extensors of the foot, hip, leading and withdrawing muscles of the hip, flexors and extensors of the hand and in the future adequately pick up the load for training the weakened muscle or group of muscles.

– goniometry is performed to detect the violation of the amplitude of motion in the ankle, knee, hip and radial-wrist joints. Conducted contralaterally.

– anthropometric measurements allow to determine the presence and extent of limb hypotrophy by measuring the centimeter band of the circumference of both shins, the upper third of the thigh, the forearm.

– plantography – allows to determine the degree of deformability of the foot due to the determination of the state of the arches (transverse and longitudinal), the presence or absence of additional x load points.

– dynamometry – allows us to assess the weakness of the muscles of the hand and forearm, necessarily measured contralaterally.

– timed 25-Foot Walking – a walking test is proposed that will allow an objective and functional evaluation of the condition of the musculoskeletal system. At runtime, in addition to the time of the test, we also pay attention to the quality of walking, the number of stops [10].

For an objective assessment of functional disorders on the part of various systems, modern informative research methods. That is why the evaluation of clinical and biochemical studies allow compiling a complete and objective picture of the patient's disorder and condition:

– analysis of the results of the magnetic resonance tomography of the shins is an objective assessment of the condition of the muscles, which further allows for maximum individualization of the physical rehabilitation program and predict its effectiveness in accordance with the patient's initial condition;

– analysis of the results of vibration sensitivity – will allow to assess violations of deep sensitivity and take into account this factor in the selection of the load;

– analysis of the results of biochemical studies in particular, the level of enzymes CPK (creatine phosphokinase) and LDH (lactate dehydrogenase) will provide information on the internal state of the muscles and their response to physical stress, both routine and specially selected.

Conclusions

Based on the above, we can conclude that to effectively overcome existing physical, functional disorders and preserve the function of the limbs, to prevent early disability of people with Charcot-Marie-Toot's disease, you must follow the developed algorithm of rehabilitation examination. This will allow us to identify various violations on the part of various systems of the body, take into account the individual characteristics of patients.

Prospect for further research. Comprehensive rehabilitation examination is the basis for the creation of an individual physical rehabilitation technique for individuals with Charcot-Marie-Toot disease, which would allow optimal resolution of existing motor and functional disorders.

Conflict of interests. The author declares that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 18.07.2017.
Published: 31.08.2017.

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UDK 616.728.3:615.825.6

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 56-60

Results of continuous passive movement method application in physical rehabilitation process of patients with knee joint pathology

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Purpose: *to evaluate the effectiveness of physical rehabilitation of patients with pathology of knee joints (KJ) in the postoperative period using the method of continuous passive movement in the joints with the help of domestic devices.*

Material & Methods: *a comparative analysis of the results of rehabilitation of two clinical groups of patients was carried out, which were identical by sex, age, type of pathology and type of surgical interventions (52 male and 37 female), at the age of 18 to 60 years with the pathology of KJ who were on inpatient treatment. In the postoperative period, patients of the 2nd group, in addition to standard rehabilitation measures, performed passive development of motions in the affected KJ with the help of domestic devices for automatic development of movements.*

Result: *program of physical rehabilitation of patients with KJ pathology, which consists of several stages, is based on the comprehensive application of a wide range of rehabilitation means with an individual approach to the course of the postoperative period in each particular patient.*

Conclusion: *high efficiency of the use of the developed domestic devices for the automatic development of movements in the joints in the process of complex regenerative treatment of patients with the CS pathology, that allows recommending them for wide introduction in clinical use in rehabilitation centers and orthopedic and traumatological departments are proved.*

Keywords: *physical rehabilitation of patients with pathology of the knee joints, method of continuous passive movement in the joints, devices for the automatic development of movements in the joints.*

Introduction

Injuries and diseases of the musculoskeletal system are among the most frequent pathologies, affecting modern humanity. "The epidemic of injuries" and the increase in diseases of the musculoskeletal system did not bypass our country. In the structure of primary disability, the consequences of trauma and orthopedic diseases have been steadily occupying the third place for several decades after cardiovascular and oncological diseases. Every year in Ukraine more than 20 000 patients from injuries become disabled. Particular importance for the state is the loss of disability in persons of working age, which leads to a reduction in the state's labor potential, additional costs for pension provision, treatment and rehabilitation of disabled people [1–3].

Rehabilitation of patients with pathology of knee joints (KJ) is a very urgent problem in our country, because surgical interventions that are performed in the treatment of such pathology restore certain anatomical structures, but not completely eliminate their functional inferiority (the limitation of movements in the joints, muscle weakness, the cicatrical-adhesive process, the phenomenon of local osteoporosis develops or progresses, etc.), which in turn requires a long-term recovery treatment [4; 5; 7; 8].

In the domestic literature, there are isolated works describing the method of continuous passive movement (MCPM) in the system of physical rehabilitation of patients after surgical interventions at KJ (P. Bolkhovitin et al., 2013) and indicated its method of use. However, by providing some clinical recommendations, they do not detail the timing and duration of this method – a powerful factor in the prevention and elimination of morpho-functional disorders in the postoperative period. They require a methodological solution to the issue of detailing and clarifying the timing of the appointment of MCPM, there was a need to develop a methodology for its application depending on the nature of the surgical procedure (diagnostic arthroscopy, arthroscopic removal of the meniscus, open or arthroscopic restoration of the ligaments of the knee joint, endoprosthetics of the knee joint, interventions for joint injuries and periarticular bone fractures, etc.) and the course of the postoperative period [6; 9].

One of the significant factors hampering the active introduction of the method of continuous passive traffic in Ukraine is the lack of domestic devices for their implementation and the high cost of foreign analogs.

Thus, the creation of domestic devices for the automatic development of movements in KJ and the active introduction of MCPM in the complex physical rehabilitation of patients after knee joint surgery to improve the efficiency and quality of the recovery process is relevant, which led to the choice of the direction of our study.

Purpose of the study: to evaluate the effectiveness of physical rehabilitation of patients with pathology of knee joints in the postoperative period using the method of continuous passive movement in the joints with the help of domestic devices.

Objectives of the study:

1. Compare the results of the rehabilitation treatment of the control (standard rehabilitation program) and the research group (complex restorative treatment with MCPM) of patients with pathology of knee joints in the postoperative period.

2. Analyze the results of clinical data (the volume of joint movements, the presence and magnitude of contracture in KJ, the intensity of the pain syndrome) and instrumental research methods before, during and after rehabilitation treatment in two groups of patients with pathology of knee joints in the postoperative period.

Material and Methods of the research

A comparative analysis of the results of rehabilitation of two clinical groups of patients was carried out, these groups were identical in gender, age, type of pathology and type of surgical interventions (52 men and 37 women) aged 18 to 60 years with KJ pathology (all patients had monolateral joint damage), who were on inpatient treatment in the Sytenko Institute of Spine and joint Pathology, Academy of Medical Science, for the period from 2010 to 2016. In the 1st, the control group included 43 patients, and in the 2nd, main group – 46 patients (Table 1). Criterion of selection in the study groups was: patients with KJ pathology who underwent arthroscopic surgical interventions and who required the application of physical rehabilitation methods in the immediate postoperative period.

In the postoperative period, patients of the 1st group received standard rehabilitation treatment, and patients of the 2nd group, in addition to standard rehabilitation measures, performed passive development of movements in the affected KJ with the help of domestic devices for automatic development of movements (DADM), which we developed together with LLC «Svarcon» (Figure 1) [10; 11].

In the manufacture of DADM, the conditions for medical devices (safety A) are met, and the possibility of changing and smoothly adjusting the speed of the development of movements, the angle of flexion-extension in the joints and the adjustment of the lodgment length, depending on the patient's anthropometric data.

Patients were examined according to conventional methods before surgical treatment, 9–10 days after the beginning of rehabilitation treatment and 3 months after surgery (questioning patients on a visual analogue scale of pain, measuring the volume of movements, dopplerography and rheovasography of vessels, electromyography of the muscles of the affected limbs) and made a special questionnaire, where they noted the individual anatomical and functional features of the KJ and developed an individual plan of rehabilitation measures and an assessment of the condition of each patient. All data from clinical and special research methods were calibrated for the characteristics obtained and a certain score was given in scores.

Results of the research and their discussion

We have developed a program for physical rehabilitation of patients with pathology of KJ (Figure 2), which consists of several stages, involves the definition of the goal, clarification of tasks, organizational features, contains guidelines, principles and characteristics of the rehabilitation survey, criteria for assessing their effectiveness, is based on the integrated application of a wide range of rehabilitation tools with a differentiated individual approach, depending on the features of the KJ pathology and the course of the postoperative period in each individual patient.

Patients of each group were: massage (general, local), therapeutic gymnastics (active exercises of the affected limb, corrective passive and active, breathing exercises, regressive gymnastics – according to indications), physiotherapy (electrophoresis, magnetotherapy), in addition, the patients of the main group underwent mechanotherapy by the method of continuous constant passive movements simultaneously with the electrical stimulation of the 4-golem muscle.

Table 1

Distribution of patients by sex and type of pathology of the knee joint

Pathology KJ	Number of observations				
	control group		main group		total number
	men	women	men	women	
damage of the medial meniscus	8	5	9	5	27
damage of the anterior cruciate ligament	15	8	16	8	47
combination of damage of the medial meniscus and anterior cruciate ligament	5	2	5	3	15
Total	28	15	30	16	89

a b

Fig. 1. General view of the device for the automatic development of movements in the knee joint

Development of movements with DADM was performed according to the following procedure: on the 2nd day after surgery (and 1st day of rehabilitation treatment) performed a survey and made a decision about the possibility of starting the development of movements in the KJ – 3 times for 5–10 minutes with a minimum rate of development of movements and an angle of flexion-extension in the joint from 5 to 15°; 2nd day of rehabilitation – 3–4 times for 15–20 minutes with minimum speed and volume of movements in the KJ from 10 to 25°; 3rd – 3-4 times for 40–50 minutes with minimum speed and volume of movements in the joint from 25 to 45°; in the following days the multiplicity (up to 6–7 times a day) and the development rate and duration (up to 2 hours per one session) were increased, and the volume of movements was adjusted to 70–90° (depending on the characteristics of the underlying disease and the intensity of the pain syndrome) [10; 11].

It should be noted that restorative treatment was carried out taking into account the psychological characteristics of patients:

– many patients had a negative psychological reaction to the "white coat", and also a slight local pain in the development of movements without DADM often caused severe pain and myotonic reactions, with the development of rigidity of the operated and adjacent joints;

– when carrying out rehabilitation measures, there is a need for a constant reminder of the frequent and prolonged repetition of certain exercises or procedures and movements, etc., which in itself can cause a negative reaction.

A retrospective evaluation of clinical data and indices of instrumental research methods showed the positive effect of MCPM on the process of restoring the volume of movements in the joints in the main group as compared to the control group (Table 2).

Dynamics of recovery of the volume of movements in the joints was determined primarily by the initial condition of the joint and the severity of the pathology and, as can be seen from the data in Table 2, the volume of movements in the joints of both groups was approximately the same: before surgery – 81±4,5 in main group and 82±5,1 – in control; immediately after the intervention – 86±6,3 in main group and 85±5,5 – in

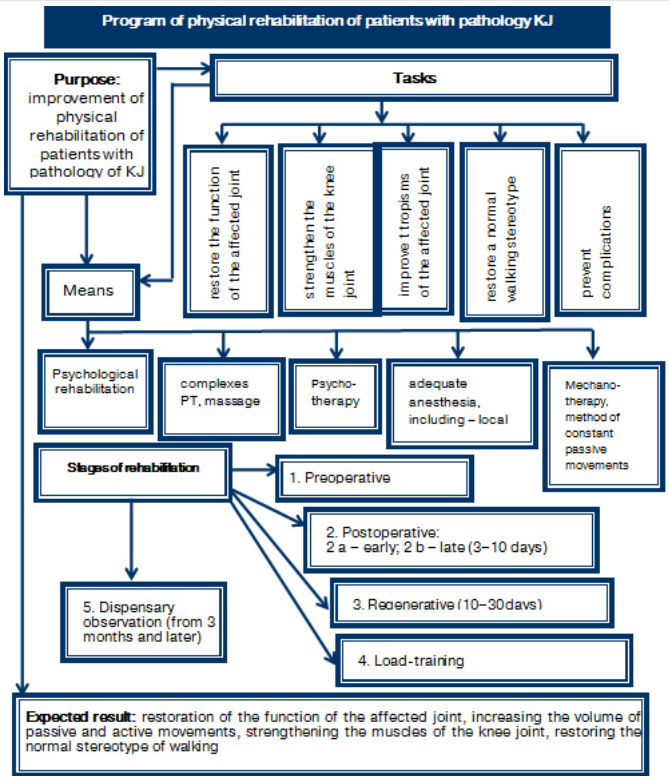

Fig. 2. Program of physical rehabilitation of patients with KJ pathology using the method of permanent passive movements in the postoperative period

control (data are given in% to the normal volume of movements, which is taken as 100%). 3 weeks after the first course of restorative treatment in the joints of the patients of the main group, the volume of movements in the joints increased to 97±2,5% of the norm, and in the control group – to 90±3,1%. In 3 months after the repeated course of restorative treatment in the control group of patients, the volume of movements averaged 96±2,4% of the norm, and in the main – 98 ± 1,6%, which demonstrates a clear tendency to a better volume of movements in the main group.

Comparing the intensity of the pain syndrome according to the VAS scale, we determine that the indices differ in two groups. Thus, in the control group before the treatment, pa-

Table 2

Dynamics of indicators of the dynamics of pain syndrome, the volume of movements in the knee joints, the tone of the vessels of the lower extremities, and the degree of edema around the joint tissues in patients of the control and main groups, %

Indicators	Distribution of indicators by maturity (in brackets - the data of the control group)			
	before treatment	after treatment	3 weeks after the onset of restorative treatment	3 months after the onset of restorative treatment
Volume of movements in the joint (in% to norm)	81±4,5 (82±5,1)	86±6,3 (85±5,5)	97±2,5* (90±3,1)*	98±1,6* (96±2,4)*
Degree of pain syndrome by VAS (0 to 100)	75±10,5 (76±10,1)	51±9,5* (49±11,5)*	28±11,5* (39±8,5)*	23±10,5* (33±9,5)*
Reduction of the degree of edema of tissues (in% of the opposite limb)	33±5,5 (34±6,0)	37 ±6,5 (39±7,5)	15±4,5* (24±5,5)*	5±4,5* (9±5,5)*
Tone of the vessels of the lower extremities (the elasticity index) (in% of the opposite limb)	97±11,5 (96±7,5)	61±9,5* (59±10,5)*	81±10,5 (69±8,5)*	93 ±7,0 (81±8,5)

Note. ** – changes are reliable in comparison with the initial state, P>0,05.*

tients noted a degree of pain syndrome by 76 units (possibly a discrepancy ±10,1), which is 0.4% more than in the main group (75 units, possibly a discrepancy ±10,5). After the rehabilitation treatment for 3 weeks after the intervention, a significant reduction in the pain syndrome in the main group was obtained in comparison with the control group, in the control group there was a reduction in the pain syndrome to 27 units in the main group and 39 – in control (possibly a discrepancy ±8,5). After a second course of restorative treatment, the degree of pain syndrome is 19 units (±6,5 difference) in the main group and 33 units in the control group (discrepancy ±7,5), the final difference in the VAS score is 14% reduction in pain in favor of the main group.

Analysis of the degree of edema of the tissue shows that in the control group for surgical treatment the degree of edema of the tissues in % to the opposite limb is 34% ±6,0, and the degree of edema of the tissues in % to the opposite limb in the main group was 33% ±5,5. After the treatment and the beginning of rehabilitation activities in the main group, edema of the limb was 37% ±6,5, in control; – 39% ±7,5. 3 weeks after the commencement of rehabilitation, there was a significant reduction in edema to 15% ±4,5 in the main group and 24% ±5,5 in the control group, which is 9% less in the main group when compared with the control group. A significant decrease in the degree of edema of the tissues in % to the opposite extremity occurred after 3 months after the onset of restorative treatment: in the main group – 5% ±4,5 and in the control – 9% ±5,5).

Analyzing the data of the study of the vascular tone of the lower extremities in % to the opposite extremity (elasticity index according to the data of rheovasography), the following data were demonstrated: before treatment in the main group – 91% ±11,5 respectively in the control – 96% ±7,5), after the surgical treatment, the reduction to 61% ±9,5 and 59% ±10,5 respectively, which is caused by low motor activity of patients. After restorative treatment, improvement in the elasticity index up to 81% ±10,5 in the main group and up to 69% ±8,5 in the control. The results after 3 months of restorative treatment were 94% ±6,0 and 81% ±8,5, respectively, with the difference between the main and the control group was 13%.

Conclusions

1. Evaluation of the results of clinical data and instrumental research methods of the two groups shows that the method of continuous passive movement using domestic DADM devices in the complex physical rehabilitation of patients with pathology of the knee joints reliably leads to a reduction in the duration of rehabilitation, an increase in the volume of movements by an average of 7% in the immediate postoperative period (up to 3 weeks after the operation) compared with the control group, with a significant reduction in pain (according to the VAS scale, pain reduction is 14% in favor of the main group), myotonic and neurotrophic syndromes.

2. The expediency and high efficiency of using the developed domestic devices for the automatic development of joint movements in complex restorative treatment of patients with KJ pathology, which significantly improve the quality of life of patients in the first 3 weeks of the postoperative period, which allows them to be recommended for widespread use in clinical use at the stages of physical rehabilitation in rehabilitation centers and orthopedic and trauma units.

Prospect for further research. in this direction are the wide introduction of the method of continuous passive movement in the joints at the stages of physical rehabilitation in rehabilitation centers and orthopedic and traumatological units with the simultaneous establishment of industrial production of developed domestic devices for automatic development of movements.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 11.06.2017.
Published: 31.08.2017.

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SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 796.413/418+796.012.442

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 61-66

Method of biomechanical analysis of kicks of the main course in acrobatic rock'n'roll

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Purpose: *biomechanical analysis of kicks of the main course in acrobatic rock'n'roll.*

Material & Methods: *following research methods were used: theoretical analysis and generalization of data from special scientific and methodological literature; pedagogical observation; biomechanical computer analysis; video footage of the finals of World championships, Europe championships, Cup of Ukraine (2017) in acrobatic rock and roll.*

Result: *biomechanical analysis of the kicks of the main course by qualified athletes was conducted; kinematics characteristics (path, speed, acceleration, effort) of the center of mass (CM) biolinks of the athlete's body (male partner, female partner) were obtained: feet, shins, hips. The energy characteristics are determined – mechanical work and kinetic energy of the legs links when performing the kick of main course.*

Conclusion: *it is established that the method of biomechanical analysis of the kick of the main course performance significantly affects the level of technical training of qualified athletes in acrobatic rock and roll.*

Keywords: *acrobatic rock'n'roll, kick, biomechanics of motor actions, main course, male partner, female partner.*

Introduction

Modern system of training requires constant improvement of the technical preparedness of the rock'n'rol athletes, aimed at implementing effective technical actions of qualified athletes in the conditions of preparation for competitive activities. Strengthening competing in competitions requires coaches and athletes to find new ways to increase the effectiveness of competitive activities [10].

An analysis of recent research and publications on the problem of the technique of performing the main course in acrobatic rock'n'roll shows that the main focus is on the dynamics of the exercise.

It should be noted that the scientific and methodological literature does not adequately address the problem of the efficiency of the biomechanics of the motor actions of the partner and partner in performing the main course in acrobatic rock and roll, which determined the relevance of the chosen research topic.

Purpose of the study: biomechanical analysis of kicks of the main course in acrobatic rock'n'roll.

Objectives of the study:

1. To study the problem of technical training of qualified athletes in acrobatic rock and roll.

2. Determine the biomechanical characteristics of the performance of the kick the main move in acrobatic rock and roll.

Material and Methods of the research

Methods of research were: theoretical analysis and generalization of data from special scientific and methodological literature; photography, video shooting, biomechanical computer analysis, pedagogical observation.

In our studies qualified sportsmen (n=6) of the sports center of childhood and youth "Grand" took part. Appropriate kinematic characteristics of the performance of kicks of the main course were calculated: track path, speed, acceleration, force [1–3].

Energy characteristics are determined – mechanical work and kinetic energy of legs links in the course of the main course.

To determine the biomechanical characteristics of the performance of the kick of the main move by qualified athletes in acrobatic rock and roll, anthropometric indicators of qualified athletes were used: male partner – L-n, female partner – B-va (Table 1).

Mathematical model of trajectory of the center of mass (CM) of *leg* links: foot, shin, hip is used in the work; construction of the segment of passage of the CM of body links [3; 6; 7].

Results of the research and their discussion

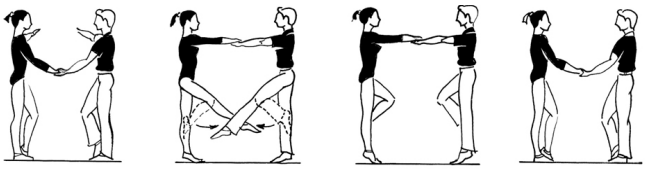
For a long time in the competitive activity in acrobatic rock 'n' roll did not pay attention to the amplitude of the movements in the main course. Analysis of the video footage of the finals of the world championships, Europe of recent times and the finals of the Cup of Ukraine (2017), qualified athletes from acrobatic rock and roll showed a trend in the variability of the amplitude of kicks in the main run (Figure 5) (main course consists of kick-ball-change and kick-stepping exercises). According to the Rules of the WRRC, kick-ball-change (the component of the main stroke) (Fig. 1) at the level 45°[11].

Performing the kick-step (component of the main course) (Figure 2) at a level of 90°, parallel to the floor [11].

Table 1

Anthropometric indicators of male partner and female partner

No.	Indicators	Male partner	Female partner
1.	Body length, cm	179	158
2.	Body weight, kg	77	48
3.	Length of right thigh, cm	51	43
4.	Length of left thigh, cm	51	43
5.	The length of right tibia, cm	41	35
6.	Length of left tibia, cm	41	35
7.	Length of right foot, cm	27	21
8.	Length of left foot, cm	27	21
9.	Weight of right hip, kg	9,4	5,76
10.	Weight of left hip, kg	9,4	5,76
11.	Mass of right tibia, kg	3,85	2,4
12.	Mass of left tibia, kg	3,85	2,4
13.	Weight of right foot, kg	1,54	0,96
14.	Weight of left foot, kg	1,54	0,96
15.	Length of radius (r) of right thigh, cm	23	19
16.	Length of radius (r) of the left thigh, cm	23	19
17.	Length of radius (r) of right tibia, cm	18	15
18.	Length of the radius (r) of left tibia, cm	18	15
19.	Length of radius (r) of right foot, cm	12	9
20.	Length of the radius (r) of the left foot, cm	12	9



Outgoing position *1-st phase* *2-nd phase* *3-rd phase*

Fig. 1. Phases of exercise *kick-ball-change:*
1-st phase – swing-up leg of the male partner and female partner perfume a kick;
2-nd phase – body's CCG moves in the direction of the swing-up leg , which is put on the half-toes, the supporting leg rises;
3-rd phase – supporting leg is puts on the half-toes.

Features of the performance of the kick in the *kick-step* exercise are reduced to the direction of the motor action of the male partner's swing-up leg and female partner. The partner does the kick straight, the partner sideways diagonally.

Construction of a mathematical model of biomechanics of motor actions in the performance of *kick* exercises *kick-ball-change*.

Main course is carried out for 1,5 cycles (t – 1,875 s; tempo 48 cycles in minute; *kick-ball-change: t* – 0,625 s; *kick: t* – 0,12 s).

Biomechanical characteristics of the motor actions of the partner in the performance of kick exercises *kick-ball-change*

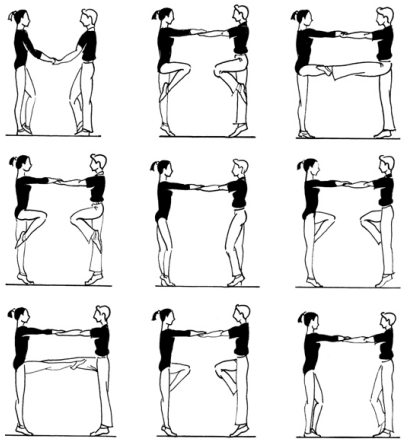


Fig. 2. Kick-step

are shown in Table 2. A male partner performs a *kick-ball-change* exercise with the left foot [9; 11].

In the table there is a numerical value of the effort of the CM legs links with a minus sign. This indicates that the counteraction of gravity is directed towards the force of the CM legs links [4; 5].

On the basis of the obtained kinematic characteristics, the energy characteristics of the leg links are determined – mechanical work $A = \int_0^s F_s ds$ i kinetic energy $E_k = \frac{mV^2}{2}$ [3; 8] when the male partner performs a *kick*.

In the calculation does not take into account the energy consumption of the internal friction of the musculoskeletal apparatus of the athlete and the costs of radiation of the thermal energy of the athlete's body into the environment [3; 7].

Based on the results of building a model of the biomechanics of the motor actions of the male partner, we can state that the energy characteristics of the performance of the *kick* in the *kick-ball-change* exercise have the following meanings:

– mechanical work – 126,22 J;

– kinetic energy – 57,26 J.

1 J ≈ 0,238846 calories (1 calorie = 4,184 J).

Obtained data of constructing the model of the biomechanics of motor actions indicate that during the performance of the *kick* in the exercise *kick-ball-change* male partner spends 30,2 cal. (performing time 0,12 s).

Biomechanical characteristics of the motor actions of the partner in the performance of *kick* exercise *kick-ball-change* shown in Table 3. Female partner performs a *kick-ball-change* exercise with the right foot.

On the basis of the obtained kinematic characteristics, the energy characteristics of the leg links are determined – mechanical work *(A)* and kinetic energy *(E_k)* [2; 3] when the female partner performs a *kick*.

In the calculation does not take into account the energy consumption of the internal friction of the musculoskeletal apparatus of the athlete and the costs of radiation of the thermal

Table 2

Biomechanical characteristics of the CM body links of the male partner body in the performance of the *kick* – exercise *kick-ball-change*

No. i/o	CM body links	Kinematic characteristics						Energy characteristics	
		t (s)	*φ* (deg.)	*S* (m)	*V* ($m \cdot s^{-1}$)	*a* ($m \cdot s^{-2}$)	*F(H)* ($kg \cdot m \cdot s^{-2}$)	*A* (J)	E_k (J)
1.	CM, left thigh	0,12	45°	0,18	1,5	9,7	–14,63	2,63	10,57
2.	CM, left shin	0,12	90°	0,28	2,33	30,2	78,54	21,29	10,04
3.	CM, left foot	0,12	90°	0,83	6,9	89,8	123,2	102,3	36,65

Table 3

Biomechanical characteristics of the CM body links of the female partner body in the performance of the *kick* – exercise *kick-ball-change*

No. i/o	CM body links	Kinematic characteristics						Energy characteristics	
		t (s)	*φ* (deg.)	*S* (m)	*V* ($m \cdot s^{-1}$)	*a* ($m \cdot s^{-2}$)	*F(H)* ($kg \cdot m \cdot s^{-2}$)	*A* (J)	E_k (J)
1.	CM, left thigh	0,12	45°	0,15	1,25	8,22	-8,8	1,32	4,8
2.	CM, left shin	0,12	90°	0,24	2,0	26,6	40,32	9,67	4,8
3.	CM, left foot	0,12	90°	0,69	5,75	75,14	62,72	43,38	15,87

energy of the athlete's body into the environment [3; 7].

Based on the results of constructing the model of the biomechanics of the motor actions of the partners, we can state that the energy characteristics of the performance of the *kick* in the *kick-ball-change* exercise have the following meanings:

– mechanical work – 54,27 J;

– kinetic energy – 25,47 J.

Obtained data of constructing the model of the biomechanics of motor actions indicate that during the performance of the *kick* in the exercise *kick-ball-change* female partner spends 12,97 cal. (performing time 0,12 s).

Construction of a mathematical model of biomechanics of motor actions in the performance of *kick* exercise *kick-step*. Main move is executed during 1,5 cycles (t – 1,875 s, the rate is 48 cycles per minute; *kick-step: t* – 0,625 s; *kick: t* – 0,156 s) (Figure 3, 4).

Biomechanical characteristics of the motor actions of the partner in the performance of *kick* exercise *kick-step* are shown in Table 4.

Based on the results of constructing a mathematical model of the biomechanics of motor actions by the partner, we can

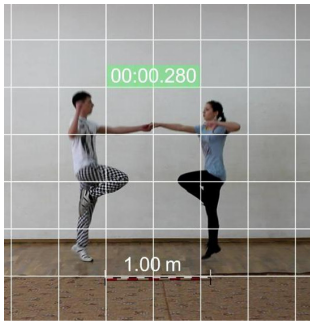


Fig. 3. Position of the swing-up leg (raising the hip)

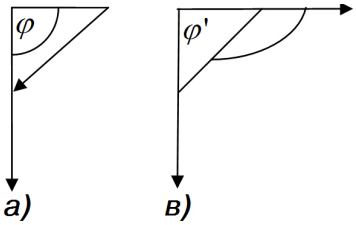


Fig. 4. Scheme trajectory of the path (S) of the CM links of the swing-up leg (optimal technique for performing the kick in the given parameters):
a *– lifting of the hip of the swing-up leg, φ=90° (foot at the shin of the support leg);*
b *– performing kick swing-up leg CM leg and foot path extends along the segment forming an angle φ'=135°.*

Table 4

Biomechanical characteristics of the CM body links of the male partner in the performance of *kick* –exercise *kick-step*

No. i/o	CM body links	Kinematic characteristics						Energy characteristics	
		t (s)	*φ* (deg.)	*S* (m)	*V* ($m \cdot s^{-1}$)	*a* ($m \cdot s^{-2}$)	*F(H)* ($kg \cdot m \cdot s^{-2}$)	*A* (J)	E_k (J)
1.	CM, left thigh	0,156	90°	0,36	2,31	23,2	196,04	70,64	25,08
2.	CM, right thigh	0,156	90°	0,36	2,31	23,2	196,04	70,64	25,08
3.	CM, left shin	0,156	135°	0,43	2,75	42,0	123,97	53,3	14,55
4.	CM, right shin	0,156	135°	0,43	2,75	42,0	123,97	53,3	14,55
5.	CM, left foot	0,156	135°	1,25	8,01	121,06	171,34	214,18	49,4
6.	CM, right foot	0,156	135°	1,25	8,01	121,06	171,34	214,18	49,4

state that the energy characteristics of the performance of the *kick* in the *kick-step* exercise have the following meanings:

– mechanical work – 338,12 J;

– kinetic energy – 89,03 J.

Obtained data of constructing a mathematical model of the biomechanics of motor actions indicate that, in order to perform *kick* in the exercise *kick-step* male partner spends 80,8 cal. (performing time 0,156 s).

Biomechanical characteristics of the female partner's motor activities in the performance of *kick-step* exercises are shown in Table 5.

Based on the results of constructing a mathematical model of the biomechanics of motor actions by the partner, we can state that the energy characteristics of the performance of the *kick* in the *kick-step* exercise have the following meanings:

– mechanical work – 120,15 J;

– kinetic energy – 37,9 J.

Obtained data of constructing a mathematical model of the biomechanics of motor actions indicate that, in order to perform *kick* in the exercise *kick-step* female partner spends 28,7 cal. (performing time 0,156 s).

This mathematical model of the biomechanics of the motor actions of the male partner and female partner in the technique of performing the *kick* of the main course in acrobatic rock'n'roll shows the ratio of effective motor actions (lifting and vigorous straightening of the swing-up leg) to movements that are performed by inertia without additional use of muscles [11]:

– time of effective motor action 23%;

– time of inertial motions 77%.

The results of effective ergonomic performance of the kick performance of the main course:

– male partner: t – 0,432 s, F – 1197 H, A – 802 J, for the time of effective motor actions of the performance of the kick spent 192 calories;

– female partner: t – 0,432 s; F –469 H; A – 294,47 J; for the time of effective motor actions of the performance of the kick spent 70, calories.

Mathematical model and biomechanical characteristics show the effectiveness of the biomechanics of the motor actions of the male partner and female partner, and can be defined ***as the optimal technique for performing kicks for given parameters*** (Figure 4). From this definition it follows that if the male partner and female partner during the *kick-step* exercise in the competitive program increase the angle of the raising of the thigh of the swing-up leg, and also the angle of the knee joint extension, the energy characteristics of the kick performance will increase in their ratio (Tables 6, 7).

When the leg is raised to 110° ($\phi+d\phi$) and the knee joint is straightened to the angle $\phi''=155°$ ($\phi'+d\phi$) the male partner's energy costs, according to mathematical calculations, increased by 58,2% (Figure 6).

When the leg is raised to 110° ($\phi+d\phi$) and the knee joint is straightened to the angle $\phi''=155°$ ($\phi'+d\phi$) the female partner's energy costs, according to mathematical calculations, increased by 61,1% (Figure 6).

Figure 3 shows the positions of the swing-up leg with the male

Table 5

Biomechanical characteristics of the CM body links of the female partner in the performance of *kick* –exercise *kick-step*

No. i/o	CM body links	Kinematic characteristics						Energy characteristics	
		t (s)	*φ* (deg.)	*S* (m)	*V* ($m\cdot s^{-1}$)	*a* ($m\cdot s^{-2}$)	*F(H)* ($kg\cdot m\cdot s^{-2}$)	*A* (J)	E_k (J)
1.	CM, left thigh	0,156	90°	0,3	1,92	19,42	55,4	16,62	10,6
2.	CM, right thigh	0,156	90°	0,3	1,92	19,42	55,4	16,62	10,6
3.	CM, left shin	0,156	135°	0,35	2,24	24,6	35,52	12,43	6,02
4.	CM, right shin	0,156	135°	0,35	2,24	24,6	35,52	12,43	6,02
5.	CM, left foot	0,156	135°	1,04	6,66	100,9	87,5	91,0	21,29
6.	CM, right foot	0,156	135°	1,04	6,66	100,9	87,5	91,0	21,29

Table 6

Biomechanical characteristics of the CM body links of the male partner in the performance of *kick* – exercise *kick-step* (increment of the formed angles *φ* and *φ'* by the value *dφ*)

No. i/o	CM body links	Kinematic characteristics						Energy characteristics	
		t (s)	*φ* (deg.)	*S* (m)	*V* ($m\cdot s^{-1}$)	*a* ($m\cdot s^{-2}$)	*F(H)* ($kg\cdot m\cdot s^{-2}$)	*A* (J)	E_k (J)
1.	CM, left thigh	0,156	110°	0,44	2,82	34,6	362,8	159,6	37,4
2.	CM, right thigh	0,156	110°	0,44	2,82	34,6	362,8	159,6	37,4
3.	CM, left shin	0,156	155°	0,49	3,14	54,77	173,13	84,83	18,98
4.	CM, right shin	0,156	155°	0,49	3,14	54,77	173,13	84,8	18,98
5.	CM, left foot	0,156	155°	1,43	9,16	158,3	228,7	327,0	64,6
6.	CM, right foot	0,156	155°	1,43	9,16	158,3	228,7	327,0	64,6

Table 7

Biomechanical characteristics of the CM body links of the male partner in the performance of *kick* –exercise *kick-step* (increment of the formed angles φ and φ' by the value $d\varphi$)

No. i/o	CM body links	Kinematic characteristics						Energy characteristics	
		t (s)	φ (deg.)	*S* (m)	*V* ($m \cdot s^{-1}$)	*a* ($m \cdot s^{-2}$)	*F(H)* ($kg \cdot m \cdot s^{-2}$)	*A* (J)	E_k (J)
1.	CM, left thigh	0,156	110°	0,36	2,3	27,8	103,7	37,32	15,23
2.	CM, right thigh	0,156	110°	0,36	2,3	27,8	103,7	37,32	15,23
3.	CM, left shin	0,156	155°	0,4	2,56	43,7	81,4	32,6	7,9
4.	CM, right shin	0,156	155°	0,4	2,56	43,7	81,4	32,6	7,9
5.	CM, left foot	0,156	155°	1,19	7,63	132,3	117,6	140,0	27,9
6.	CM, right foot	0,156	155°	1,19	7,63	132,3	117,6	140,0	27,9

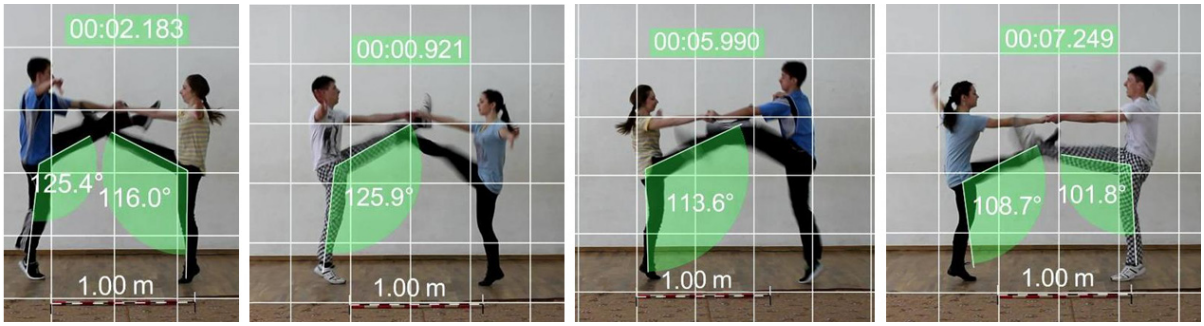


Fig. 5. Variability of the amplitude of the performance of the kick of the main course

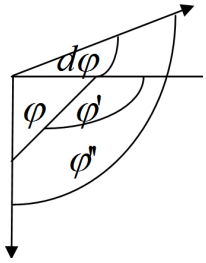


Fig. 6. Scheme trajectory of the path (S) of the CM links of the swing-up leg with increasing angles φ and φ' by the angle $d\varphi$ of the knee extension: *Performing kicks of a swing-up leg with a hip raising to an angle in 110°, CM leg and foot path extends along the segment forming an angle φ''=155°.*

partner and female partner hip raised to the level ϕ=90˚ parallel to the floor.

Figure 5 shows the variability in the amplitude of the performance of the kick in the maximum upper position qualified athlete foot of swing-up leg. Each athlete increases the angles ϕand ϕ′ by the angle $d\phi$ (Figure 6) of the knee extension.

In the competitive program, according to the WRRC Rules, qualified athletes perform at least six major moves [11].

Biomechanical characteristics of the male partner with the optimal technique of *kick* performance in the given parameters during the competition program have definitions: *t – 2,592 s, F – 7182 H, A – 4812 J.* During the time of effective motor actions performing the ***kick*** male partner spends 1150 calories.

With an increase in the angle of raising the hip to 110° (ϕ+$d\phi$) and straightening the angle of the knee joint of the right and left legs to 155° (ϕ′+$d\phi$) biomechanical characteristics of the male partner in the performance of the ***kic***k in the main course during the competition program have definitions: *t – 2,592 s; F – 10470 H; A – 7614 J.* During the time of variative motor actions, performing the ***kick*** male partner spends 1819 calories.

Biomechanical characteristics of the female partner with the optimal technique of *kick* performance in the given parameters during the competition program have definitions: *t – 2,592 s, F – 2814 H, A – 1766,82 J.* During the time of effective motor actions performing the ***kick*** f***e***male partner spends *422* calories.

With an increase in the angle of raising the hip to 110° (ϕ+$d\phi$) and straightening the angle of the knee joint of the right and left legs to 155˚ (ϕ′+$d\phi$) biomechanical characteristics of the male partner in the performance of the ***kick*** in the main course during the competition program have definitions: *t – 2,592 s; F – 3954 H; A – 2844,6 J.* During the time of variative motor actions, performing the ***kick*** female partner spends 680 calories.

Process of fatigue of qualified athletes takes place during the performance of the competition program. The expenditure of the energy resource of rock'n'rol athletes depends on the performance of the biomechanics of motor actions.

Biomechanics of motor actions of the implementation of the *kick* of the main course by the male partner and female partner in the first case showed the rationality of the *energy characteristics.*

With the increase in the parameters of the kinematic characteristics of the biomechanics of motor actions, the kick in the main course by the partner and partner led to an increase in their *energy characteristics*:
– energy costs of the male partner increased by 58,2%;

– energy costs of the female partner increased by 61,1%.

Conclusions

Proposed biomechanical analysis of the kick main course in acrobatic rock'n'roll gives a creative approach to the technique of mastering basic dance movements, exercises, acrobatic elements in the training process, which will make it possible to improve the technical training of qualified athletes more efficiently and rationally, with less physical effort.

Prospect for further research are to find ways to apply the basics of biomechanics in this direction, using methodological recommendations and writing manuals.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 20.07.2017.
Published: 31.08.2017.

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SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 796.077

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 67-72

Club form of organizing classes in the development of student sport

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Purpose: *to establish the place and importance of the club form of organizing classes in the development of student sports.*

Material & Methods: *analysis and generalization of scientific literature and the Internet using a combination of methods of historical knowledge.*

Result: *prerequisites for the emergence and development of student sport are revealed and have a certain sequence of events: association of people, the emergence of clubs, the creation of sports clubs, the formation of student sports clubs, the competition between educational institutions of the country clubs, association clubs in the national university sports associations, holding international meetings between the teams of sports students clubs, the emergence of international sports associations of students, holding complex international competitions.*

Conclusion: *the introduction of the club form of organization of sports activities of youth has made student sport a global social phenomenon. It becomes relevant dissemination activities of the higher educational institutions sports club outside the student sports.*

Keywords: *student sport, organization of classes, club form.*

Introduction

Student sport is regarded as an essential social phenomenon [8; 22; 24]. The main components of it include the organizational basis [3; 12]. In the modern scientific space, a lot of information has been accumulated on the organization of sports activities for young people in specific historical circumstances [1; 23]. This led to a scientific discussion about the role of sports clubs in the student environment [9; 18]. An important component of the logical argumentation of the affirmation of the positive influence of the club organizational system on the development of student sports can be comprehensive coverage of the available information in chronological order with the disclosure of the interconnection and interdependence of events and processes in different time and spatial planes.

Purpose of the study: to establish the place and importance of the club form of organizing classes in the development of student sports.

Material and Methods of the research

Data of the scientific literature and the Internet network were analyzed and summarized using a set of methods of historical cognition that make it possible to reproduce the development of student sports in an organic relationship with the activity of sports clubs.

Results of the research and their discussion

Clubs have a long history. Earlier, the reference to the unification of people with a common goal and interests refers to Ancient Greece (5th century BC), Where so-called hetriaries were created for mutual assistance in achieving political and military goals, worshiping a particular deity, spreading education and culture among Greeks etc. In ancient Rome, the sodalitas (religious associations), political, social, cultural and professional colleges functioned.

Modern name of the club (from the English Club - to bring down together) arose in England in the XVII century. Conducting joint entertainment and communication was financed by making money (clubbing) of club members [26]. Process of the formation of sports clubs began. In Scotland, there were a golf club (1676), a curling club (1716), a skating club (1742) in England, a jockey club (1727), a cricket club (1750) and others. Although as early as the fourteenth century fraternities began to be created in France, England and Germany, which united craftsmen for practicing one or another of the physical exercises [28]. Composition of sports clubs was changing: if the traditional English club was represented by sportsmen and hired workers in their service, then at the end of the 19th century – athletes, sports organizers, coaches, sports fans [7]. On the territory of Ukraine, the first sports clubs began to be massly created at the end of the XIX century: gymnastics in 1865 (Lviv), in football in 1878 (Odessa), in athletics in 1887 (Kiev), weightlifting – in 1895 (Kiev) and others [1].

It is believed that the first student club appeared in 1816 in the city of Bern (Switzerland). Later they began to be massively created in other countries: in Yale (1843) and Harvard (1844) universities in the United States, Cambridge (1846) and Oxford (1869) universities in the UK, Sydney University of Australia (1854), Dublin University of Ireland (1854), McGill University in Canada (1877) and others [28; 30].

On the territory of modern Ukraine, the first sports student clubs began to form in the early twentieth century. At that time, sports institutions of their own choosing could be called a society, a circle or a club. So, in 1906 in the Ukrainian Academic Gymnasium in Lviv, the Ukrainian Sports Club was founded. In the Russian Empire, the first sports student group was established at the St. Petersburg Polytechnic Institute in 1908, who before the others used the permission to open in the educational institutions various groups on the Provisional Rules for the organization of student institutions of the Ministry of Education in 1901. At the beginning of the First World

War, 40 student sports clubs were officially registered in the country: in St. Petersburg – 13, in Moscow – 6, in Kiev – 4, in other cities – one at a time [14].

In the USSR, the official use of the word combination "sports club" began in 1935. In status as the highest form of the collective of physical culture. In the same year, the People's Commissar of Health approved the charter of the first in the USSR student sports club of the 2nd Moscow Medical Institute.

V. V. Zolochevsky [5] among the important events of the development of physical culture and mass work with students in the late XIX – early XX century. distinguished the foundations of the first professional sports clubs, athletic clubs, gymnastic societies, amateur athletic organizations, student sports circles of universities (1889–1917), conclusions of the regulations and methodological recommendations on the organization of circles of physical culture, creation of circles for mass sports in higher educational institutions (1918–1929), transition from club and territorial circles to the production teams of physical culture with the gradual consolidation of them into voluntary sports societies of trade unions (1930–1940). In the 1970s. VSS "Burevestnik" consisted of more than 600 student clubs, which involved 1.5 million athletes, in particular 70 thousand teachers and researchers.

Changes in socio-political and economic conditions after the collapse of the Soviet Union forced to seek appropriate changes in the nature, content, directions of organizational forms of sports club work in Ukraine In the modern conditions of Ukraine there is an expansion of the network of sports clubs. As of 2015 in Ukraine, there are 4,900 sports clubs, among them 712 at the place of study of citizens.

Creation of sports clubs in universities laid the groundwork for conducting competitions between athletes and teams of educational institutions. Among them, competitions between the English universities of Oxford and Cambridge on the game of cricket in 1827, between the teams of Harvard and Yale universities in rowing, which took place in the USA in 1852, between the teams of American universities in baseball (1859), American football (1869), track and field (1872), rugby (1874), basketball (1896) and others [27].

Spread of competitions between educational institutions led to the creation of sports university associations. At first they were created for individual sports: Rowing Association of American Colleges (1858), Inter-College Association of Amateur Athletes of America (1873), American Student Baseball League (1879) and others. Later in America, a complex of student sports structures began to be formed: the Southern Interuniversity Sports Association (1894), the Western Conference (1896), etc. [2]. USA includes the creation of the first national Interuniversity Sports Association, in 1905 united thirteen universities and later, in 1910, changed its name to the National University Sports Association (NCAA). Similar associations began to form in Australia (1906), Poland (1908), Czechoslovakia (1910), Sweden and Norway (1913), and others [28; 29].

On the territory of modern Ukraine in 1911 in Galicia was established Sports Society of students of higher schools "Ukraine", which lasted until 1944. In the Russian Empire for the systematization and registration of all student sections, circles and societies, the conduct of unified All-Russian student competitions in 1916 acted General Moscow Student Sports Society.

In the Union of Soviet Socialist Republics (USSR) in 1926, the Central Bureau of "Proletustud" held the first all-union student competitions. Since 1936 64 voluntary sports societies (VSS) of trade unions have started functioning, among which many were engaged in the organization of work of physical culture teams, competitions, and promotion of sports in educational institutions. In 1957, all of them were united in VSS "Burevestnik". Since 1951 All-Union student sports days have been held, and since 1957 – All-Union sports student games. In 1987 "Burevestnik" together with other sports societies of trade unions united in the All-Union Voluntary Physical Culture and Sports Association of Trade Unions (UVPCSATU), which in 1991 was reorganized into the sports society of trade unions "Ukraine".

For the state management of sports and physical culture among children and youth in 1992, the Central Sports Club "Gart" was formed in the structure of the executive authority for education. Since 1993, the All-Ukrainian Public Association "Sports Students Union of Ukraine" has been operating, which represents national interests in the international student sports movement and in all activities conducted by the International Federation of University Sports. In 2001, the Committee for Physical Education and Sports was established in the executive branch of education for the proper organization of physical education and sports in educational institutions. Every 2 years the Universiade of Ukraine is held [23].

Conducting international student meetings led to the formation in 1919 of the International Student Confederation, under the auspices of which, before the Second World War, International University Games. After the Second World War, two international structures were formed as a result of the confrontation between the capitalist and socialist countries: the International Students Union (ISU, 1946) and the International Federation of University Sports (FISU, 1948), which simultaneously held their comprehensive international competitions – International University Games and "Weeks university sports". Their confrontation lasted until 1957, when students from different countries took part in the world championship among universities. The result of the reconciliation was the entry of the members of the International Student Union into the International Federation of University Sports and the holding, since 1959, of comprehensive competitions – the Universiade. Universiade became the basis for the development of student sports, which provided a systemic character, organizational and substantive structure of physical culture and sports activities in the youth environment of the world and individual countries [16; 29].

Student's sport should be multifaceted and varied for development of students in educational institutions on the basis of organization of physical culture and sports work, preparation and participation in sports and sporting events [15]. Organizational features of student sports are accessibility and the opportunity to play sports in the framework of training sessions on the discipline "Physical Culture"; the opportunity to play sports in free from academic study time in university sports sections and groups, as well as independently; possibility to participate systematically in student sports competitions of an accessible level.

Contradictions of student sport include: the desire of students to obtain higher professional education and their focus on improving their sports qualifications; pedagogical possibilities of socialization of an athlete's personality in student sport and the unavailability of the trainer-teaching staff for its purposeful and planned implementation; lack of systematic scientific, theoretical and practical data on the management of student sport and regulating the requirements of state, regional and university structures; lack of justified coordination in the activities of state education, physical culture, sports, youth policy and the multilevel development of sport among university students; dynamic development of the sports and sports movement and slowed-down improvement of the regulatory, financial and organizational conditions for the management of the development of student sports in universities; the need for the evolutionary integration of the domestic system of student sports into the international system of discrete development of the management of domestic student sport [6].

Sociocultural meaning of physical culture and sport activity is revealed not only in its value sense, but also in the motives that motivate it. According to social surveys, the rank structure of these motives is as follows: 1) desire to increase physical fitness; 2) optimize weight, improve the figure; 3) to strengthen health; 4) educate the will, character, purposefulness; 5) to remove fatigue and improve efficiency 6) to achieve sporting success; 7) timely receive a test for physical training; 8) the habit of such activities; 9) to bring up a good manner, culture of movements; 10) to spend time rationally; 11) the desire to keep up with friends; 12) the desire to defend the honor of the faculty, course [22].

Among the main functions that student sport must perform, consider the strengthening of health and physical fitness of youth. There is a decrease in the interest of young people in regular exercise and sports, which worsen the overall health of society and leads to significant consequences in the social sphere, the importance of student sport in shaping a healthy personality, harmoniously developed intellectual, spiritual and creative potential, satisfaction of the needs for motor activity and leisure activities [15; 24].

Reasons for the lack of effectiveness of the current system of physical education include: low level of physical condition and health of schoolchildren and entrants; the provision of a normative approach in the learning process; decreased interest and motivation of students to the traditional form of organization of physical education classes; lack of a differentiated approach in the process of physical education, the insufficient variety of forms of organization of physical education, the increase in the educational load, the reduction of motor activity, bad habits and other unfavorable factors that do not allow to provide the necessary level of physical fitness and health of students [3; 8; 12; 17].

A promising direction in addressing these problems is the introduction of physical education with a sports focus in universities, taking into account the free choice of students by the sport, given its popularity among students, the possibility of the educational and sports base of the educational mortgage and the availability of specialists in sports in the teaching staff of the Department of Physical Education [6]. It is emphasized that many modern sports, for example, basketball, volleyball, rugby, originated from student sports. And the model of sport of Pierre de Coubertin – to a greater extent can be realized precisely in student sport [10].

In the realization of the social function of student sport, the rapprochement of physical culture and sport is important, has transferred high sports technologies to the practice of sports education, to ensure the training process and to organize pedagogical control of students. System of student sport summarizes the training and competitive activities, there is a clear distinction between the mass sport and the sport of high achievements differentiation of the learning process is considered, an individual approach to those involved in sports, the methods, forms and means of instruction are optimally combined, taking into account their conformity with the content of education and the real learning opportunities.

Development of student sports contributes to maintaining the integrity of the physical culture and sports movement. It is fair to define student sport as one stage with multilevel training of highly qualified athletes. As a result of the analysis of information documents, the generalization of the experience of the international sports student movement, the study of national programs for the development of student sports, it is proved that student sport in many countries is the basis of the national sports policy and is governed by state laws and regulations. main motive for admission is the opportunity to continue to play sports while studying, and obtaining a specialty is not a priority for students. Student sport is considered as an effective means of training highly qualified athletes, as the base and source of replenishment of national teams of the country. Very relevant is the problem of adapting professional athletes who, after completing a career, are without sufficient professional knowledge, with insufficient preparation for production activities [20].

An important place in the sporting life of young people is occupied by competitions. Their conduct prompts a healthy lifestyle, emotional relaxation, a sense of joy of communication in a healthy environment, not only the participants of the competition, but also the spectators in the stands. Support the team of athletes of his university provides a safe way out of accumulated emotions. Through a positive example and empathy in the process of watching the competitions of friends, there is an educative impact on the viewer.

It is important to have normative bases for financing student sports, where not only the state but also representatives of the domestic business play a significant role, which can provide significant resources for improving sports policy. This approach is observed in most countries, where student sports' funding is provided through sports scholarships of universities, the state, as well as public organizations.

The presence of a large number of social, economic, legal and other factors involved in the innovative development of student sport necessitated their structuring on the basis of sports clubs.

The term "club" is understood as a voluntary association of people for joint collective activities with socially valuable and personally significant content in accordance with their common purpose and interests (political, scientific, creative, sports, etc.) [25]. Sports clubs are among the primary organizations of physical culture and sports, in which directly conducted training and various forms of physical culture and health classes with a population of various social and demo-

graphic groups. These institutions of physical culture and sports ensure the development of certain different areas of physical culture and sports, sports, exercise and health and / or sports activities; provide physical culture and sports services.

Sports clubs are classified according to different criteria: by the contingent of those involved; on the goals, which are solved, and their quantity; for selected sports and motor activity; by scale; by types and forms of ownership; in relation to profits, etc. Taking into account the contingent, serviced sports clubs of industrial enterprises, companies, firms, students in universities, school, children and youth, amateur and professional sports, territorial (in the place of residence, in parks), fitness clubs, physical culture and sports for the disabled, health treatment in the clinics and resorts, etc. on the list of services – complex sports and recreational and specialized (for one or several kinds of sports). On the organizational form – private, collective (based on the ownership of the association of citizens), municipal and state. Under the form of economic activity – commercial or non-commercial [17].

Specific features of the functioning of various types of sports clubs are considered taking into account the external environment. In the conditions of market relations, sports and health club are considered as the main organizational form of sports management, where the constituent component is a sports and sports service. Favorable factors in these conditions are high level of incomes of the population, availability of a free time fund, economic interest of business to active cooperation, interest of state structures. The main indicator of the effectiveness of the management of the sports club is the economic analysis of its activities, fixed and running costs [11].

Concept of regulation of the sphere of physical culture and sports based on the theory of systems is proposed, as well as specific mechanisms for improving the performance of the sports industry, which is based on methodological foundations and takes into account the totality of influence of the state, enterprises, educational and sports institutions, as well as the mechanism for effective management of physical culture and sports, the evaluation of the effectiveness of the sports industry as a factor in the regulation of development in the conditions of economic transformation, providing an increase in the efficiency of its functioning due to the nation's health and replenishment of the state budget of Ukraine [13].

Marketing should take into account the features of physical culture and health services, namely their immateriality, inability to store, inseparability from the supplier or the surrounding conditions, uniqueness. Key function of marketing fitness and health services is the ability to meet the needs of people, given the types of fitness and health services. Directions of marketing is working with sponsors and attracting direct consumers of services. The main articles of profit for clubs on sports are income from television, advertising, selling tickets for sports events and club attributes. In addition, cooperation with the media contributes to the formation of a positive image of the sports club, increasing its credibility and reputation [11].

In Ukraine, large companies are interested in cooperation with only a limited range of sports, provides an unsystematic nature of sports marketing. The slow development of the commercialization of sports and sports organizations is due, first of all, to insufficient financial support. In this regard, there is a contradiction between the tasks of the sphere of physical culture and sport in the state, declared by the citizens' rights to engage in physical culture and sports and the conditions of sports societies, clubs [13].

To resolve the contradiction of the limited possibilities of a social organization and the need to conduct its commercial activities in modern conditions, it is proposed to operate a sports club, as well as a unitary commercial enterprise founded by it, which makes it possible to distinguish two types of activities: physical culture and sport, aimed at achieving the relevant indicators of health, physical form and capacity of the body; commercial services related to physical culture and sports, with the corresponding fee-based services, and provide an economic opportunity to realize the actual physical and sporting achievements [4].

An important direction of the activity of sports clubs is the involvement of volunteers, whose presence contributes to the development of public relations, the solution of social problems of athletes, the addictive attitude, and the formation of a team of like-minded people.

Important for the successful operation of sports clubs is the development of competitive sports for children as a means, first of all, education, and then sportsmanship; stimulation of children and adolescents who are not suitable for competitive sports, to engage in sports as a hobby; involvement of younger coaches and trainers; identify and meet new needs; ensuring economic stability through paid services [17].

The main goal of the activity of sports clubs in higher educational establishments is to create favorable conditions for practicing various forms of rehabilitation, physical culture and sports of students, teachers and employees of the institution. Activity of sports clubs is aimed at the formation of their need for strengthening health by means of physical culture and sports; attracting as many young people as possible, employees to systematic physical training and sports; provision of fitness and health services; organization and holding of mass physical culture and health and sporting events, competitions, etc. [8]. Under certain conditions, the activity of sports clubs can be considered as a specific system of education and socialization in a holistic pedagogical process. This is achieved due to the presence of specific examples of observing a healthy lifestyle, stimulating a multifaceted informal communication, integrating the efforts of students and teachers, ensuring the active position of students in the activities of the club, motivating students to friendly group solidarity, self-improvement, internal group rivalry, the pursuit of high individual indicators and results, sports interest and the need for cognition [21].

Among the main tasks of the student club is the creation of highly qualified athletes the necessary material and living conditions for the combination of education with active sporting activities. However, after graduating from college, young people often lose interest in healthy lifestyles. Prevention of this negative phenomenon can be achieved by increasing the overall level of financing of student sports, to facilitate the functioning of sports clubs, the development of infrastructure that belongs to the payment of coaches [8].

According to the Regulations on the Organization of Physical Education and Mass Sports in Higher Educational Establish-

ments, approved by the Ministry of Education and Science of Ukraine in 2006, the integration of training sections and training groups is carried out taking into account the sports interests of students, their state of health, physical and motor (technical) preparedness, sport qualifications [19].

There is a search for effective organizational forms of sports work with students. Among them, the branches of the sports club are in an independent structure. Creation and operation of sports clubs based on student government in organizing and conducting internal university mass sports and recreation activities for students with guidance to departments of physical education and sport. Creation of interuniversity regional branches of higher sports skills by kinds of sports in order to provide the necessary conditions for the preparation of highly qualified student athletes. Functioning of the centers of student sports, providing the creation of favorable conditions for combining studies at a higher educational institution and preparing students for participation in major international competitions. Creation of sports clubs of state level on the basis of large universities with differentiation of activities, developed sports infrastructure, sufficient resources, and new organizational forms. Association of industrial universities in large scientific and educational centers. Three directions of creation and development of sports clubs in higher educational institutions are proposed as an independent structural unit with a staff of independent workers; as an independent financial unit of the university with full-time coaches, is not included in the structure of the Department of Physical Education; finding a sports club in the structure of the department. The sports club should become the unifying link of all subjects of the sports student community: sports team, sports group, support group, fans, IT specialists, sponsors, graduates [2; 9; 15].

Taking into account the above factors indicates that to improve the effectiveness and effectiveness of sports club activities as a multifaceted social phenomenon, the methodological and practical importance of an integrated approach. The need to take into account the interaction of all actors of this multifaceted social phenomenon determines the use, instead of the narrower concept of a "sports student club", the term "sports club of a higher educational institution". Standards of activity of the sports club of a higher educational institution should include the following components: the target (the purpose and objectives of the complex organization of the sports club's activities) is meaningful (the main areas of sport: mass, reserve, top achievements, in some cases, professional), procedural (a complex of technologies for each of the semantic activities of the club) regulating (monitoring, control and correction of the actions of the subjects of the club) effective (the final result of the process of the club's work in various sports areas); resource (environmental factors affecting the effectiveness of the sports club).

Conclusions

Student sport has a rich history, which attracts a significant part of society and is entrusted with the solution of many tasks that go beyond the education of young people in higher education institutions. At the same time, the analysis of scientific works showed that their solutions are provided mainly by the possibilities of student sports, ignoring the great potential of its integration with phenomena that occur with sports fans before entering a higher educational institution, with their student life and after receiving higher education.

One of the important factors that made the student sport a global social phenomenon is the introduction of the club system of organization of sports activities for students. Evidence of this statement is the results of an analysis of events related to the emergence and development of student sport: the unification of people, the emergence of clubs, the creation of sports clubs, the formation of university sports clubs, the holding of competitions between clubs of educational institutions of the country, association of clubs in national sports university associations, holding international meetings between the teams of sports university clubs, the emergence of international sports associations of students, holding complex international competitions. With the development of sports club activities, the further reform of the sphere of physical education and sport in Ukraine and in the world.

An urgent need is the introduction of such organizational and methodical foundations for the activities of a sports club on the basis of a higher educational institution, contributing to the complex solution of the tasks of sport of higher achievements, backup and mass sports; provide continuity of sports for future entrants, students with different levels of sportsmanship, graduates; support the decision of financial, material and other relevant issues of supporters of the chosen higher educational institution, locomotors activity and sport. The standard of the complex organization of sports club activities should include targeted, meaningful, procedural, regulatory, resultant and resource components.

Prospect for further research. Need to solve not only the tasks of the development of student sports, but also the general problems of reforming the sports sphere of physical education and sports determine the search for effective forms of integrated organization of sports clubs of higher educational institutions.

Conflict of interests. The author declares that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization

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Received: 10.06.2017.
Published: 31.08.2017.

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SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 797.212.2:796.056.001.57

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 73-78

Technical and tactical action modeling of highly trained athletes specializing in breaststroke swimming at various length distances

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Purpose: *definition of model parameters of technical and tactical actions of highly trained athletes specializing in breaststroke swimming at various length distances.*

Material & Methods: *analysis of literary sources, video shooting, timing, methods of mathematical data processing. The contingent of the surveyed was made up of athletes who specialized in distances of 50, 100 and 200 meters in breaststroke swimming and had the level of sports qualification of master of sports of Ukraine, Master of Sports of International grade.*

Result: *authors found that the technical and tactical actions of highly trained athletes during the swim of distances of 50, 100 and 200 meters by the breaststroke have their own characteristics; degree of influence of speed, pace and "step" of the strokes cycle on the result of swim distances of 50, 100 and 200 meters is determined; developed their model characteristics.*

Conclusion: *the definition of distance specialization in breaststroke swimming should be carried out taking into account the compliance of individual indicators of technical and tactical actions of athletes to model parameters.*

Keywords: *breaststroke, athletes, distance, technical and tactical actions, correlation, model parameters.*

Introduction

Successful performance at competitions – is the result of a directed training process, the effectiveness of which is determined by the level of theoretical knowledge of the trainers, their possession of the subtleties of technical, tactical, psychological and functional perfection of athletes, taking into account their individual capabilities [9; 11].

Finding ways to improve the competitive activities of athletes is the focus of professionals working in the field of competitive swimming, long ago. Currently, the scientific and methodological literatures are well represented improvements related to the study of factors affecting athletic performance [2; 3; 8; 10; 12]. Specialists detail the components of the structure of competitive activity, revealed the role of morpho-functional indices in swimming, the characteristic of technical and tactical operations of swimming athletes at distances of different lengths, etc. [1; 4; 5; 6; 7 etc.].

However, despite the level of knowledge of the problem, a number of its aspects require further specification. Thus, studies on indicators of technical and tactical skill of the athletes were concerned primarily with ways to swim front crawl and butterfly stroke, while the nuances of overcoming distances of varying lengths breaststroke and front crawl ways on the back were studied in fragments.

Given that a detailed and comprehensive analysis of the structure of competitive activities and special preparedness of athletes of various specializations will contribute to improving the quality of the training process, and orientation to model characteristics will allow to identify individual reserves of further growth of the skill of a particular athlete, it becomes clear the relevance of scientific work in this direction.

Relationship of research with scientific programs, plans, themes. Studies were conducted in accordance with the theme of the Consolidated Plan of Research in the field of physical culture and sports for 2011–2015: "Modeling of technical and tactical actions of qualified athletes in swimming and speed-strength disciplines of track and field athletics".

Purpose of the study: definition of model parameters of technical and tactical actions of highly trained athletes specializing in breaststroke swimming at various length distances.

Objectives of the study:

1. Characterize the dynamics of the speed, pace and "step" of the cycle of strokes in high-skilled athletes when they overcome distances of 50, 100 and 200 meters in the way of breaststroke swimming.

2. Determine the degree of influence of technical and tactical indicators on the result of the swim of distances of 50, 100 and 200 meters in the way of breaststroke swimming.

3. To develop model characteristics of technical and tactical actions of high-qualification athletes specializing in swimming at a distance of 50, 100 and 200 meters in the way of breaststroke swimming.

Material and Methods of the research

To solve the set tasks, the following methods were used in the work: analysis of literary sources, video shooting, timing, methods of mathematical processing of numerous data.

The research was conducted during the Ukrainian National Swimming Championships among men and women, as well

as at the Ukrainian Championships among adults and youth (2014–2016).

The surveyed group consisted of participants in the semifinal and final swimmers at distances of 50, 100 and 200 meters in a breaststroke swimming.

All the athletes who participated in the experiment were candidates and members of the Ukrainian national swimming team, had the level of sports qualifications of the MS and MSIG.

Results of the research and their discussion

The main technical and tactical indicators of our highly skilled athletes have been identified: speed, pace, and "step" cycle of strokes movements, which are valued areas:

- start – out of water;
- out of water – 15 meters;
- distance swimming at intervals of 15–25 meters, 25–35 meters, 35–45 meters, 65–75 meters and etc.;
- turning plot: 5 meters to the turn and 15 meters after the turn;
- finish line is 5 meters.

Dynamics of technical and tactical parameters of qualified athletes in the process of overcoming them by a distance of 50 meters in the way of breaststroke swimming is reflected in Figures 1–3.

As can be seen from Figure 1, the highest speed of all athletes is noted in the starting line. Its high values are due to the specifics of swimming activities in this area of the distance, namely, the execution of movements under water.

In the course of overcoming the competitive distance, the speed indicators gradually decrease, reaching the lowest value at the final 45–50 meters (1,13 m·s^{-1}).

When swimming a distance of 50 meters in the way of breaststroke swimming, athletes demonstrate great differences in the "step" of the cycle of strokes (Figure 2).

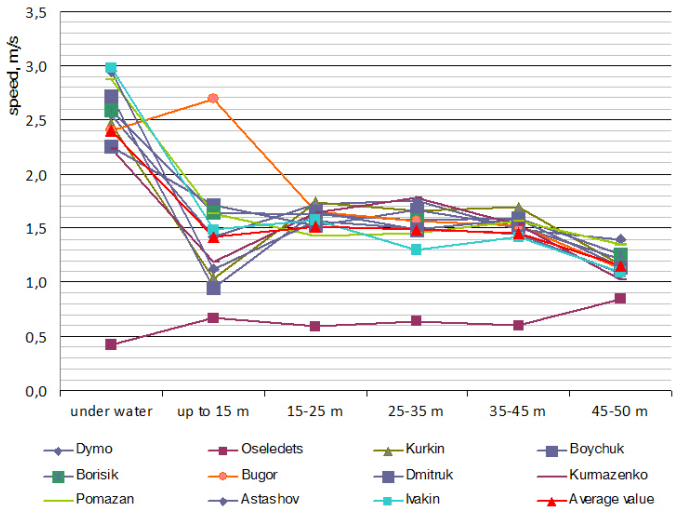

Fig. 1. Dynamics of speed indicator in the process of swimming by athletes distance of 50 meters by way of breaststroke swimming

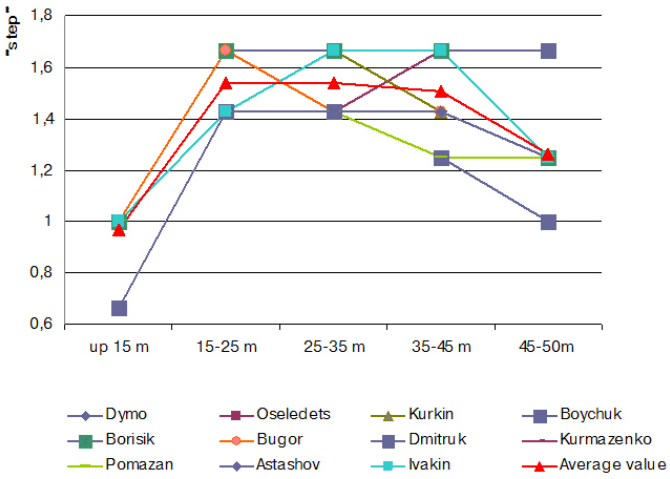

Fig. 2. Dynamics of "step" indicator of the cycle of strokes in the process of swimming by athletes distance of 50 meters by way of breaststroke swimming

At the same time, the general trend of the dynamics of this indicator is characterized by an increase in its numerical values in the "start – 25 meters" section, preservation at a relatively equal level in remote navigation areas and a decrease in the last (finishing) meters of the distance.

From Figure 3 we see that the highest rate of movement is seen on the starting segment (91,85 cycle·min^{-1}). In the process of overcoming the distance, its value does not change significantly (from 63,4 cycle·min^{-1} to 61,7 cycle·min^{-1}), at the finish line there is a decrease in the tempo to the mark 56,7 cycle·min^{-1}.

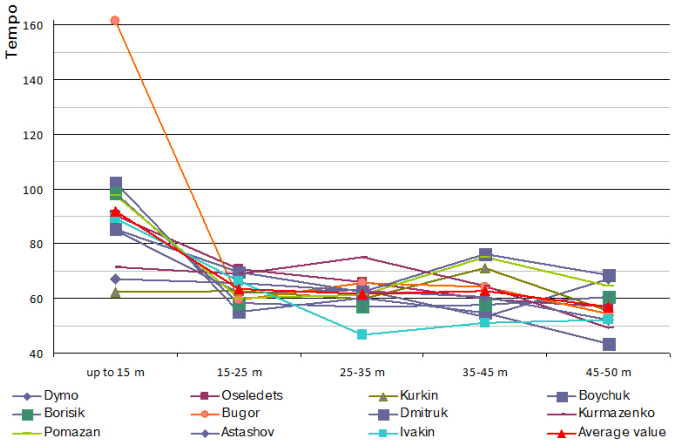

Fig. 3. Dynamics of tempo of strokes indicator in the process of swimming by athletes distance of 50 meters by way of breaststroke swimming

Dynamics of technical and tactical parameters of qualified athletes during the swimming at the distance of 100 meters by the way the breaststroke swimming is somewhat different.

As can be seen from Figure 4, the speed indicator on the starting segment has a maximum value (2,3 m·s^{-1}), after which it gradually decreases to the level 1,2 m·s^{-1}. After the turn, the speed increases to the level of 1,7 m·s^{-1} and in the future the athletes try to support it without significant fluctuations. On the finish line (95–100 m), the swimming speed slows down,

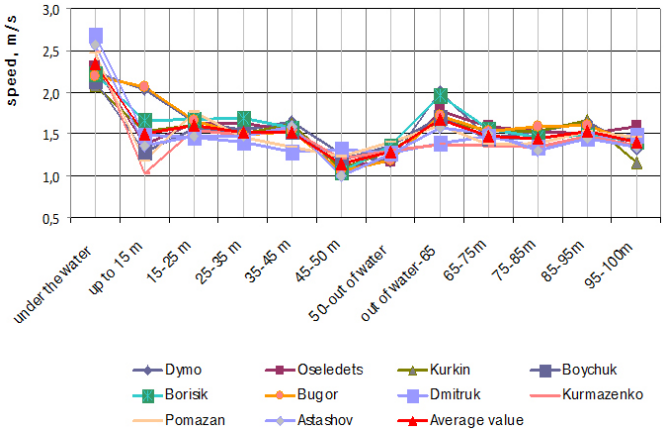

Fig. 4. Dynamics of speed indicator in the process of swimming by athletes distance of 100 meters by way of breaststroke swimming

reaching average values 1,4 m·s^{-1}.

Dynamics of the "step" of the cycle of strokes at a distance of 100 meters is characterized by insignificant fluctuations, namely, an increase in its numerical values at the "15–25 meters" (2,2 m) section, systematic decrease as it approaches the turntable (1,6 m) , small growth and preservation at one level on the segment "65–95 m" (1,9 m), a decrease in the last meters of the competitive distance (1,7 m) (Figure 5).

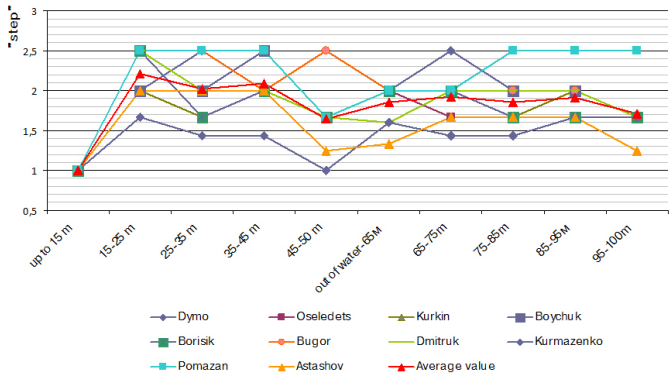

Fig. 5. Dynamics of "step" indicator of the cycle of strokes in the process of swimming by athletes distance of 100 meters by way of breaststroke swimming

At the same time, differences in individual terms "step" in different parts of the distance from the athletes quite significant.

Having considered the dynamics of the speed and "step" of the cycle of strokes, it can be concluded that both indicators are characterized by a decrease in values at the end of the race distance.

Accordingly, the tempo of strokes after a significant decrease in the first 25 meters is characterized by relative stabilization on the segments of the remote swimming (Figure 6).

The first half of the race is overcome by the athletes at the level of indicators 44,17–44,86 cycle·min^{-1}. On the "out of water – 65 m" segment, the tempo values reach the level of 54,9 cycle·min^{-1}. Then the swimmers try to maintain and even

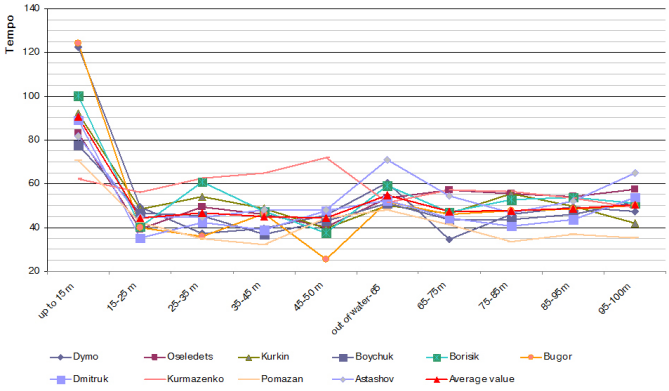

Fig. 6. Dynamics of tempo of strokes indicator in the process of swimming by athletes distance of 100 meters by way of breaststroke swimming

increase it to the finish.

It should be noted that in the course of overcoming the distance, each of the athletes have individual "peaks" of the tempo of strokes.

Dynamics of technical and tactical parameters of qualified athletes during swimming a distance of 200 meters by way of breaststroke swimming is reflected in Figures 7–9.

It is seen from Figure 7 that athletes overcome the distance of 200 meters from the relatively stable performance speed (except for the passage of turning areas). The greatest speed rises are noticeable on the segments "out of water – 65 meters", "out of water – 115 meters", "out of water – 165 meters". After these "peaks" during the course of the race, there is a gradual decrease in speed to the average mark 1,1 m·s^{-1}. At the finish, most athletes slow down their movements.

It should be noted that the greatest differences in the values of the indicator studied among athletes take place at the starting segment.

The analysis of Figure 8 allows us to state that at the starting segment all the athletes have an increase in the "step" of the cycle of strokes with its subsequent content in the areas of remote navigation. Before the turn most athletes reduce the length of the stroke (up to 1,9 m, 2,1 m and 1,7 m respectively), while after pushing away from the turntable the "step" of the cycle of strokes increases again. At the finish line, the average length of the stroke decreases to 1,6 meters.

Attention is drawn to the fact that each athlete has its own stroke length and these disagreements are quite significant.

In turn, the pace of execution of movements after a rapid decline on the starting segment (from 77,2 cycle·min^{-1} to 37,6 cycle·min^{-1}) s further characterized by a relative uniformity (Figure 9).

A slight increase in this indicator is noted at the beginning of every 50 meters of the distance. This is especially noticeable in the areas " out of water – 115 meters" and "out of water – 165 meters" (up to 43,6 cycle·min^{-1} and 44,9 cycle·min^{-1} respectively). After overcoming the mark of 165 meters, the tempo grows and reaches 45,3 cycle·min^{-1} at the finish line,

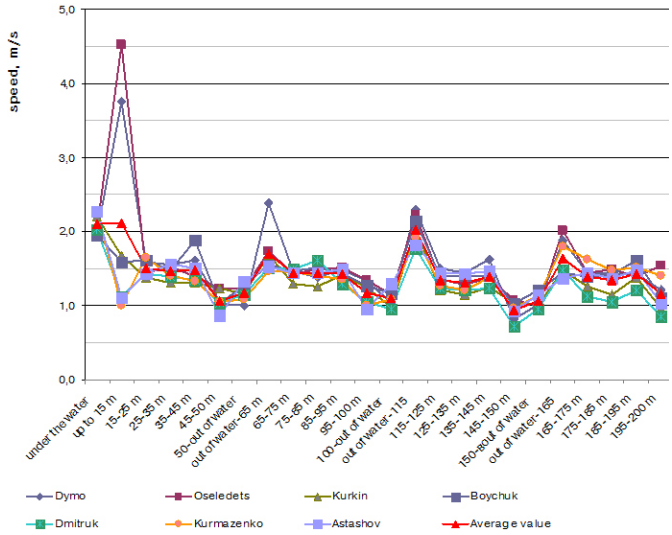

Fig. 7. Dynamics of speed indicator in the process of swimming by athletes distance of 200 meters by way of breaststroke swimming

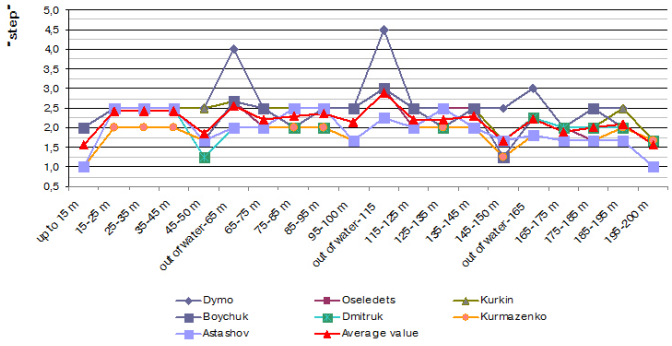

Fig. 8. Dynamics of "step" indicator of the cycle of strokes in the process of swimming by athletes distance of 200 meters by way of breaststroke swimming

reaching its maximum values at a competitive distance of 200 meters.

Thus, the technical and tactical actions of highly skilled athletes during the swimming of distances of 50, 100 and 200 meters by way of breaststroke swimming have their own characteristics.

Investigation of the degree of interrelation between the main indicators of technical and tactical skill of high-qualified athletes and the athletic result at a distance of 50, 100 and 200 meters during the swimming by way of breaststroke swimming allowed determining the following.

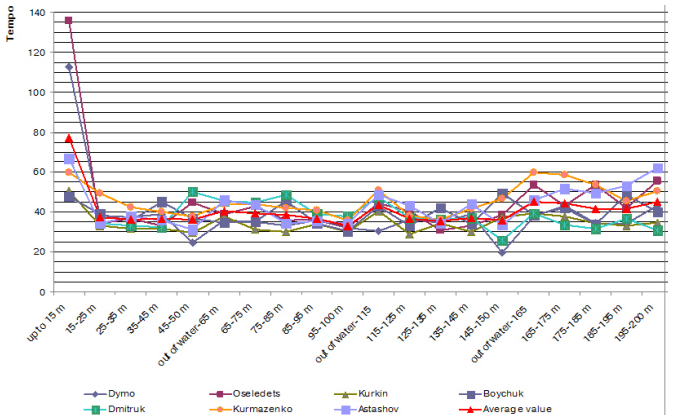

Fig. 9. Dynamics of tempo of strokes indicator in the process of swimming by athletes distance of 200 meters by way of breaststroke swimming

As a result, swimming of a distance of 50 meters is largely affected by the magnitude of the "step" of the cycle of strokes on the section "15–25 meters" (r=–0,65).

At a distance of 100 meters, the speed indicator on almost all segments significantly correlates with the final result (the value of r oscillates from –0,52 to –0,93). In turn, the correlation relationship between the tempo and the "step" of the cycle of strokes with the final result is less pronounced (Table 1).

At a distance of 200 meters when swimming by way of breaststroke, as well as at a distance of 100 meters, the speed is a more significant indicator than the tempo and "speed" of the cycle of strokes.

Speed indicators at almost all segments of the race distance correlates with the final result at a level of r>0,60, while the relationship between the tempo and the "step" of the cycle of strokes with the final result is less pronounced (r>0,54) (Table 2).

Obtained digital material allowed to develop the model characteristics of technical and tactical indicators of athletes specializing in swimming at the distance of 50, 100 and 200 meters by way of breaststroke (Table 3, 4).

In turn, an important model parameter of technical and tactical actions at a distance of 50 meters by the way breaststroke swimming is the "step" of the cycle of strokes on the section "15–25 meters", which is 1,5 m.

Developed model characteristics can serve as reference points for determining the distance specialization of athletes in swimming by the way breaststroke.

Table 1

Degree of correlation between the most significant indicators of technical and tactical actions and the sporting result at a distance of 100 meters when swimming by way of breaststroke

Indicator	Speed									"Step"	Tempo	
Stage, m	Start – entrance	Before 15	15–25	25–35	35–45	Out of water – 65	65–75	75–85	85–95	Out of water – 65	Before 15	45–50
Correlation coefficient (r)	0,74	–0,58	–0,61	–0,82	–0,61	–0,93	–0,54	–0,81	–0,52	–0,72	–0,58	0,57

Table 2

Degree of correlation between the most significant indicators of technical and tactical actions and the sporting result at a distance of 200 meters when swimming by way of breaststroke

Indicator	Speed											
Stage, m	Before 15	25–35	35–45	85–95	Out of water – 115	115–125	125–135	135–145	165–175	175–185	185–195	195–200
Correlation coefficient (r)	–0,68	–0,76	–0,60	–0,86	–0,80	–0,79	–0,71	–0,79	–0,63	–0,87	–0,65	–0,68
Indicator	**«step» of the cycle of strokes movements**						**Tempo of strokes movements**					
Stage, m	Before 15	Out of water – 65	85–95	95–100	Out of water – 115	125–135	135–145	Before 15	35–45	Out of water – 65	95–100	195–200
Correlation coefficient (r)	–0,57	–0,60	–0,65	–0,57	–0,60	–0,64	–0,57	–0,57	–0,54	0,60	0,55	–0,55

Table 3

Model indicators of technical and tactical actions of athletes who specialize in swimming by way of breaststroke at a distance of 100 meters

Indicator	Speed, m·s^{-1}						“Steep”, m
Stage, m	Start-out of water	15–25	25–35	35–45	Out of water – 65	75–85	Out of water – 65
Model indicators	2,3	1,6	1,5	1,5	1,7	1,5	1,8

Table 4

Model indicators of technical and tactical actions of athletes who specialize in swimming by way of breaststroke at a distance of 200 meters

Indicator	Speed, m s^{-1}						
Stage, m	25–35	85–95	Out of water – 115	115–125	125–135	135–145	175–185
Model indicators	1,5	1,4	2,03	1,3	1,3	1,4	1,3
Indicator	**“Step”, m**					**Tempo, cycle·min^{-1}**	
Stage, m	Out of water – 65	85–95	Out of water – 115	125–135	135–145	Before 15	Out of water – 65	95–100	195–200
Model indicators	2,6	2,4	2,9	2,2	2,3	77,2	40,4	33,2	45,3

Conclusions

1. The main goal of rational training of high-class swimmers is to identify the key factors of competitive activity and special preparedness, taking into account the individual characteristics of a particular athlete.

2. Technical and tactical actions of highly qualified athletes during the swimming of the 50, 100 and 200 meter by the breaststroke way have their own characteristics.

3. When swimming the 100 and 200 meter distances in the breaststroke way, the greatest variations in speed, tempo and “step” of the cycle of strokes occur on the rotary segments.

4. Breaststroke-athletes have significant individual differences in the “step” of the cycle of strokes.

5. With the increase in the length of the competitive distance increases the number of significant indicators of technical and tactical skills.

6. Definition of distance specialization in the way breaststroke swimming should be carried out taking into account the compliance of individual indicators of technical and tactical actions of athletes to model parameters.

Prospect for further research there are certain degrees of correlation between the psychophysiological indicators of the swimmers of high qualification and the sports result at distances of 50, 100 and 200 meters in the way breaststroke swimming.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn’t get the financial support from the state, public or commercial organization.

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Received: 16.06.2017.
Published: 31.08.2017.

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SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 796.894.000.57:796.015.1

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 79-82

A dependence of a sports result on physical development, morphofunctional and special strength preparedness data of weightlifters at the stage of preliminary basic training

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Purpose: *establishing the nature of the relationship between the sporting result of weightlifters 15–17 years and the level of their special physical and morphofunctional preparedness at the stage of preliminary basic training.*

Material & Methods: *30 athletes of the group of preliminary basic training of the second year of training were involved in the experiment. The study was conducted on the basis of the department of weightlifting and boxing of the Kharkov State Academy of Physical Culture and Children's Sports School "KhTP".*

Result: *correlation between the parameters of the morphofunctional, speed-power and special (competitive) readiness of weightlifters of preliminary basic training are identified. The conducted research shows that the result of competitive exercises of athletes specializing in weightlifting, at the stage of preliminary basic training depends on the strength and speed-strength preparedness.*

Conclusion: *it is established that the correlation between the results of competitive exercises and standing high jump, standing long jump, running at 30 m may indicate a correlation between the strength and speed-strength preparedness of athletes specializing in weightlifting at the stage of preliminary basic training.*

Keywords: *sports result, morphofunctional preparedness, preliminary basic training, competitive exercises, speed-strength preparedness.*

Introduction

Study of the dependence of the results of competitive exercises on the level of morphofunctional and special physical preparedness of weightlifters is an important condition for the construction of an effective training program for athletes at the initial stage. A number of studies have been devoted to revealing the interrelations between the indicators of physical development, the preparedness of athletes and the sport result in various power sports. V. M. Platonov, A. N. Vorobyev, I. L. Lisakovsky, V. G. Oleshko studied correlation dependence between morphological features, speed-strength qualities and sports-technical indicators in various power sports, in particular, in weightlifting [8; 1; 6]. A result of the research showed that as the sporting skills increased, the height of the jumping up increased and had an average reliable connection with the length of the body and legs, press, jerk, thrust and squats with the bar on the chest and shoulders. Based on the findings, the authors recommend jumping up from the ground as a test for selection for weightlifting. In the study of A. Dovgich, V. Y. Djim, and G. A. Roman, a reliable correlation was found between the biomechanical parameters of the projectile's movement with the level of development of motor abilities, power and speed-strength parameters when lifting weights with an index of speed-strength qualities for weight-performing classical exercises [3; 4; 11]. L. S. Dvorkin, V. A. Romanenko found the existence of interconnections between exercises in weightlifting and means of general physical training [2; 11]. Author recommends using the exercises "push-ups" and "lifting the trunk from the supine position on the back" as auxiliary to increase the level of strength in the exercises of weightlifters.

In this work, the studies of the dependence of the sports result on the data of physical development, the functional state of the cardiovascular and respiratory systems of the body, and the special strength training of weightlifters at the initial training stage.

Relationship of research with scientific programs, plans, themes. The scientific research was carried out on the theme of the Consolidated Plan of Research Work in the Sphere of Physical Culture and Sports for 2011–2015. On topic 3.7 "Methodological and organizational-methodological basis for determining the individual rate of physical condition of a person" (state registration number 0111U000192).

Purpose of the study: establishing the nature of the relationship between the sporting result of weightlifters 15–17 years and the level of their special physical and morphofunctional preparedness at the stage of preliminary basic training.

Material and Methods of the research

An experimental study of the nature of the relationship between the athletic result, the data of physical development, the functional state of the body of weightlifters was conducted on the basis of the Department of Weightlifting and Boxing of the Kharkov State Academy of Physical Culture and the Children's Sports School "KhTP". Experiment involved 30 athletes from the group of preliminary basic training of the second year of training. Training sessions for athletes were held five times a week for 2 academic hours on the weightlifting program for the Youth Sports School. At the end of the experiment, the indicators characterizing the state of morphofunctional,

speed-strength and special preparedness of weightlifters of the study group was determined.

Methods of research: according to the methodological approach to solving the problem and set tasks, research program included a set of research methods: analysis of scientific and methodological literature, method of anthropometry and studies of the state of the cardiovascular system, pedagogical experiment and methods of mathematical statistics.

Results of the research and their discussion

Table shows the data of physical development, functional state of the cardiovascular and respiratory systems of the body, special and strength training of weightlifters in the constant experiment. Analysis of the values of mass-growth indicators, the length and circumference dimensions of the various parts of the body of athletes testifies to the relative homogeneity of the vast majority of the studied indicators within the group. The variability of the series for the length body size of weightlifters was negligible.

Coefficient of variation in terms of body length is 3,89%, body length at sitting is 4,02%, lower limb 4,15%, upper limb 4,5%, shoulder width 6,04%, transverse diameter of the chest – 8,36%. For circumference sizes, the coefficient of variation was higher. For example, the variation in chest circumference at rest was 4,58% of chest circumference (exhalation) – 4,95%, chest circumference (inspiration), 4,59%, shoulder – 6,19%, hip – 7,29%. Highest coefficient of variation is noted

Indicators of length and circumference dimensions, the state of the cardiovascular and respiratory systems, testing of special physical qualities and competitive exercises of weightlifters of the study group (n=30)

Indicators	$\bar{X}$±m	V,%
Length and circumference dimensions		
Body length, cm	170,35±1,99	3,89
Body weight, kg	72,60±2,17	8,48
Body length at sitting, cm	92,10±0,32	4,02
Length of lower limb, cm	78,05±0,51	4,15
Length of upper limb, cm	70,91±0,32	4,35
Shoulder width, cm	51,75±0,36	6,04
Chest circumference at rest, cm	100,24±2,17	4,58
Chest circumference on exhalation, cm	98,07±2,17	4,95
Chest circumference on inspiration, cm	103,41±2,17	4,59
Shoulder circumference, cm	36,20±0,92	6,19
Hip circumference, cm	57,70±1,29	7,29
Transverse diameter of the chest, cm	38,15±0,34	8,36
State of the cardiovascular and respiratory systems		
HR at rest (beats·min^{-1})	64,32±1,33	9,52
BPs at rest (mm Hg)	121,25±1,64	5,27
BPd at rest (mm Hg)	80,35±1,98	8,53
PWC170, kgm·min^{-1}	1343,10±48,12	13,87
PWC/kg, kgm·min^{-1}·kg	20,21±1,07	21,82
MOC, ml·min^{-1}	3979,10±126,59	12,32
MOC /kg, ml·min^{-1}·kg^{-1}	59,80±2,95	19,12
Cooper test, m	2448,3475,98±	11,74
Vital capacity of lungs, l	4,23±0,16	15,38
Vital index, ml kg^{-1}	67,60±0,78	5,32
Breathing rate	12,80±0,55	5,96
Breathing inspiration, s	48,44±2,69	21,30
Retention of breath on exhalation, s	31,62±3,25	29,50
Special physical qualities		
Run at 30 m, s	5,30±0,35	5,19
Shuttle run 4x9 m, s	10,30±0,90	3,34
Jump up, cm	10,30±1,37	7,30
Standing long jump, cm	217,7±2,63	6,91
Lifting body, number of times per minute	51,69±1,55	9,19
Push-ups, number of times	42,46±2,58	12,49
Pull-ups, number of times	12,60±2,25	19,73
Jump over rope on 2 legs, number of times	86,23±2,80	6,46
Competitive exercises		
Snatch classic, kg	19,24±0,45	16,04
Clean and jerk classic, kg	26,73±0,41	10,56
Snatch, clean, and jerk combination, kg	45,97±0,76	11,42
Back squat, kg	43,65±0,72	11,45
Benchpress, kg	31,86±0,44	9,55
Deadlift, kg	44,36±0,55	8,57

for the athlete's body weight – 8,48%.

In athletes of the study group, the average heart rate, as seen from the table, is 64,32 beats · min^{-1}. The values of the standard quadratic deviation and the coefficient of variation were 6,22 beats · min^{-1} and 9,52%. It was established that the BPs of the athletes of the study group was at rest in the dormant state, the mean value was 121,25±1,64 mm Hg. For BPd, the average in the group is close to the lower limit of the age limit – 80,35±1,98 mm Hg. Results of the submaximal test of Valund-Shestrand indicate a sufficient level of physical preparedness for the athletes of the study group. Values of the standard deviation and coefficient of variation for the PWC170 were 48,12 kgm · min^{-1} and 13,87%. Average value of PWC170 is 1343,10±48,12 kgm · min^{-1}, which exceeded the standards for healthy untrained children. The average values of the MOC were in absolute terms and the calculation per kilogram of body weight, respectively 3979,10±0,126,59 ml min^{-1} and 59,80±2,95 ml kg^{-1} · min^{-1}, 12-minute Cooper test – 2448,34±75.98 m. and characterized a sufficient level of aerobic endurance. Indicators of the VCL of the athletes were 4,23±0,16 l. and were within the norm for healthy adolescents. Values of the standard deviation and coefficient of variation for this indicator were equal 0,60 l and 15,38%. Vital index of weightlifters at the stage of ascertaining experiment was 67,60±0,78 ml kg^{-1}. Such VI values correspond to the average level of physical health. Respiration rate of athletes was within the normal range for healthy adolescents and averaged 12.80±0,55 times, the coefficient of variation was 15,96%. Significant variability of the results was observed in the test parameters of Stange and Genci. The average values of these indicators were 48,44±2,69 times and 31,62±3,25 times, coefficients of variation – 21,30% and 29,50% respectively. Thus, the physiological state of the cardiovascular and respiratory systems of the body of the athletes of the study group is satisfactory, the values of the studied indicators were within the limits of the norm and characterized a sufficient level of physical performance [6].

Average result in standing long jump was 217,7±2,63 cm; coefficients of variation – 6,91%. In the jump to a certain height, the average result was 10,30±1,37 cm, coefficients of variation – 7,30%. Average results in the exercises that characterize the power capacity, namely, pull-up and push-up, were 12,60±2,25 times and 42,58 times; coefficients of variation was 19,73% i 12,49% respectively. For the indicators characterizing speed and agility, there was a slight variability in the results. The coefficient of variation for run indicator 30 m is equal to 5,19%; shuttle run – 3,34%. For indicators characterizing endurance, there was a slight variation in the following results, the coefficient of variation in terms of lifting body – 9,19%, respectively jump over rope on 2 legs – 6,46%.

To establish the dependence of the sports result on the morphofunctional indicators and the level of special physical preparedness of the athletes, a correlation analysis is performed. It is established that all indicators correlate with each other, but the degree of these interrelations is different. A correlation was found between the result of a classic snatch and length and body weight (r=0,70, r=0,85), hip circumference (r=0,66), chest on inspiration, expiration, breath hold (r=0,69; r=0,67). Training weightlifters to expand the chest increase the amount of muscle involved in the work, which is confirmed by the correlation coefficients between these indicators. Relationship between the result of squatting and hip circumference may indicate that to achieve the best result in this exercise, you should work on increasing the mass of the muscles of the hip.

Interrelationships found between the classic snatch and the maximum oxygen absorption and PWC170 (r=0,45 and r=0,57) can be explained by an increase in the indices of aerobic endurance and the level of physical preparedness of the organism that occur in the process of sports training. Noted an inverse relationship between the results in the snatch classical and run at 30 (r=–0,63), which can be explained by the fact that when the snatch classical and run at 30 m to the work involved various types of muscle fibers. In the snatch classical fast-contractile fibers are involved, in the run-slow-contractile fibers. Since when performing competitive exercises in weightlifting, fast-contractile muscle fibers are involved in work, their proportion in the muscles of the legs is increased and the athlete can not perform physical work for a long time, which is manifested in the negative value of the correlation coefficient between these indicators.

A correlation was found between the results in the classic jerk and long jump and at a certain height (r=0,43, r=0,67), which may indicate a correlation between the power and speed-strength preparedness of weightlifters at the initial training stage.

For the result in the clean and jerk classic, a correlation was found with the length and mass of the body (r=0,65, r=0,80), chest circumference in inspiration, exhalation (r=0,74, r=0,72), and pull-ups (r=0,40), push-ups (r=0,51). When performing the clean and jerk classic and the flexion-extension exercises on the uneven bars, the same muscle groups are involved in the work, including deltoid, triceps. The overwhelming majority of athletes in weightlifting during the jerk use a technique in which the exercise is performed with various techniques [7]. The work of the muscles using this technique of pushing is as close as possible to the work of the muscles in the push-ups exercise, as evidenced by the correlation relationship between these exercises.

For the result in a jerky thrust, a correlation was observed with the chest circumference on inspiration, exhalation (r=0,55; r=0,60). During strength training, the relationship between the result of this exercise and PWC170 and MOC, vital capacity of the lungs (r=0,57; r=0,55; r=0,42 respectively). In our study, a correlation was found between the result of jerky thrust and a standing long jump (r=0,52), which may indicate the relationship between the power and speed-strength preparedness of athletes specializing in weightlifting, at the stage of preliminary basic training.

It has been established that the most important morphological indicators for ensuring a high sport result in competitive exercises for weightlifters are the length of the lower limbs, upper limbs, chest and hip circumference [4]. The results of our correlation analysis are confirmed by the data obtained in Dvorkin study (1992), who showed that a high correlation relationship (from r=0,6 to r=0,9) with the level of achievement in competitive weightlifter exercises has the following indicators: with a snatch classic – length, body weight, chest and hip circumference, length of the lower limb, length of the upper limb. With the jerk classic – body mass, girth of the shoulder, chest, length of the upper limb, the length of the lower limb, the width of the shoulders [5].

Conclusions

It has been established that the most significant morphological indicators for ensuring a high sport result in competitive exercises for weightlifters are hip circumference, circumference of the shoulder muscles, and circumference of the chest.

A correlation was found between the results of competitive exercises and jumps up from the place, standing long jump, running at 30 m, which may indicate a correlation between the strength and speed-strength preparedness of athletes specializing in weightlifting, at the stage of initial training.

Prospect for further research will be directed towards of determining the structure of the preparedness of weightlifters at the stage of preliminary basic training.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 20.07.2017.
Published: 31.08.2017.

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SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 796.012.61.035:612]:061-057.875-055.2]-047.82

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 83-87

Preconditions for the physical state optimization concept formation of female students of medical higher educational institutions

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Purpose: *on the basis of the analysis of the special literature to determine the preconditions for the formation of technology to optimize the physical condition of female students by means of fitness in the conditions of medical higher educational institutions.*

Material & Methods: *preconditions for the formation of the concept of optimizing the physical condition of female students of medical higher educational institutions are determined on the basis of theoretical analysis and generalization of literary sources and data from the Internet network.*

Result: *directions of formation of the concept of optimization of a physical condition of female students of medical higher educational institutions are determined on the basis of use of means of fitness.*

Conclusion: *indicated the need to create a technology to optimize the physical condition of female students of higher educational institutions on the basis of primary monitoring of the physical condition and the use of fitness in the process of physical education.*

Keywords: preconditions, concept, optimization, technology, physical condition, fitness, female students.

Introduction

During the training in the university students are influenced by a number of factors that significantly determine their physical condition. Specialists note that in the conditions of higher educational institutions of the medical profile, complex, prolonged and intense educational activity in combination with hypodynamia and high requirements to the level of professional preparedness of future medical workers form specific morphofunctional conditions characterized by reduced levels of physical development, physical performance and health [4]. Existing state of affairs is also conditioned by the rather weak sports base of Ukrainian universities and low motivation of the overwhelming majority of female students to the formation of a healthy lifestyle and exercising, adversely affects both the state of health and the indices of the professionally applied physical training of future medical workers. On the other hand, it is in medical higher educational institutions that there are specialized specialists controlling the physical condition of female students on annual preventive medical examinations and providing the necessary advisory assistance to determine the direction of practical exercises in physical exercises for physical rehabilitation, medical physical training and physical education. So, there is a problem that relates to the discrepancy between the physical conditions of female students of medical schools and the availability of conditions for exercising during training, indicates its relevance and timeliness.

According to the definition of the International Committee for the Standardization of Tests (ISO), the physical state comprehensively characterizes the level of physical health, physical development, and functional capabilities of the organism, physical working capacity and preparedness [31]. In the categories of "healthy" and "practically healthy" people, respectively, the following levels of physical condition (low, below average, average, above average, high) [1]. Optimization is usually understood as an activity or a complex of them aimed at providing the most advantageous characteristics of the subject of research [22]. Thus, the optimization of the physical state should be understood as a complex increase in the level of physical development, physical fitness and health.

Problem of determining the prerequisites for the formation of the concept of optimizing the physical condition of female students by means of physical education is not entirely new in the scientific and methodological literature. In the study A. Buikova, V. Tristan (2016) [4] noted the need for the formation of a fund of assessment tools for physical education in a medical school, which will improve the procedures for monitoring the physical condition of female students who are engaged in physical exercises. The questions of diagnostics of psycho-physiological states of the organism as one of the key problems of sports medicine are considered in the study of L. Korobeinikova et al. (2016) [10]. Authors of the study emphasize the need for systematic, integrated approaches to solving this problem and allocate physical education as the most effective factors for correcting the physical condition.

One of the most effective means of physical education in the conditions of the university is a practical training in fitness fitness. J. Persheguba et al. (2015) point out the need for the formation of conceptual approaches to the optimization of the physical conditions at the same time, highlighting the rational nutrition factors in practical conjunction with health and fitness classes [18]. Many studies have examined the impact of practical training in physical education on the physical condition of students. Importance of using the optimal systems for assessing the level of the physical state as a tool for quality control of physical education and physical health of students [2; 3; 5]. V. Koryagin, A. Blavt (2013, 2016) note that, in accordance with the current level of health of student youth, there are certain contraindications for exercising and the possibility of correct-

ing the physical states of students in the course of physical education classes with exercises of a certain orientation [8; 9].

Foregoing allows us to state that the problem of optimizing the physical states of student youth has been paid enough attention in scientific research, but taking into account the specifics of higher educational institutions of the medical profile, the educational process in which has a specific nature, which is related to the complexity and large volume of educational material,. In addition, in higher educational institutions of the medical profile there is a clinical and laboratory base for preventive medical examinations in order to determine the level of health, diagnosis of diseases and primary prevention, including physical education. In combination with the consultative services of the profile specialists of the Departments of Physical Rehabilitation, Sports Medicine, Physical Culture, Physical Education and Health, this creates a specific specificity for the process of optimizing the physical condition of female students in the conditions of a medical school, testifies to the final unresolved issue.

Relationship of research with scientific programs, plans, themes. Theoretical studies were conducted in accordance with the plan of research work of the Department of Physical Rehabilitation, Sports Medicine, Physical Education and Health of the Zaporozhye State Medical University of the Ministry of Health of Ukraine on the topic "Optimization of the physical condition of students by means of physical education and sports in the conditions of medical high school". The research topic is consistent with the Consolidated Plan of Research in the field of physical culture and sports for 2016–2020. Ministry of Youth and Sports of Ukraine on the topic 3.13. "Theoretical and methodical foundations of health forming technologies in the process of physical education of various population groups", state registration number 0116U001615.

Purpose of the study: on the basis of the analysis of the special literature to determine the preconditions for the formation of technology to optimize the physical condition of female students by means of fitness in the conditions of medical higher educational institutions.

Material and Methods of the research

Prerequisites for the formation of the concept of optimizing the physical condition of female medical students are determined on the basis of theoretical analysis and generalization of literary sources and data of the Internet network. Our own theoretical generalizations regarding the definition of the prerequisites for the formation of the concept of optimizing the physical condition of female students in medical schools by means of fitness is the basis for the formation of practical technology for optimizing the physical state.

Results of the research and their discussion

Concept of research – is a system of initial theoretical propositions that are the basis of a research search. In the process of scientific search, the adopted initial assumptions that verify, develop, correct, if necessary - exclude, which leads to its modification or modernization. Concept includes the following components [30]:

– methodology (the system of research principles), which is based on a dialectical method and system approach: the concept of optimizing the physical condition of female students is based on general scientific laws – knowledge of the system approach, which treats the system under study as an integral set of individual elements, taking into account the internal relationships and relations between them; dialectical-materialistic method – studying regularities, trends of development and transformation of reality; scientific method as a set of basic methods and technologies for obtaining new knowledge and solving problems. This allows us to consider the process of optimizing the physical state as a variable hierarchical process with medical and biological and social characteristics that are inherent in the body of students;

– a list of relevant research methods. In general, the set of methods for optimizing the physical state of the body of students is divided into three main groups: research methods aimed at studying the processes of physical development; methods of research aimed at studying the processes of physical preparedness, development of motor abilities and physical performance; methods of research aimed at the primary monitoring of morbidity;

– principles of the organization of the process, the nature (theoretical, descriptive, analytical, empirical) and the research program: concerning the problems of optimizing the physical state in the process of physical education, the most effective and rational means.

Analysis of scientific and methodological literature and data from the Internet allows us to state that fitness tools are important for optimizing the physical condition of student youth, which are available and effective in improving the level of physical preparedness, physical development and morbidity [27; 29]. Researchers note that, in addition to purely physical recovery, fitness exercises have a positive effect on the psychological sphere of students, allow the formation of important communications during extra-curricular time, which in turn contributes to a better recovery of the student body after training [6; 12; 23; 28]. As the most popular and common today, the following types of fitness are distinguished: aerobics and its varieties, bodyflex, shaping, pilates, callanetics, stretching, fitball, crossfit, TRX-exercises, etc. [16; 25]. From the point of view of such approaches, questions on the formation of technology to optimize the physical condition of female students by means of fitness are important [7; 13; 19]. Peculiarities of the educational process in the conditions of medical universities are quite difficult for mastering the educational material, on the one hand, and the availability of qualified medical personnel, controls the state of physical health and the incidence of female students on annual preventive medical examinations. Thus, in the process of formation the concept of optimizing the physical condition of female students in medical schools, fitness means also need to take into account the levels of physical development, physical preparedness and the peculiarities of the primary monitoring of morbidity, which makes it possible to raise the question of professional and applied physical training as a component of the professional training of future medical workers in general [24].

This statement is the basis for a possible correction model curricula of medical schools in the field 7.12010001 "Medical case" 7.12010005 "Dentistry" (direction of training 1201 "Medicine") and 7.12020101 "Pharmacy" (direction of preparation 1202 "Pharmacy"). Thus, it can be argued that in order to improve the professional training of future specialists in the

medical field, the issues of increasing the importance of the professionally applied physical fitness and physical working capacity are topical, which will make it possible to realize the existing professional potential in the work of a doctor or pharmacist. In turn, this situation requires more attention from the medical universities guide to the appropriate logistics practical lessons on discipline "Physical Education and Human Health", revitalization of sports clubs, scientific and methodological support for physical education classes and mass sports in universities [14].

Figure shows the general scheme of the optimization of the physical state of students of medical universities by means of fitness, which consists of three main areas, namely: improving the level of physical fitness and physical development, reducing the incidence and harmonization of the psycho-emotional sphere.

Pedagogical analysis of the above-mentioned concept of optimizing the physical condition of female students of medical

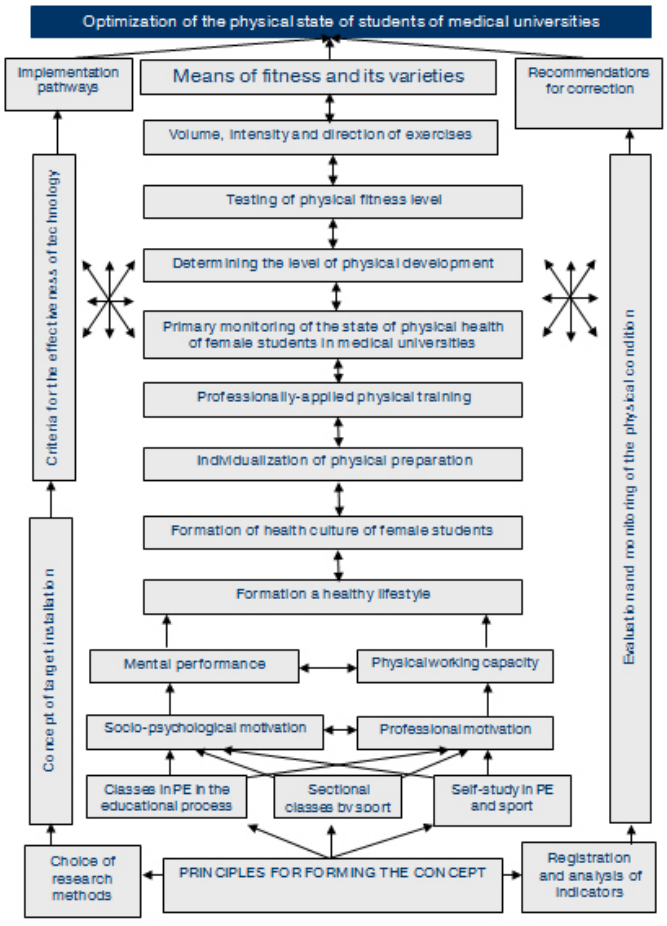

Fig. General scheme for optimizing the physical condition of female students in medical schools by means of fitness

universities allows us to determine the prerequisites for its formation. In the process of generalization of the data available in the scientific and methodical literature, we state the presence of the following prerequisites for the formation of the concept of optimizing the physical condition of female students in the conditions of medical universities:

– availability of appropriate material and technical base and financial support for practical training in physical education and sectional classes in sports [21; 26];

– presence of an appropriate clinical-laboratory base and specialized specialists in medical universities for primary prevention of morbidity, early diagnosis of pre-morbid and premorbid conditions of the body, annual preventive medical examinations;

– the formation of motivation for a healthy lifestyle, fashion to maintain a high level of health [15];

– orientation of practical training in physical education and sectional occupations by sports for an increase in professional-applied physical preparedness, mental and physical performance [11; 17; 20].

Conclusions

Analysis of data from special scientific and methodological literature and the Internet network allowed us to formulate the following:

1. Means of fitness is an effective and affordable tool for optimizing the physical condition of female students in medical universities in physical education classes and sectional classes in sports (aerobics, bodyflex, shaping, pilates, callanetics, stretching, fitball, crossfit, TRX exercises, etc.), basis for the creation of appropriate technology.

2. In medical universities there is a clinical and laboratory base for primary monitoring of the state and determining the level of health, diagnosis of diseases and primary prevention, including physical education and physical rehabilitation. In combination with the possibility of providing consultative services to specialized specialists in the departments of physical rehabilitation, sports medicine, medical physical training, physical education and health, this creates a specific specificity for the process of optimizing the physical condition of students by means of fitness.

3. As the preconditions for the formation of the concept of optimizing the physical condition of female students in medical universities, the following:

– presence in the university of a modern material and technical base and appropriate financial support for practical classes in the discipline of "physical education and health" and sectional classes in sports;

– presence in the structure of higher educational institutions of the appropriate clinical and laboratory basis for primary prevention of morbidity, early diagnosis of donor and premorbid states of the body, conducting preventive medical examinations and determining the appropriate groups for classes (basic, preparatory, special medical);

– focus of practical classes on the formation of motivation for a healthy lifestyle, fashion to maintain a high level of health, improve the professional and applied physical preparedness, mental and physical performance of students.

Prospect for further research based on the need to create a comprehensive practical technology to optimize the physical condition of female students of medical university by means of fitness on the basis of the above concept.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 11.06.2017.
Published: 31.08.2017.

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UDK 796.034.2-057.875

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 88-91

Mass student sport in domestic and foreign practice

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Purpose: *carrying out of the comparative analysis of features of the organization of mass student's sports in domestic and foreign practice and their influence on the personality of students.*

Material & Methods: *analysis of the special literature in which features of the organization of domestic and foreign mass student's sports are revealed.*

Result: *currently in the development of student sports are two strategically different directions. One, based on the territory of the Soviet Union and which is being implemented in modern Ukraine, provides for students mandatory physical exercises in the educational discipline "Physical Education", as well as doing sports of their choice at leisure. The second direction, which is a consequence of the evolution of the Euro-American civilization, provides for the creation of conditions and opportunities for students to freely choose their types of motor activity, as a form of their leisure activities.*

Conclusion: *conducted analysis testifies that in Ukraine in the student's environment there are four possible directions of the influence of sports on the formation of the personality of students: a) sports lessons for physical education in the educational process; b) sports sections; c) low cost sports clubs; d) sports clubs operating on a commercial basis. In foreign practice, the influence of sports on the formation of the personality of students is realized through various forms of club work.*

Keywords: *physical education of students, physical health, motor activity, physical culture and sports activities, sectional occupations, needs.*

Introduction

Integration processes that unfold all over the world, including all aspects of human existence, concern the spheres of mass student sport, as well as systems for organizing and conducting sports events (competitions, entertainments, games, etc.) for mass types of motor activity [3]. These processes in the domestic practice are due to the fact that the vast majority of students (67,2%) are engaged in physical exercises (or were engaged) only in physical education classes and only about 9,7% of students who study in the 1–4 courses attend sports health-improving sections [4].

As the materials obtained using the Google Ngram search engine indicate, the term «student sports» has been consistently used in scientific and social practice since the middle of the nineteenth century. Student sport went through a complex path of historical evolution. It is actually the basis of modern sports, as evidenced by historical materials. A special role in this process was played by the Oxford and Cambridge universities, the last of which was founded in the 13th century. a group of students and professors who left Oxford University. So, in 1829 the first rowing competitions took place, which were held on the river Thames between the teams of these universities. The first unified rules for playing football were prescribed by representatives of the universities of Oxford and Cambridge. They were approved by most schools and clubs, and later they were adopted as the basis of the rules of the Football Association of England. In 1855, in England, for the first time, a circular system of competitions was used, in which students from 17 colleges took part. In 1880 an amateur track and field association was founded in England. In 1891, a teacher from one of the US colleges in Springfield, Massachusetts, James Naismith, invented a new game – basketball. These examples clearly demonstrate the important role of the student environment in the development of modern sport.

Purpose of the study: carrying out of the comparative analysis of features of the organization of mass student's sports in domestic and foreign practice and their influence on the personality of students.

Material and Methods of the research

Research methods are based on the analysis of special literature, which reveals the features of the organization of domestic and foreign mass student sport.

Results of the research and their discussion

Student sport in the domestic practice. Currently in the development of student sports two strategically different directions. One, based on the territory of the Soviet Union and which is being implemented in modern Ukraine, provides for students compulsory physical exercises within the framework of the educational discipline "Physical Education", as well as sports of their choice at leisure [1]. This direction, reflecting the state policy in the field of physical education of student youth, inherently assumes a relatively centralized management of the processes that unfold in this area. So, the practical organization of physical education and mass sports in higher educational institutions is regulated by the relevant Regulation [3]. In accordance with this provision, the educational process of physical education and mass sports in higher education is based on the following basic principles:

– priority of the educational orientation of the process of physical education and the functional factor in assessing the physical development of students;

– multistructurality, which provides for the creation in the higher educational institutions of conditions for a wide choice of physical education for students to study and participate in sports events that meet their needs, interests, health status, physical and technical preparedness, sports qualifications;

– individualization and differentiation of educational process on physical education;

– combination of public administration and student self-government.

This provision provides the universities with ample opportunities for organizing the physical education of student youth. In accordance with them, students for the organization of practical classes are divided into training groups – physical education, sports education and physical rehabilitation. However, practice shows that the most common is a sports-oriented form of organizing student's classes in physical education. This is the first and most massive level of attracting students to sports activities, and accordingly this is the first organizational form of the mass influence of sport on the personality of the student. Second level of attracting students to sports activities is associated with the functioning in universities of sports clubs and a section on sports. For example, at the Yaroslav Mudryi National Law University [7], in which sport is an integral part of the formation of the general and professional culture of the student's personality, six sports clubs (chess, volleyball, swimming-sports, sports wrestling, Olympic wrestling, boxing and kickboxing) and 18 sports sections (badminton, sports aerobics and cheerleading, basketball (women and men), bridge, athletics, athletic gymnastics and other). About 600 students train in sections. Practice of functioning of university sports clubs also testifies to the fact that a significant part of them go to the conditions of commercial activity (as, for example, various fitness clubs). This is how the private company "Sport and Technical Club of Kiev University T. G. Shevchenko" [8] or a private company" Sport-swimming club "Sokols" of the Carpathian University named after. V. Stefanika [9], whos provide services in the field of sports and recreation.

Student sport in foreign practice. Second direction in the historical development of student sport, which is a consequence of the evolution of the Euro-American civilization, provides for the creation of conditions and opportunities for students to freely choose their types of motor activity, as a form of their leisure activities (sports or exercise at leisure). Such an approach presupposes the formation of appropriate needs for students, is solved at the expense of two interrelated components: the formation of appropriate social thought, and through it the influence on the formation of the students' relevant needs, that is, a certain level of their personal physical culture (if we use the terminology adopted in the domestic scientific environment), and the creation of conditions for the practical implementation of such needs. For example, in the United States, the formation of a corresponding social environment began in the sixties of the last century when, under President D. Eisenhower, the Council for Sports and Physical Fitness was set up, which coordinated activities at the state level in this field. As a result, by 1977 in the US, about 87,5 million people participated in various sporting events. At that time, the most noticeable sign of the fitness boom was that about eight million people were engaged in recreational running [10]. Currently, about 7–8% of the adult population in the United States is doing physical exercises three or more times a week. In the United States, there are 36,3 million people attending gyms, fitness centers or are members of various health clubs [10]. Noted tendencies also appeared in the system of higher education. The need to attract students to exercise was recognized in the university environment, because their academic prestige was already not enough to attract the best students and athletes to training. To do this, universities began to create special sports and recreational centers. The analysis of the information posted in the message about the top 25 such centers shows that, for example, the University of Texas has seven basketball and handball courts, a full-size Olympic pool, archery areas, dance classes and much more, and the University of Cincinnati has three swimming pools, several gyms, a climbing wall, a football and basketball stadiums. Obviously, the development of university sports and recreational centers was possible only if there was adequate funding. Some ideas about this process give such data. For example, at the University of South Florida in 2014-2015 school years, 48373 students were studying. The university has an annual budget of $ 1.5 billion, and the annual economic effect is more than $3,7 billion, although in the rating compiled by the National Science Foundation, this university occupies only 43 places. University Sports and Recreation Center (fitness center) has two basketball courts, a number of specialized sports halls, six fitness halls, an indoor track and field athletics arena, badminton courts, and an indoor pool [11]. Significant revenues to the university budget come from paying students for tuition. So, for example, at the University of New England in Maine (USA), the cost of training for students is more than 20,000 dollars, and for graduate students from 12,500 to 15,000 dollars [12]. Despite the fact that in universities, tuition fees are paid to support talented student athletes, as well as to attract them to scientific activities, special scholarships. For example, at the University of New England (Australia), about 18,000 students study. Every year the University allocates more than 2,5 million dollars in scholarships, various awards, as well as more than 18 dollars million for the staff and students who are involved in scientific research. Various benefits are used to attract students and teachers to sports and sports activities in US higher education institutions. For example, the Institute of Mining and Technology, which is located in New Mexico and is a public institution, has about 2,000 students. Employees and students engaged (for a fee) in the sports center of the institute have the right to engage their husbands or wives, as well as dependent children (aged 11 to 21 years) [13]. Analysis of 25 best sports and recreational centers at universities in America showed that in all universities there are special sports and fitness centers in which students and teachers are engaged. Despite the seemingly effective functioning in foreign universities of the system of attracting students to exercise, as well as the availability of an appropriate sports and recreational base for the realization of their needs for motor activity, however, according to the results of special studies, about 50% of modern young Americans still do not receive the necessary volume of motor activity. Le Sorre [14] noted that, despite the flourishing health and fitness industry, life expectancy in the US has declined for the first time since 1993, and the health of modern people, including student youth, is declining. A number of foreign specialists state that one of the most common obstacles

Forms of influence of student sports on the personality of students

No. i/o	Forms of influence of student sports on the personality of students, which are realized: in domestic practice	in foreign practice
1.	Sports classes in physical (sports) education in the educational process	Absent
2.	Sport sections	Absent
3.	Budget sports clubs	Absent
4.	Sports clubs operating on a commercial basis	Common form
5.	Practically absent (Principles of work are different)	Club, as a special form of self-organization of students' activities in the implementation of common interests in the field of sports
	Sports competitions in which students take part	
6.	Participation during the academic year in university, interuniversity and international student championships	Participation during the academic year in university, interuniversity and international student championships

for physically active rest of students is their lack of free time. In their opinion, the system of education in higher educational institutions should be changed in order to create conditions conducive to a rational and healthy way of life for students in their free time [5; 6].

As analysis of information posted on the Internet shows, sports activities in foreign universities are organized in the form of club work. It should be noted that the concept of "club" is used to characterize the activities of people aimed at meeting the general (group) needs. He (the club) is a special form of self-organization of people's activities to implement common interests, in this case – in the field of student sports. For example, at Cambridge University there are more than fifty sports clubs in which badminton, football, gymnastics, basketball, volleyball, triathlon, golf, etc. are cultivated (Data for 2016). At the University of Birmingham, for example, there are 53 sports clubs (from American football in windsurfing) that create opportunities for sports both for beginners and qualified athletes, and in the sports center of the University of Athens students can choose any of the following sports: tennis, basketball, volleyball, football, traditional dances, classical sports, table tennis, gymnastics, physical training, aerobics, chess and others. Self-organization in the activities of such clubs is manifested in the fact that students can form teams that represent their departments or university and participate during the academic year in university, inter-university and international student championships. In this university, to raise the prestige of club sports activities at the end of the academic year, winners at a special ceremony are awarded with valuable prizes from the Senate.

Summarized results of the above analysis are shown in Table. They testify to the essential differences in the process of the influence of sport on the individual, which unfolds in domestic and foreign sports practice. In domestic practice such influence is realized mainly through sports training in the educational process and, to a lesser extent, in sports sections. In foreign practice, it is realized through clubs that represent a special form of self-organization of students' activities for the realization of common interests in the sphere of sports. In this approach, the activity approach is practically implemented, which is the basis of the impact on the individual [2].

Conclusions

1. Analysis shows that in Ukraine in the student environment there are four possible areas of influence of sports on the formation of the personality of students: a) sports lessons on physical education in the educational process; b) sports sections; c) budgetary sports clubs; d) sports clubs operating on a commercial basis.

2. In foreign practice, the influence of sports on the formation of the personality of students is realized through various forms of club work.

Prospects for further research. In the future, it is planned to investigate the impact of the activities of domestic sports clubs on the personality of student-athletes.

Conflict of interests. The author declares that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 19.06.2017.
Published: 31.08.2017.

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UDK 793.3+796.012.1

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 92-95

An effectiveness analysis of a developed differentiated program for dancer's motor quality development at the stage of specialized basic training

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Purpose: *practical substantiation of the effectiveness of using the developed differentiated program for the development of motor qualities of skilled dancers in sports dances at the stage of specialized basic training.*

Material & Methods: *in the study involved 30 athletes, dancers aged 14–18 years who were engaged in a differentiated program for the development of motor qualities (experimental group) and the generally accepted program of a sports and dance club (control group). Methods: analysis and generalization of information of special literature, method of pedagogical observation, method of pedagogical experiment, method of pedagogical testing, method of mathematical statistics.*

Result: *analysis of the state of special physical preparation of dancers before and after using the developed differentiated program for the development of motor qualities is presented and obtained results of the values of the indices of their leading motor qualities.*

Conclusion: *the efficiency of application of the developed differentiated program for the development of motor qualities of qualified dancers has been proved at the stage of specialized basic training.*

Keywords: *special physical preparation, physical readiness, motor qualities, dancers.*

Introduction

Analysis of scientific and methodological literature indicates that a sport dancing has become a sport that urgently needs the development of scientific foundations for organizing the training process, a critical rethinking of the means currently used, the forms and methods of physical training [2; 3; 4; 5–7].

Studies of past years found that the achievement of mastery in sports associated with the art of movement requires the athlete special physical preparedness, including the use of such exercises, which in their structure are similar to sports movements (G. A. Chikalova, M. A. Terekhova, 2001).

Rational organization of the training process aimed at fostering the physical qualities and abilities of dancers is designed to provide the necessary conditions for the creation of an appropriate technical base of motor activity during the execution of competitive variations in all types of competitive sports dancing program.

Physical training in sports dances is needed not only as a basic component of successful technical training, but also must be built taking into account the specific requirements of competitive activity. Each of the structural components is provided by the level of development of such integral qualities as speed, strength, coordination abilities, endurance and flexibility.

In the practice of sports dances, education and training are most often conducted by the method of repeated repetition of specific compositions, i.e., in practice of competitive exercises, which reduces the quality of their development. At the same time, sports training does not provide for a purposeful basic improvement of the physical and functional capabilities of the athlete.

Therefore, one of the topical problems of sports dances is the development of simple and affordable complexes or blocks of exercises that allow the competent training of qualified dancers in sports dances on a scientific basis.

Purpose of the study: practical substantiation of the effectiveness of using the developed differentiated program for the development of motor qualities of skilled dancers in sports dances at the stage of specialized basic training.

Material and Methods of the research

In the study, 30 dancers from 14-18 years old took part in the «Aurora» CSD (Kyiv). Athletes were divided into control (n=15) and experimental (n=15) groups, which are identical in age and physical development. Athletes of the control group (CG) were engaged in the generally accepted program of the club. Athletes of the experimental group (EG) were engaged in the developed differentiated program for the development of motor qualities of qualified dancer's.

In the work such methods were used: analysis and generalization of the information of special literature, method of pedagogical observation, method of pedagogical experiment, method of pedagogical testing, and method of mathematical statistics.

Pedagogical testing used in the process of pedagogical research allowed the use of quantitative methods for assessing physical preparedness, as well as assessing the driving qualities of dancer's [4]. In our study with the help of tests such as "standing long jump" and "running at 30 m", we evaluated the speed-strength abilities of dancer's. Strength, strength and special endurance assessed with the help of such tests: "lifting the trunk from the prone position with bent knees", "lifting and lowering the straight legs for 1 min", "push-ups," "jumps with a rope for 1 min".

Coordination, ability to maintain static and dynamic balance, we evaluated with the help of tests: “shuttle run 3x10 m”, “M. E. Romberg’s test”, “walking on the gutter gymnastic bench”. Summarizing the practical experience of foreign professional sports dance trainers (Roberto Villa (Italy), Roberto Giuliato (Italy), Vaidotas Lacitys (Lithuania), Marak Kosatu (Poland), etc.), we evaluated the ability to maintain a static balance using tests that are more specifically suitable for dancer’s: “holding the standard European position in the lines of the body, standing on the heel, opening your eyes,” “holding the standard European position in the lines of the body, standing on the toe, opening your eyes,” “holding the standard European position in the lines of the body, standing on the heel, closing your eyes”, “Keeping the standard European position in the lines of the hull, standing on the toe, closing your eyes”.

Flexibility of the spinal column, shoulder girdle, hip joints, ankle joints is estimated using such tests: “tilt forward from the starting position, standing on the bench”, “connect hands behind the back”, “legs apart” (right and left forward split, middle split)”,”maximum taking a foot on yourself, leaning it against an even wall”,” maximum tension of the foot, sitting on the floor”.

To obtain indicators of the level of physical preparedness of dancers in the established groups and their homogeneity, we used the generally accepted statistical indicators: arithmetic mean ($\bar{X}$), standard deviation (S), level of statistical significance (p) [1].

Processing of the above indicators was carried out in accordance with the recommendations of specialists and with the use of a package for the processing of statistical data “Statistica 10”.

Results of the research and their discussion

Analyzing the initial values of all the indices of the dancers of the CG and EG dancers to the passing of the experiment, we can conclude that they are characterized by homogeneity and do not have statistically probable differences.

In EG, the values of the speed-strength training indicators after the passing of the experiment improved. Therefore, we can speak about the effectiveness of the proposed differentiated program for the development of motor qualities, Comparing the values of the indicator of speed training “running at 30 m” before and after the experiment, which was statistically proved ($p \leq 0,05$). By this indicator, the value improved by 33,3%. Value of the “standing long jump” indicators increased by 4,9%, but this value was statistically unreliable ($p \geq 0,05$).

Values of speed strength after preparing CG passing experiment remained at the same level, comparing to their initial values, and the differences between the indices before and after the experiment was not statistically proven – $p \geq 0,05$ (Figure 1).

Comparing the parameters of CG and EG with each other after passing the experiment, according to the values of the speed training indicator “running at 30 m”, there are obvious differences between their values, which is statistically proved ($p \leq 0,01$).

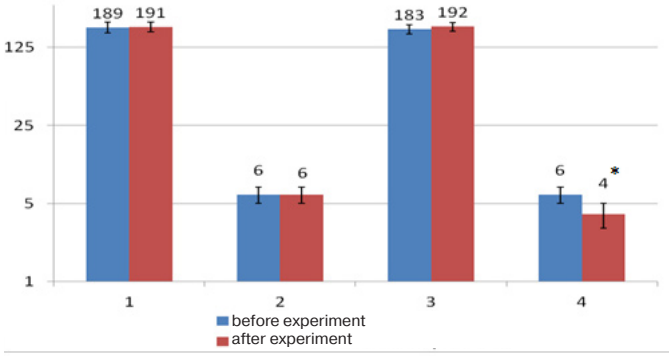

Fig. 1. Values of the rates of speed-strength preparation of EG and CG before and after the experiment: *1 – standing long jump CG (cm); 2 – running at 30 m CG (s); 3 standing long jump EG (cm); 4 running at 30 m EG (s); * – values before and after the experiment are significantly different when $p \leq 0,05–0,01$.*

Analyzing the values of strength, strength and special endurance of the EG of dancers after the experiment, we can conclude that the values for all four indicators, comparing with the initial ones, improved and were statistically proved (Figure 2). Namely, the value of the indicator “lifting the trunk from the prone position with bent knees” improved by 13.7% and was statistically proven ($p \leq 0,05$). Value of the “raising and lowering of straight legs for 1 min” improved by 30.8% and was statistically proved when $p \leq 0,01$. Value of the indicators “push-ups” improved by 60% and was statistically significant when $p \leq 0,01$. Indicators of special endurance (“jumping with a rope for 1 min”) showed an improvement of 16.7% and was statistically proved ($p \leq 0,05$).

Values of strength, strength and special endurance CG after the passing of the experiment showed statistically unreliable differences in comparison with the initial values prior to the beginning of the experiment, since $p \geq 0,05$. Values of the strength and strength endurance indicators of the CG (“lifting the trunk from the prone position with bent knees”, “raising and lowering the straight legs for 1 min”, “push-ups”) improved slightly by 2%, 3,8%, 11,5% respectively. Indicators of special endurance (“jumping with a rope for 1 min”) increased its value by 2,4%.

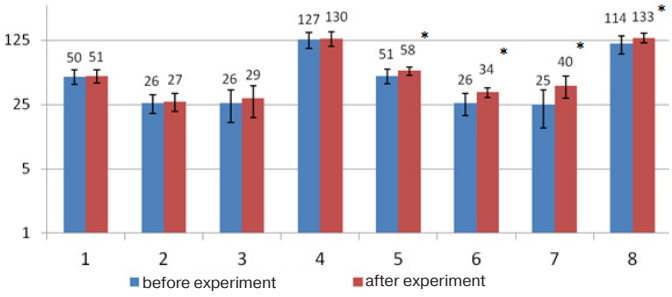

Fig. 2. Values of strength, strength and special endurance of EG and CG before and after the experiment: *1 – lifting the trunk from the prone position with bent knees CG (times); 2 – raising and lowering the straight legs for 1 min CG (times); 3 – push-ups CG (times); 4 jumping with a rope for 1 min CG (times); 5 – lifting the trunk from the prone position with bent knees EG (times); 6 – raising and lowering the straight legs for 1 min EG (times); 7 – push-ups EG (times); 8 – jumping with a rope for 1 min EG (times).*

Comparing the values of the EG and CG values with each other after the experiment, significant differences ($p \leq 0,01$) were obtained in comparison with the initial values before the start of the experiment in terms of indicators: "raising and lowering the straight legs in 1 min", "push-ups". By the value of the indicator "lifting the trunk from the prone position with bent knees ", statistically significant differences between the values ($p \leq 0,05$).

Values of the coordination indicators, the ability to maintain the static and dynamic equilibrium of the EG after the experiment, showed statistically significant differences in comparison with the values before the experiment in five of the seven indicators. On two indicators, the values were not statistically reliable ($p \geq 0,05$). Significance coordinate "shuttle run 3x10 m" improved by 25% and was statistically reliable ($p \leq 0,01$). Values of the indicators of the ability to maintain a static equilibrium have an improvement in three of the five indicators. Namely, the index "holding the standard of the European position in the hull lines, standing on the toe, opening the eyes" has improved its value by 42,5% and statistically proven at $p \leq 0,05$. Indicator "holding of the standard European position in the lines of the hull, standing on the heel, closing the eyes" improved its value by 51,6% and was proved statistically for $p \leq 0,01$. Indicator "holding of the standard European position in the lines of the body, standing on the toe, closing the eyes" improved by 100% with $p \leq 0,01$. Indicator of the ability to maintain a dynamic balance ("walking along the gutter of a gym bench") improved by 33,3% and is statistically significant when $p \leq 0,01$ (Figure 3).

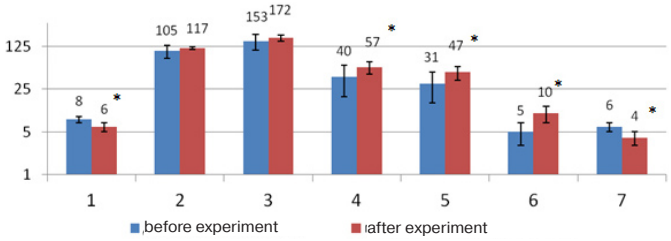

Fig. 3. Values of the coordination indicators, the ability to maintain the static and dynamic equilibrium of the EG before and after the experiment: *1 – shuttle run 3x10 m (s); 2 – M. E. Romberg test (s); 3 – holding the standard of the European position in the hull lines, standing on the toe, opening the eyes (s); 4 – holding the standard European position in the lines of the body, standing on the toe, opening the eyes (s); 5 – holding of the standard European position in the lines of the hull, standing on the heel, closing the eyes (s); 6 – holding of the standard European position in the lines of the body, standing on the toe, closing the eyes (s); 7 – walking along the gutter of a gym bench (s).*

For indicators CG after the passing of the experiment it was observed improvement in values, but the change is not statistically proven at $p \geq 0,05$. Value of the coordination indicator "shuttle run 3x10 m" remained at the same level (Figure 4).

Comparing the parameters of CG and EG with each other after the experiment, statistically significant differences between the values of the groups for such indicators: "holding of the standard European position in the lines of the hull", "standing on the toe, opening the eyes" ($p \leq 0,05$), "holding the standard European position in the lines of the body, standing on the heel, closing the eyes" ($p \leq 0,05$), "holding the standard

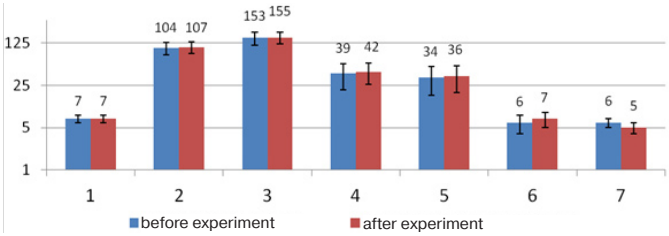

Fig. 4. Values of the coordination indicators, the ability to maintain the static and dynamic equilibrium of the CG before and after the experiment: *1 – shuttle run 3x10 m (s); 2 – M. E. Romberg test (s); 3 – holding the standard of the European position in the hull lines, standing on the toe, opening the eyes (s); 4 – holding the standard European position in the lines of the body, standing on the toe, opening the eyes (s); 5 holding of the standard European position in the lines of the hull, standing on the heel, closing the eyes (s); 6 – holding of the standard European position in the lines of the body, standing on the toe, closing the eyes (s); 7 – walking along the gutter of a gym bench (s).*

European position in the lines of the body, standing on the toe, closing the eyes" ($p \leq 0,01$), "walking along the gutter of a gym bench" ($p \leq 0,01$). This shows the expediency of using the developed differentiated program for the development of the motor qualities of dancers to improve the coordination indicators, the ability to maintain static and dynamic balance.

Analyzing the indices of flexibility of the spinal column, shoulder girdle, hip joints, ankle joints of the EG after the experiment, statistically significant values for six indicators out of seven were revealed (Figure 5). Indicator of flexibility of the spinal column ("forward bend from the starting position, standing on the bench") increased by 40%, with a reliable value $p \leq 0,01$. Flexibility index of hip joints: "right forward split" improved on 50% ($p \leq 0,01$), "left forward split" – on 46,2% ($p \leq 0,05$), "middle split" – on 50% ($p \leq 0,01$). An improvement in the flexibility of ankle joints was also noted. In terms of "maximum take a foot on yourself, leaning it against an even wall," you can see an improvement of 20% $p \leq 0,01$. According to the indicator "maximum tension of the foot, sitting on the floor" – on 50% ($p \leq 0,05$). Value of the flexibility indicators of the shoulder joints ("connect hands behind the back") improved by 21,4%, but was not statistically proven ($p \geq 0,05$).

Values of CG have a slight increase in improvement after the passing of the experiment, but none of the flexibility indica-

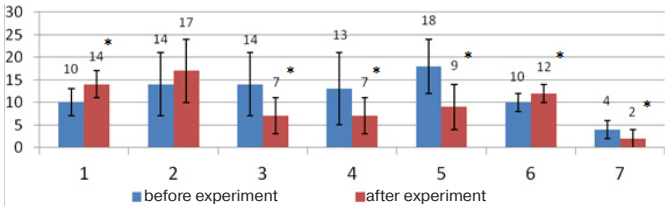

Fig. 5. Values of flexibility indices of the spinal column, shoulder girdle, hip joints, ankle joints of the EG before and after the experiment: *1 – forward bend from the starting position, standing on the bench (cm); 2 – connect hands behind the back (cm); 3 – right forward split (cm); 4 – left forward split (cm); 5 – middle split (cm); 6 – maximum take a foot on yourself, leaning it against an even wall (cm); 7 – maximum tension of the foot, sitting on the floor (cm).*

tors of the control group has been statistically proved, since p≥0,05 (Figure 6).

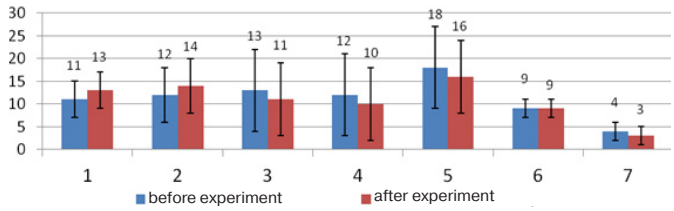

Fig. 6. Values of flexibility indices of the spinal column, shoulder girdle, hip joints, ankle joints of the CG before and after the experiment: *1 – forward bend from the starting position, standing on the bench (cm); 2 – connect hands behind the back (cm); 3 – right forward split (cm); 4 – left forward split (cm); 5 – middle split (cm); 6 – maximum take a foot on yourself, leaning it against an even wall (cm); 7 – maximum tension of the foot, sitting on the floor (cm).*

Comparing the values of the indicators of CG and EG between themselves after the experiment, it can be concluded that there are statistically significant differences in comparison with their baseline values for the flexibility of the hip and ankle joints: "middle split" (p≤0,05) and "maximum take a foot on yourself, leaning it against an even wall" (p≤0,01).

Conclusions

1. Analyzing the indicators of speed-strength training, strength and special endurance, coordination, ability to maintain static and dynamic balance, indicators of flexibility of the spinal column, shoulder girdle, hip joints, ankle joints, we can conclude that in most cases, the experimental group that worked on a differentiated program for the development of motor qualities had statistically significant values (p≤0,05–0,01). Compared with this, the control group had a positive tendency to increase the values of the indicators, but they were not statistically proven (p≥0,05).

2. Before the experiment, the parameters of the experimental group of athletes were almost identical with those of the physical training of the control group of dancers. But after passing the experiment, statistically significant differences between the control and experimental groups were obtained in comparison with their initial values prior to the start of the experiment (p≤0,05–0,01).

3. Highest average percentage of statistically significant improvement in the values of the experimental group after passing the experiment was noted for coordination, the ability to maintain static and dynamic equilibrium – 50,5%. Indicators of flexibility of the spinal column, hip and ankle joints showed an improvement of 42.7%, strength and strength endurance – on 34,8%, the rate of speed abilities – on 33,3%.

4. Comparison and analysis of physical readiness indicators of the control and experimental groups of dancers during the research showed the effectiveness of the application of the developed differentiated program for the development of the motor qualities of dancers in sports dances at the stage of specialized basic training.

Conflict of interests. The author declares that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 12.07.2017.
Published: 31.08.2017.

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ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 96-99

Organizing and running winter triathlon competitions in Ukraine

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Purpose: *to analyze the system of organizing and running competitions according to the type of the triathlon-winter program in Ukraine for compliance with the rules of the International Triathlon Federation.*

Material & Methods: *on the basis of the study of the specialized literature and the regulatory framework of a number of triathlon federations, a comparative analysis of the winter triathlon emulation at competition distances abroad and in Ukraine.* ***Result:*** *correspondence of two winters combined distances in Ukraine to the official formats of the international winter triathlon competitions in Europe and the world are found out.*

Conclusion: *in basis for organizing and conducting competitions for a new variety of continuous triathlon in our country are the rules of the International Triathlon Federation, and the competitive distances in the form of the triathlon-winter program in Ukraine correspond to international standards.*

Keywords: *type of program triathlon-winter, mountain bike, ski segment, continuous triathlon, transit zone, triathlete.*

Introduction

Published in the American magazine "Sport Illustrated" article of journalist Barry McDermott about the 1979 "Iron Man" competitions in Hawaii (3,862 km swimming + 180,2 km bicycle + 42,195 km running) caused the sports community increased interest in the unusual start and served as an impetus for the popularization of a new direction in sports - the athletes overcome the combined distance in a continuous sequence [2; 3].

Due to the spectacularity and attractiveness in the eighties of the last century, rapid development of triathlon began all over the world. In different countries there are a group of enthusiasts who organize and running continuous triathlon competitions at various distances along the length and different combinations of types of physical activity. Their spontaneous activity is gradually self-organizing, the distances and the sequence of stages are standardized when the triathlete passes the combined distance [2; 3].

The most common types of continuous triathlon were: triathlon proper (swimming + bicycle + running), aquatlon (running + swimming + running), duathlon (running + bicycle + running), cross-country triathlon (swimming + bicycle in rough terrain + cross-country running) [4].

In 1989, the International Triathlon Federation (ITU) was established in Avignon (France), which spearheaded all the work on holding annual sports events in the new sport.

In 2000, at the Olympic Games in Sydney, the triathlon made its debut and was represented by the same type of program at one combined distance of 51,5 km (1,5 km swimming + 40,0 km bike + 10,0 km running) [3; 4].

In addition to the types of the program, triathlon, aquatlon, duathlon, cross-country triathlon, consisting of combinations of physical activities of predominantly summer sports, the sport boom that was going on in the West in the 80 s of the last century around continuous triathlon caused the appearance of a winter version of the triathlon [3].

Considering that the preparation and participation in the competitions in innovative triathlon is one of the most promising areas for the development of winter sports in the world, the Federation of the Triathlon of Ukraine (FTU) has started to promote a relatively new direction in sports in our country [11; 12].

However, issues relating to becoming a kind of program of continuous triathlon, winter triathlon, the organization and conditions of the competition, and the degree of compliance with the basic requirement of triathlon – continuous and successive overcoming of the combined distance through running, bicycling and skiing is far from fully understood.

Purpose of the study: to analyze the system of organizing and running competitions according to the type of the triathlon-winter program in Ukraine for compliance with the rules of the ITU.

Objectives of the study:

1. Consider the process of becoming a kind of program of continuous triathlon winter triathlon.

2. Disclose the conditions for organizing and conducting competitions according to the type of the winter triathlon program on the basis of international rules.

3. Determine the correspondence of competitive distances according to the type of winter triathlon program in Ukraine to international standards in this sport.

Material and Methods of the research

1) studying and summarizing the literature and Internet sources, the ITU, FTU and other international federations regulations for assessing the degree of research of the problem and determining compliance with the basic requirement of continuous triathlon, which is the basis of the competitive process

in the winter triathlon;

2) comparative analysis of the competitions conduct at officially recognized international formats of distances abroad and at competitive distances in Ukraine by the type of winter triathlon program.

Results of the research and their discussion

Sports lovers have not yet had time to properly understand all the intricacies of the new continuous triathlon and understand what different types of programs differ from each other, as in Europe there was a winter version of the triathlon that combined running, bicycle and skiing (the first two stages are also held on the snow) [2; 3].

There are other varieties of it. In 1989 in the German city of Inzel, competitions were held to overcome the winter combined distance by running, running on skis and running on skates (20,0 km + 30,0 km + 40,0 km respectively) [14].

In the Scandinavian countries, triathletes instead of bicycling are skating (running + skating + skiing), and in Russia (St. Petersburg), these competitions are held in 1997 according to the formula: skating 8.0 km + 16,0 km ski race + running on snow cover 8,0 km [3; 14].

Remark. *Further integration of physical activities with cycling and swimming (skating 8,0 km + cross-country skiing 16,0 km + running 8,0 km + bike 9 km 445 m / sailing 750 m) when overcoming a combined distance of 42 km 195 m marked the beginning of a promising marathon – quintatlon. The first four segments of the track athletes pass in a continuous sequence, and the swimming time in the pool is summed with the overall result (In accordance with the schedule of the Gorsport Committee, these competitions have been held annually in St. Petersburg since 2005, for the first time organized and conducted a combined marathon in 1995, Ph.D. Stazhkov, M. A., he is also the chairman of the organizing committee) [14].*

International Triathlon Federation (ITU) from the whole tested "diversity of species" and distances was used as a basis in the winter triathlon by the formula of running + bicycle + running on skis, and the standard distance is 7–9 km + 12–14 km + 10–12 km respectively. According to the current international rules, the variation in the length of the stages in insignificant limits is allowed in competitions of all ranks and depends on the characteristics of the terrain where they pass [4; 13].

First competitions in ITU-approved combinations and distances (8,5 km running + 12,5 km bike + 10,0 km cross-country skiing) were held in 1995 in Italy (Mals) under the name "Winter Triathlon of South Tyrol". In 1997, in the same place and on the same distance of ITU, the first World Triathlon Winter Championships was held. First champions were: men – italian Paolo Riva (ski specialization), women – his compatriot, professional racer Maria Canins-Bonaldi [1].

In 2001, the first US winter triathlon championship was held, where the winners were the American cyclist Gretchen Reeves and the legendary sportsman – six-time United States cross country cycling champion, two-time champion of the "Xterra series" (1998, 1999) for cross-country triathlon (Ibiza, Spain) 46-year-old mountain bike veteran Ned Overland [14].
In the post-Soviet space, the first All-Russian competitions for winter continuous triathlon took place in Moscow on March 19, 2005 in the territory of Izmailovsky Park. In 2006 the first Russian Winter Triathlon Championship was held in Yaroslavl. The winners were Ksenia Chernykh (previously engaged in bicycle orientation) and former skier Andrei Mishanin [9; 14].

In Europe, interest in winter continuous triathlon is very high and it is popular in countries such as Italy, Spain, Austria, Germany, France, Switzerland, Sweden, Finland, Norway, Czech Republic, Slovakia, Estonia, Latvia and a number of other [14].

In 2006, the X World Championships in Winter Triathlon are attended by athletes from 37 countries from 5 continents.

ITU made a lot of efforts to include the International Olympic Committee (IOC) and the winter version of the triathlon in the program of the Winter Olympic Games in Vancouver (2010), but was refused (hopefully a temporary one) [1; 2; 3].

Official distances in the form of a winter triathlon program (running, bicycling, skiing), which currently host international competitions in Europe and the world under the auspices of the European Triathlon Federation (ETU) and ITU are: junior (2,0 + 4,0 + 3,0 km), short (3,0 + 5,0 + 5,0 km, standard (7,0 + 12,0 + 10,0 km) and long (9,0 + 14,0 + 12,0 км) [4].

Remark. *In 2014, in the Norwegian ski resort Skeikempen, for the first time in the world championships, the "Royal Winter Triathlon" competitions for the winter triathlon at a long distance were held 21,0 km run + 30,0 km bicycle + 30,0 km ski race (echoes of the German Inzelew 1989 start) [6].*

The conditions of the winter triathlon competition are the same for both men and women and represent overcoming the selected winter combined distance by cross-country run + cross-country cycling race + cross-country race. Rules for the behavior of athletes on the race segments are the same as in the constituent sports. A certain specificity is observed when athletes pass the transit zone, where a change in the types of physical activity. Triathlet must know and observe the rules of the competition during their conduct [7; 8].

Requirements for sports outfit and equipment.

On a bicycle stage, mountain bikes are usually used, which cyclists use in cross-country competitions (cross-country race).

Remark. *Necessarily having two brakes.*

Cross-country skis and sticks select the triathletes themselves, depending on their preference (there are no strict requirements) and anthropometric features.

Basic equipment consists of a jumpsuit, a sports cap, gloves, a bicycle helmet (for safety according to the international standard), cross-country running shoes and ski boots.

In the form of **additional** equipment use glasses, ski balaclava, thermo-flaming, bike shoes with contact pedals (in contrast to the bicycle in them you can not only ride a bicycle, but also run, since the fixation mechanism with the pedal is placed not on the outside, but in the sole, and the base shoes are not rigid, but flexible).

Remark. *It is also necessary to have several lubricants in order to achieve the best ski slip, depending on the temperature and*

snow structure at the site of the competition.

Before start. In advance of the start, the snow cover is rolled by snowmobiles along the entire length of the race distance. In parallel to the track at the start-finish site, the organizers arrange a transit zone, where each athlete is assigned an individual place for storing sporting equipment and equipment according to his starting number. Structurally, it is arranged in such a way that when it passes (during the change of stages), each triathlet overcomes the same distance.

Prior to the start of the competition, the athlete must pass the triathlon routine of the pre-start registration procedure, and also provide the judges with a technical inspection with their bike and bicycle helmet. After registration and receiving the start package, the participant can enter the transit and place his sports outfit and equipment in the place corresponding to his starting number [2].

Remark. *For the installation of bicycles a special ramp is provided, which the organizers of the competition establish in the transit zone.*

In the startup package is located:

– number on the bike (fastened in front in the area of the rudder and base of the bicycle fork);

– three self-adhesive sticker numbers for a bicycle helmet (glued in front and on each side);

– two basic numbers in the form of a jersey (it is put on top on a overalls, therefore on an athlete's body one number is constantly in front, and another – behind at all stages of continuous triathlon);

– one special indicator chip informing the computer of the distance of the triathlete (is attached to the ankle area of the participant's leg and is given if the course is equipped with appropriate equipment).

Before the start access to the transit zone is terminated.

Remark. *In very cold weather, competitions can be postponed to the daytime or canceled if the air temperature is 18 degrees below zero (athletes' health is above all) [1].*

Running segment. Competition in the form of the winter triathlon program begins with a cross run. Participants, wearing an indicator chip, a shirt with a personal number, line up (or several lines, depending on the number of athletes) on the border of the transit zone. After the shot of the starting pistol, everyone rushes to the road. The track of the running stage runs along the rolled snow cover, is designated by pointers and has a closed form.

First transit. Observance of the change in the types of physical activity in overcoming the winter combined distance is strictly regulated. Therefore, upon completion of the running stage, the triathletes are sent to their place in the transit zone. After taking off running shoes and getting into bike shoes, putting on his head and fastening (without removing the sports cap) bicycle helmet, participants take their bicycles and run with them (movement on a bicycle inside the transit is prohibited) are sent to the exit from the transit zone.

Bicycle segment. At the border of the transit zone, athletes board mountain bikes (the width of the tires is preferably not already 40 mm) and go to the second stage of the winter triathlon. Cycle of the bicycle stage is also laid along the snow cover and is complicated by the ascent and descent (for more complete disclosure of the possibilities of the race participants), has a closed form and is indicated by pointers.

Remark. *All the bike malfunctions that have arisen during the race are eliminated by the athletes themselves, and on the steep climbs cycling can be replaced by running, while holding the bicycle by hand (a fairly frequent sight with an incorrectly selected gear ratio of the leading and driven sprockets that do not correspond to the topography of the area).*

Second transit. Completing the race in the snow, the triathletes dismount before the border of the transit zone (driving inside is unacceptable) and running, holding the bicycle by hand, go to their place in transit. Having installed the bicycle on the ramp, taking off the bicycle helmet and changing into ski boots, picking up skis and ski poles, run to the border of the transit zone, where, having fastened skis to the toes of shoes, go to a ski race.

Ski segment. At the third stage of passing the winter combined distance, athletes are allowed to use any style of running (skating or classic). Also, if there are snow glades on the track, it is allowed to ski along the ground, or with ski equipment in hands.

Remark. *Existing rules the triathlete is not forbidden to get rid of two ski poles and one ski and finish the ski run by running, carrying one ski in hands.*

Completion of the run on skis and the competitions themselves in the form of the winter triathlon program takes place in the "finishing gates".

In addition to individual competitions of athletes in the winter triathlon, there is also a relay race where teams of 3 people take part, each of which successively overcomes a short distance (3,0 + 5,0 + 5,0 km). Championships of Europe and the world held since 1997 [2; 4].

Remark. *At competitions of the highest level, before the start of the competition, the participants, coaches and team representatives are informed of the selection system of athletes subject to anti-doping control (usually winners, prize-winners and triathletes, determined by lot). At the end of the distance passage, the indicated persons in the medical commission's premises shall pass tests for the presence in their bodies of prohibited pharmacological substances [2].*

In Ukraine, the winter direction in continuous triathlon under the leadership of the Federation of Triathlon of Ukraine is only developing. The purpose of organizing the All-Ukrainian competitions in the form of the winter triathlon program is the further popularization of the innovative direction in the domestic sport [10; 11; 12].

The first winter triathlon championship in our country with the support of the Ministry of Education and Science, Youth and Sports of Ukraine under the auspices of the FTU was held in 2007 in Kiev on the plateau of Holosiivsky Forest (standard distance) [5].

The rank of sporting events for the winter triathlon, distances,

age groups, dates and place of the starting are annually indicated in item II "Regulations on All-Ukrainian Triathlon Competitions", published on the site of the FTU: http://triathlon.org.ua/federation [11; 12].

So, according to the calendar of All-Ukrainian triathlon competitions for 2009, on January 18, Kiev hosted the next Ukrainian winter triathlon championship in accordance with the requirements and the current rules of ITU: For men at a standard distance of 7 km running + 12 km bicycle + 10 km ski race, and for women, juniors and veterans – for a short 3 km + 6 km + 6 km respectively. Winners were: men – V. Mukhidinov (Mukachevo), women – Y. Began (Lviv), juniors – V. Vovkodav (Kiev), veterans – V. Petrovich (Kiev) [5; 10].

Remark. *In the triathlon, the veteran movement is widespread and often amateurs show high sports results. So, in 2006, the current champion of Russia in the category "elite" took part among amateurs (age groups 18–19, 20–24, 25–29, etc., with an interval of five years) in the popular "Berezhkov triathlon" and suffered a complete fiasco by coming to the finish line only 21th in the overall classification [14].*

According to the calendars of the FTU in Kiev, since 2007, competitions for winter continuous triathlon are held. Thus, in recent years the Federation has conducted 02–03.03.2014, 07–08.03.2015, 13–14.02.2016, 24–26.02.2017 open championships of Ukraine among juniors and adults at distances 8,0 + 12,0 + 10,0 km and 4,0 + 6,0 + 5,0 km [11; 12].

Analysis of compliance with the rules of the ITU held by the FTU competitions in the form of the winter triathlon program in the framework of the unified calendar plan for the sporting and sporting events of Ukraine testified that in the All-Ukrainian starts, the specificity of continuous triathlon is fully observed: the triathlete's successive overcoming of the combined distance through various types of physical activity (running, bicycling and running on skis) against the background of spent neuromuscular energy.

In Ukraine, individual competitions for the winter triathlon are held only at two of the four officially recognized international distances, and team competitions – relay race (3 people, distance 3,0 + 5,0 + 5,0 km for each participant) have never been held at all [11; 12; 13].

Conclusions

Based on this study, the following conclusions can be drawn:

1. Increased popularity of the new sport triathlon served as the basis for the appearance and winter variety of continuous triathlon.

2. At the heart of the organization and conduct of the FTU competitions in the form of the winter triathlon program in Ukraine are the rules of the International Triathlon Federation.

3. Two distances (short and standard), at which the FTU holds competitions in Ukraine in the form of a triathlon-winter program, are slightly different in length from those in the world, however, due to the fact that the ITU rules allow the variation of the length of the stages, they generally correspond to international competitive distances.

Prospects for further research. Subsequent studies will be aimed at determining the compliance of discharge standards by the type of winter triathlon program in qualifying competitions in the countries of the post-Soviet space.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 17.06.2017.
Published: 31.08.2017.

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UDK 796.06-057.875/656.2

ISSN (English ed. Online) 2311-6374
2017, №4(60), pp. 100-104

Organization and content efficiency substantiation of a strengthened professional and applied physical training course for railway higher educational institution students

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***Purpose*:** *to experimentally substantiate the effectiveness of the application of the experimental program for physical education with an intensified course of professional-applied physical training (PAPT) for students of I–II courses of railway specialties.*

Material & Methods: *analysis and generalization of literary sources, pedagogical experiment, pedagogical testing, physiological and psycho-physiological methods, methods of mathematical statistics.*

Result: *obtained data after the introduction of the experimental program on physical education with an intensified course of professional-applied physical training, students of railway universities.*

Conclusion: *analysis and generalization of the literature sources found the absence of a scientifically based program of PAPT for students of higher education institutions of the railway profile. The introduction in the educational process of physical education of the experimental program on physical education with the strengthened course of the PAPT showed an increase in the level of physical, professionally applied physical and psycho-physiological readiness of students.*

Keywords: *professional-applied physical training, railway engineers, physical training, experimental program, students, psycho-physiological preparedness.*

Introduction

Uncontrollable development of scientific and technological progress, global changes in the political, economic and social spheres fundamentally change the perception of the quality process for the training of the future specialist, requires fundamentally new approaches to the entire system of physical education, especially in the process of professional-applied physical training (PAPT).

In modern conditions of reforming the system of the educational process in higher educational institutions of Ukraine, many domestic researchers note the relevance of substantiating the content and organization of programs for professional-applied physical training, taking into account the requirements of a particular profession and the search for new technologies for their implementation.

Successful functioning of such a strategically important complex as rail transport is largely determined by the human factor. High demands placed on modern railroad specialists every year increasingly illuminate the contradictions between the need for Ukrzaliznytsia in highly qualified, harmoniously developed specialists and the traditional system of physical education in the university, does not take into account the specific nature of future professional activity and does not provide this need in full; between the rapid development of the railway industry and the needs for specialists, capable of prolonged professional longevity and inadequate elaboration of the content of existing programs for physical education in the conceptual plan; between the requirements for physical, psychophysical and mental preparedness of modern specialists of the railway industry and the available level of training graduates of higher educational institutions. So, it is obvious that the existing system of physical education needs to be improved and the search for new, more effective forms of its organization in higher educational institutions [2; 4; 7].

Problem of optimization and improvement of professional-applied physical training of future specialists of various specialties is devoted to a considerable number of scientific works [1; 2; 5; 8]. This is not an accident, because a modern specialist should differ not only in the quality of professional training, but also have a high level of physical development and functional state of the body. So, the programs of professionally-applied physical training for students of high schools of energy specialties [9], machine-building industry [3], students studying on the profile of radio engineering [8] and others. However, it should be noted that the issues of professionally-applied physical training have not been adequately covered in the literature, in particular, with reference to the specifics of the railway industry. Do not disclose the features of profiled training, taking into account the professional orientation of the work process of electrical engineers of the railway transport, organizational and methodological foundations of the construction of technology of professionally-applied physical training are not developed taking into account the structure and functioning of the universities of railway transport. Such training of railway engineers is practically not carried out either during study at the university, or during the further production activity. Main reason for this is the lack of a scientifically based system presentation of professional-applied training of future railway specialists and the technology of practical implementation of this training in specialized educational institutions, Ukrzaliznytsia and other industrial enterprises.

In the scientific literature [2, 3, 4] it is proved that the level of physical preparedness of workers in the railway industry does not meet modern requirements on a number of criteria. Weak physical fitness is the reason for the low level of efficiency of specialists, rapid fatigue, psychological breakdowns, which leads to a large number of production errors in railway transport. In addition, as A. I . Davidenko [2] notes, the professional activities of railway specialists are carried out under conditions of exposure to harmful factors of the production environment: noise, vibration, dust, unfavorable microclimate, heavy physical labor, neuro-emotional tension and inefficient nutrition. Such working conditions provoke the emergence of many occupational diseases. Thus, among the most common diseases among railway workers are: respiratory diseases, peripheral nervous and musculoskeletal systems, circulatory system, digestive organs, occupational deafness, diseases and injuries of the musculoskeletal system, poisoning. Scientists [2, 7] note that workers in the railway industry have a reduced level of psycho-physiological and psychophysical preparedness, a high incidence rate, an early professional aging, is the cause of many accidents and incidents.

Researches of scientists [5, 7] show that the production activity of workers in the railway industry is more than 60% dependent on the human factor and up to 50% on the quality of psycho-physiological and psychophysical preparedness of specialists. R. T. Rayevsky [6] determined that for the development and improvement of sensory, volitional and mental qualities, specially selected means of applied orientation. Due to their purposeful impact, the optimum level of functioning and reliability of all organs and systems.

In order to substantiate the need for PAPT railway specialists, it is necessary to consider the specific features and requirements for employees of this industry. Thus, V. A. Sadovsky [7] notes that the general requirements include: professional psychophysical readiness, mental abilities, sensory, motor, physical, volitional, organizational skills and abilities of railroad specialists. High labor productivity largely depends on individual abilities for mental and physical labor, the level of endurance and restorability of an organism, efficiency, etc.

Scientists [2, 4, 5, 7] note that the physical reliability and readiness of railway specialists is effectively achieved through the special, professionally directed use of PAPT tools and methods.

The scientific works indicate that the formation of professionally important physical qualities and skills in future specialists, the increase in the body's resistance to the adverse effects of the external and industrial environment is most effectively achieved in the process of specially directed use of methods and means of physical education.

At present, the issue of the professionally applied physical training of railroad specialists, in particular, electrical engineers of railway transport, has not been practically investigated. Significant requirements that professional activity impose on the physical, psychophysical and mental training of modern railroad specialists, high social importance of their work activity make it especially relevant to develop and introduce in the process of physical education in universities a strengthened course of the PAPT, with the aim of acquiring, by future specialists, the professionally required level of professional physical and psycho-physiological readiness for railway engineers.

Current situation determines the relevance of the scientific substantiation of the content and organization of professionally-applied physical training and their introduction into the educational process of future electrical engineers of the railway transport.

Purpose of the study: to experimentally substantiate the effectiveness of the application of the experimental program for physical education with an intensified course of professional-applied physical training (PAPT) for students of I–II courses of railway specialties.

Material and Methods of the research

In the course of the research, the following methods were used: analysis and generalization of literary sources, pedagogical experiment, pedagogical testing, physiological and psycho-physiological methods, and methods of mathematical statistics.

In order to test the effectiveness of the organization and content of the experimental program for physical education with a strengthened PAPT course for students, future electrical engineers of railway transport, a pedagogical experiment was conducted. In the experiment, 50 students (young men) took part, of which an experimental (25 people) and control (25 people) group of first year students of the Ukrainian State University of Railway Transport. Classes of students of both groups were held under the same conditions: two-time classes per week for 90 minutes. Structures of the sports base of UkrSURT and the necessary sports equipment were used. All studies in the experimental group were carried out by the author of the work, in the control group – by teachers of the Department of Physical Education and Sports in accordance with the curriculum for physical education for higher educational institutions of Ukraine III–IV levels of accreditation.

Results of the research and their discussion

At the beginning of the experiment, both groups (experimental and control) did not have significant differences in all studied parameters.

It was revealed that the data of the initial level of anthropometric and psycho-physiological indices of physical and psychophysical development as a whole corresponded to the average age norms. Level of physical and professionally-applied physical preparedness is low.

An analysis of the results of the initial study made it possible to conclude that it is necessary to introduce a strengthened course of PAPT in the physical education of railway higher education institutions in order to reach future physicists with a high level of physical and psycho-physiological readiness that are important for the further successful work.

In the developed experimental program, a wide application of exercises aimed at increasing the overall physical preparedness and performance in conjunction with a large arsenal of PAPT, most effective for this professional activity, as well as the introduction of methods for optimizing occupations, which allowed to increase the intensity and motor density of occupations, not exceeding the limits of the hours allocated

by the program. means of GPP and PAPT were distributed as follows: exercises aimed at increasing physical performance and development of physical qualities – 40%, on development of strength qualities – 25%, speed-strength endurance – 15%, exercises aimed at improving attention functions and kinestatic sensibility – 10%, general and special working capacity – 10%.

Pedagogical experiment was designed for two years. Results of testing conducted at the end of the second year of the study showed that the students of the experimental group had significant positive changes in their physical preparedness for almost all indicators. Thus, the results in pull-ups increased by 75,5%, by 49,9% – arm-pumping exercises, by 61,9% – in the bent suspension, by 36,5% - in the rise of the trunk in squat and 57% – in the angled position from the squat position. Indices of endurance (run on 3000 m) among the students of the experimental group improved by 19,2%, agility by 9,6%, speed-strength qualities by 9,7% (standing long jump) and by 5,3% – speed (running on 100 m).

One of the important components of testing the effectiveness of the experimental program was testing of professionally important physical, psychophysical and mental qualities and abilities of future electrical engineers of railway transport. Results of a two-year experiment prove that an experimental program has been developed that has positively influenced the development of such professionally important physical qualities as kinestatic sensuality, strength, strength endurance of the back muscles and coordinated movements. Thus, the increase in the parameters of the kinestatic sensibility of the leading brush was 10,76±0,19 kg ($p<0,05$), that is 26,8%; indicators of strength – 31,2±0,7 kg ($p<0,05$), That corresponds to 33.8%; indicators coordinated movements (test Kopilova "Ten eights") – 2,53±0,16 s ($p<0.05$), i.e. 23,9%; static endurance performance (retention time 50 % weight of the maximum) – 20,72±0,73 s ($p<0,05$), that is 33,4% (Table 1).

Positively influenced of experiment program and on professionally important for railroad specialists attention functions. Thus, the indicators of volume, distribution and switching of attention (Gorbov's method) in the students of the experimental group improved 115,08±4,57 c.u. ($p<0,05$), equal to 57,1%; results of attention selectivity (Munsterberg's method) increased by 10,32±0,38 c.u. ($p<0,05$), which was 70,9%; indicators of the stability of attention (the technique of "confused lines") improved by 10,64±0,16 c.u. ($p<0,05$), which corresponded to 79%. Analysis of voluntary attention (the technique of "Arranging numbers") showed that they increased by 4,52±0,28 c.u., that is, by 22,2%, and attention-level indicators (Bourdon's technique) improved by 220,57±31,57 c.u. ($p<0,05$), i.e. 137,8% (Table 2).

After applying the experimental program, the students of the experimental group decreased the time of a simple reaction to light by 49,4 ms ($p<0,05$) (15,6%) and the time of a simple reaction to sound at 38,32 ms ($p<0,05$) (9,5%); time of a complex reaction to the presence of a sign decreased by 220,44±0,25 ms ($p<0,05$), which was 22,2%, and the time of a complex reaction for the absence of a sign was 168,48±2,56 ms ($p<0,05$), i.e. 17%. The parameters of the muscular sensitivity of the leading brush without visual control in the students of the experimental group improved after two years of training on 4,80±0,17 kg ($p<0,05$). Positive changes were observed in the parameters of the muscular sensitivity of the leading brush with visual control. After two years of classes, they decreased by 5,56±0,21 kg ($p<0,05$) (Table 3).

Table 1

Dynamics of indices of professionally applied physical readiness of the students of the experimental group, n=25

Normative indicators	Research stage	$\bar{X}$±m	Probability evaluation	
			t	p
Brush dynamometry, kg	before	40,12±0,65	13,50	<0,05
	after	50,88±0,46		
Dead lift dynamometry, kg	before	92,4±3,37	7,26	<0,05
	after	123,6±2,67		
Ten eights (test Kopilova), s	before	10,59±0,19	13,31	<0,05
	after	8,06±0,03		
Retention time 50 % weight of the max, on the dead lift dynamometry, s	before	62,92±2,47	6,87	<0,05
	after	83,64±1,74		

Table 2

Dynamics of indicators of professionally important attention functions of students of the experimental group

Normative indicators	Research stage	$\bar{X}$±m	Probability evaluation	
			t	p
Volume, distribution and switching of attention, c.u. Gorbov's table	before	358,64±6,11	32,52	<0,05
	after	153,72±1,54		
Attention selectivity, c.u. Munsterberg's test	before	14,56±0,45	22,81	<0,05
	after	24,88±0,07		
Stability of attention, c.u. technique of "Confused lines"	before	13,48±0,43	20,81	<0,05
	after	24,12±0,27		
Voluntary attention, c.u. technique of "Arranging numbers"	before	20,36±0,35	12,84	<0,05
	after	24,88±0,07		
Attention, c.u. Bourdon's technique	before	160,11±6,56	5,70	<0,05
	after	380,68±38,13		

Table 3

Dynamics of indices of the professionally applied preparedness of the students of the experimental group

Normative indicators	Research stage	$\bar{X}\pm m$	Probability evaluation t	p
Time of a simple reaction, ms	before	316,16±3,24	13,18	<0,05
	after	266,76±1,88		
Time of a simple reaction to sound, ms	before	405,04±6,37	5,41	<0,05
	after	366,72±3,11		
Time of a complex reaction to the presence of a sign (mean response time for the presence of a sign), ms	before	994,72±10,17	15,52	<0,05
	after	774,28±9,92		
Time of a complex reaction for the absence of a sign (mean response time for the absence of a sign), ms	before	991,16±9,14	14,96	<0,05
	after	822,68±6,58		
Muscular sensitivity of the leading brush without visual control, kg	before	32,64±0,78	3,91	<0,05
	after	27,84±0,95		
Muscular sensitivity of the leading brush with visual control, mg	before	30,52±0,80	5,57	<0,05
	after	24,96±0,59		

Testing of the properties of the nervous system at the end of the experiment showed a significant increase in the functional stability of the nervous system, which was reflected in the improvement of the parameters of the taping test ($p<0,05$). After two years of application of the experimental improvement program, 1,2±0,03 Hz, i.e. 20,7% (Fig. 1).

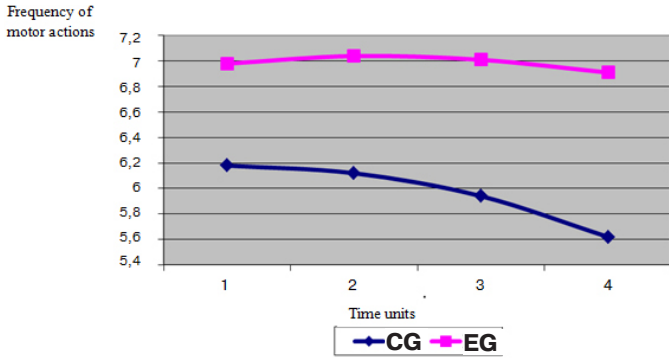

Fig. 1. Dynamics of indicators of the taping test of the experimental group students after the experiment

Dynamics of indicators tapping test indicates the stabilization of movements per unit time students in the experimental group, both after the first and after the second year of implementation of the pilot program.

Analyzing the state of mental working capacity for simple but monotonous work (E. Krepelin's technique), it is necessary to note the positive dynamics that took place during two years of studies among students of the experimental group. The study of quantitative indicators revealed that the final values for two years amounted to 3,5%, which was 4,6±0,2 correct answers. In addition, the students of the experimental group significantly reduced the number of errors in the test, the time spent on the test was improved, and the efficiency factor. So, after two years of lessons on the experimental program, the number of errors decreased by 4,6±0,2 errors, was 92%, the time spent on the test was reduced by 66,0±6,02 s, that is, by 25,9 %, and the coefficient of efficiency increased by 0,04±0,005 c.u., which equals 4,2%.

Thus, the analysis of the results of the pedagogical study of physical, vocational and psycho-physiological preparedness revealed a positive dynamics of practically all indicators in the students of the experimental group, which is a confirmation of the positive impact of specially selected exercises of the experimental program on physical education with the strengthened course of PAPT on the level of professionally necessary psychophysical and psycho-physiological qualities and abilities of students, future electrical engineers of railway transport.

Conclusions

1. Analysis and generalization of the literature sources revealed the absence of a scientifically grounded program of PAPT for students of higher education institutions of the railway profile.

2. Analysis of the results of the study indicates an increase in the level of physical, professionally applied physical and psycho-physiological readiness of students, is the result of the introduction of an experimental program for physical education with a strengthened course of PAPT.

Prospects for further research. In subsequent studies, it is planned to make a comparative analysis of the dynamics of the group's indices, which was dealt with according to the author's program with an intensified course of professionally-applied physical training with the indicators of a group of students who were involved in the curriculum for physical education for higher educational institutions of Ukraine III-IV levels of accreditation.

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 27.06.2017.
Published: 31.08.2017.

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The reliability of the presented results correspond to authors

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