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Original Article

The complex effects of health-improving fitness on the physical condition of students

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Abstract
The research presents the results of the pedagogical experiment, in which 58 students of Yuriy Fedkovych Chernivtsi National University of the city of Chernivtsi took part. The study is aimed to determine the complex effects of health-improving fitness on the physical condition of young men and girls.

The program for physical education for first-year students, which included means of health-improving fitness was developed. The program was designed for one academic year (2018-2019). The study presents the results of the complex effects of health-improving fitness on the main components of the physical condition of young men and girls.

The introduction of the proposed program in the process of physical education of students with health-improving fitness means significantly ($p < 0.05$; $p < 0.01$) improves the functional ability of the cardiovascular system, manifests itself in an increase in adaptive potential capacity, a decrease in heart rate at rest by 10.6 % in young men and 10.9 % in girls, an increase in the level of physical performance according to indicators of the Ruffier index in boys by 47.0 % in boys and 38.4 % in girls and PWC170 in boys by 13.5 %, in girls by 10.1 %.

The proposed program with health-improving fitness means increases the functional level of the respiratory system, in particular, the lung capacity in boys increased by 11.8 %, in girls - by 15.6 %, the Shtange test with breath-holding in boys improved by 23.0 % in girls by 16 5 %, the Genchi test improved in young men by 19.2 %. Health-improving fitness means have complex positive effects on the fundamental components of the physical condition of students.
Key words: health-improving fitness, physical condition, students.

Introduction

Over the past ten years in Ukraine, a lot of research has been conducted on the study of the issue of physical development, functional status, physical fitness and working capacity (Kashuba, 2010; Bolotin, 2016; Galan, 2017; Bolotin, 2017; Ivashchenko, 2017; Pityn, 2017) of students. The urgency of this problem exists today, as many authors note a low level of physical performance (Serhiienko, 2014; Bolotin, 2015; Azhippo, 2016; Yarmak, 2017), an increase in the number of students with overweight (Lazareva, 2017), and a low level of physical fitness (Kashuba, 2017; Yarmak, 2018).

The results of the annual assessment of the physical preparedness of the population of Ukraine indicate that the first-year students are not able to perform tests characterizing speed-strength qualities, general endurance, flexibility and strength. On average, 65.7 % of girls and 53.8 % of boys do not cope with the credit requirements of the physical education program. Standards characterizing endurance are performed only by individual students.

Many researchers (Balamutova, 2011; Kozhokar, 2018) consider that a decrease in the adaptive capabilities and the energy potential of the students is connected with a low level of physical condition, which is identified as a complex of morphological, physical and functional indicators of the development and status of the body.

Having such properties as integration and combinability, the multi-component concept of health-improving fitness represents the freedom to choose the available forms of occupation combining the most effective types of physical activity for healing. This peculiarity allows us to introduce them widely to the educational process of student youth.

One of the tools to improve the physical condition of students is health -improving fitness (Galan, 2017). To achieve the appropriate level of physical condition, specialists usually use conditioning workouts applying optimal physical activity, which causes a training effect. (Usacheva, 2015).

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A prerequisite for achieving the optimal effects from the classes is that the orientation, intensity and volume of physical activity and frequency of classes in the weekly micro cycle should be suitable to the level of the physical condition of the people involved.

Materials and Methods

The analysis of literary resources and the generalization of the data of specific research and methodological literature made it possible to form a general conception of the topic of the study, to determine the working hypothesis and aim of the study, to verify the degree of its development and potential. Analysing literary sources, the main attention was paid to the general methodological approaches to physical preparation of students and the application of physical culture and health technologies, in particular, means of health-improving fitness. Pedagogical research methods included: pedagogical observation, pedagogical testing of physical fitness and pedagogical experiment. Pedagogical observation of students of the studied groups was carried out throughout the pedagogical experiment, in educational classes on physical education. During the classes, attention was paid to the adequacy of physical exertion, to the degree of student fatigue when they performed training loads.

Pedagogical testing was conducted to determine the dynamics of the physical fitness of students. The base of testing included tests and standards for conducting an annual assessment of the physical fitness of the population of Ukraine. When conducting pedagogical testing, we have taken into account all the necessary methodological recommendations.

The research used the methods of anthropometry and functional diagnostics. We determined body length, body weight, heart rate, systolic and diastolic blood pressure, vital lung capacity, Shtange test, Genchi test, Ruffier test, hand dynamometry. To study the physical performance of students, a functional test of PWC170 was used. This test was performed on a standard stationary bicycle ergometer in compliance with WHO recommendations in conjunction with a medical professional.

To calculate the maximum oxygen consumption, the following formula was used:

$$VO_{2\ max} = 1, PWC_{170} + 1240$$

Legend: W1 - power of the first load; W2 - power of the second load; W3 - power of the third load; f1 - heart rate during the first load; f2 - heart rate during the second load; f3 - heart rate during the third load.

The research study was conducted at Yuriy Fedkovych Chernivtsi National University; altogether 58 first-year students, aged 18-19 years (26 young men and 32 girls) were involved in the research.

Results

The formation of the fitness culture of contemporary students requires physical education teachers to develop and implement programs that will successfully achieve the main pedagogical tasks. Focusing on the value system of priorities for the fitness culture of students, we pay special attention to the development of fitness technology, in which the pedagogical and methodological principles of the educational training were implemented. The pedagogical experiment continued for the 2018-2019 academic year. Students had four hours a week of classes and two hours a week of extracurricular training. The methodological peculiarities of constructing health-improving fitness classes were based on a sequential combination of weight training and working on simulators with various aerobic exercises, as well as stretching and relaxation. The power segment of the classes envisaged the use of different movements not only with normal loads but also with specific simulators, as well as with the weight of one's own body. The program includes exercise complexes for the main muscle groups, taking into account problem zones.

Preliminary control of the physical condition of boys and girls made it possible to differentiate the intensity of physical activity. For boys and girls whose level of physical condition corresponded to low and below the average level, the volume of anaerobic exercises amounted to 60.0% -75.0% of the total volume, for persons with an average level of physical condition it amounted to 50.0%, and for individuals who had above average and a high level, the volume was 20.0% -25.0%.

At the classes, we used conditioning training, the intensity of physical activity ranged from 40.0% to 90.0% of the maximum oxygen consumption. The rational training volume for endurance exercises was in the ranges of 50.0% -75.0% of the maximum value of the exercises and the intensity of 50.0% -75.0% of the maximum oxygen consumption. The results reflecting the dynamics of indicators of the physical state during the pedagogical experiment under the influence of health fitness classes are presented in Table 1.

An analysis of the literature on age physiology indicates that physical development is always connected with human health and is one of its objective indicators.

In students, the indicators of physical development, on the one hand, characterize compliance with the statistical norms of their biological age, on the other hand, reveal their morphofunctional state at a given particular time.

The average results of the body length and body weight of boys and girls at the beginning of the pedagogical experiment correspond to age norms. Among girls, 18.7% (n = 6) are overweight, and 12.5% (n = 4) have weight deficit of body. Among young men, the number of persons with overweight is much less, only 11.5% (n = 3), but significantly more people with a deficit of body weight, there are 23.1% (n = 6).

At the beginning of the pedagogical experiment in boys and girls, the average statistics characterizing the dynamometry of the right and left hands indicate asymmetric muscle development, and the heart rate indicators at rest (HR rest) exceed age norms and indicate excitement and the presence of a stress state. Young men and girls showed low rates of the Shtange and Genchi breathing tests, and a low level of physical performance and maximum oxygen consumption (VO2max). At the beginning of a pedagogical experiment, only the indicators of blood pressure and lung capacity (VC) corresponded to age norms in young men and girls.

Individual indicators of blood pressure in boys and girls ranged from 85-130 mm Hg. for systolic and from 60-85 mm Hg, for diastolic pressure corresponding to the boundaries of normal values. Normal vascular tone was inherent in 69.2% (n = 18) of young men and 65.6% (n = 21) of girls with signs of hypertension revealed 18.7% (n = 6) of girls and 11.5% (n = 3) boys, and with hypotonic signs -12.5% (n = 4) girls and 23.1% (n = 6) boys.

A pedagogical formative sequential experiment with students was conducted to evaluate the effectiveness of the health-improving fitness training program.

Although, according to the results presented in table 1, positive dynamics is observed from 0.8% to 8.2% of the indicators under study.

Table 1. The dynamics of the morphological and functional indicators of boys and girls during the pedagogical experiment under the influence of health-improving fitness classes (n = 58)

Indicators under study	Before the pedagogical experiment		After the pedagogical experiment		±Δ, %	p
	$\bar{x}$	S	$\bar{x}$	S		
Young men (n=26)						
Body length, cm	178.7	4.18	180.2	3.35	0.8	p>0.05
Body weight, kg	65.9	12.36	67.4	9.19	2.2	p>0.05
Dynamometry right, kg	38.9	9.28	43.8*	7.12	11.2	p<0.05
Dynamometry left, kg	31.4	10.33	34.2	5.21	8.2	p>0.05
$HR_{rest,}$ beats /min^{-1}	88.9	5.32	80.4*	3.12	10.6	p<0.05
SBP, mmHg	114.9	7.24	115.2	4.28	0.3	p>0.05
DBP, mmHg	71.8	7.12	72.4	5.14	0.8	p>0.05
VC, ml	3,650.7	340.72	4,140.6**	213.41	11.8	p<0.01
Shtange test, sec	41.8	9.28	54.3*	5.19	23.0	p<0.05
Genchi test, sec	21.9	5.31	27.1**	2.15	19.2	p<0.01
Ruffier index, nominal units	10.6	3.22	7.21**	1.56	47.0	p<0.01
$PWC_{170,}$ kg • min-1•kg-1	13.4	2.21	15.5**	1.87	13.5	p<0.01
$VO_{2\ max}$, ml·min^{-1}·kg^{-1}	36.9	5.48	41.8**	2.38	11.7	p<0.01
Girls (n=32)						
Body length, cm	165.7	5.13	165.9	5.17	0.1	p>0.05
Body weight, kg	57.9	12.81	55.7	8.32	3.9	p>0.05
Dynamometry right, kg	19.6	7.97	19.9	6.29	1.5	p>0.05
Dynamometry left, kg	13.7	6.12	13.9	4.22	1.4	p>0.05
$HR_{rest,}$ beats /min^{-1}	90.4	9.28	81.5*	4.54	10.9	p<0.05
SBP, mmHg	111.2	15.78	112.9	11.91	1.5	p>0.05
DBP, mmHg	69.5	6.91	70.1	4.21	0.9	p>0.05
VC, ml	2,514.8	346.79	2,978.7**	164.87	15.6	p<0.01
Shtange test, sec	37.4	8.46	44.8*	7.53	16.5	p<0.05
Genchi test, sec	20.1	4.98	22.6**	3.73	11.1	p<0.01
Ruffier index, nominal units	11.9	4.18	8.6**	2.47	38.4	p<0.01
$PWC_{170,}$ kg • min-1•kg-1	12.4	1.62	13.8*	1.08	10.1	p<0.05
$VO_{2\ max}$, ml·min^{-1}·kg^{-1}	32.1	5.11	34.7*	3.11	7.5	p<0.05

Note: ± Δ, % - difference at the end of the experiment;

Note: * the difference is statistically significant at the level of p <0.05; ** the difference is statistically significant at p <0.01

In boys and girls, the most significant changes (p <0.05; p <0.01) under the influence of health-improving fitness classes are observed in terms of heart rate at rest, tests with breath-holding on inhalation and exhalation, the Ruffier index, physical performance (PWC170), and also the maximum oxygen consumption(VO2max); in the young men -dynamometry of the right hand. A significant increase in the result is observed in the indicator that characterizes the response of the cardiovascular system to dynamic load, in young men the average statistical result of the Ruffier index improved by 47.0%, in girls by 38.4%. In both sex groups, the indicator of physical performance corresponded to the average level at the end of the pedagogical

experiment. In young men, there is a significantly better increase in the result of the Shtange test (23.0%) and the Genchi test (19.2%) and the average results in breathing tests are significantly ($p < 0.05$) higher than in girls. The analysis of the dynamics of indicators of physical fitness in boys and girls is presented in table 2.

Table 2. Dynamics of indicators of physical fitness of boys and girls during the pedagogical experiment under the influence of health-improving fitness classes (n = 58)

Indicators under study	Before the pedagogical experiment		After the pedagogical experiment		±Δ, %	p
	$\bar{x}$	S	$\bar{x}$	S		
Young men (n=26)						
Running 100 m, sec	13.9	1.34	13.7	0.98	1.5	p>0.05
Shuttle running 4 × 9 m, sec	9.8	1.45	9.7	1.12	1.0	p>0.05
Running in a steady pace 3,000m, min	15.54	1.35	14.32*	1.14	8.5	p<0.05
Bending forward from the sitting position, cm	3.21	2.11	5.3	2.05	39.4	p>0.05
Standing long jump, cm	231.4	18.7	241.2**	12.58	4.1	p<0.01
Girls (n=32)						
Running 100 m, sec	15.4	1.43	15.3	1.09	0.7	p>0.05
Shuttle running 4 × 9 m, sec	11.2	1.88	10.7*	0.81	4.7	p<0.05
Running in a steady pace 2,000m, min	11.52	0.46	11.30	0.49	1.9	p>0.05
Bending forward from the sitting position, cm	10.3	2.16	16.4*	2.04	37.2	p<0.05
Standing long jump, cm	183.1	13.76	192.5*	9.57	4.9	p<0.05

Note: ± Δ, % - difference at the end of the experiment;
Note: * the difference is statistically significant at the level of $p < 0.05$; ** the difference is statistically significant at $p < 0.0101$

Significant changes ($p < 0.05$) under the influence of health-improving fitness classes occurred in motor qualities characterizing endurance, speed-strength qualities, dexterity and flexibility.

In young men, a statistically significant difference at the end of the pedagogical experiment is observed in the motor tests; the results improved by 8.5% ($p < 0.05$) in running in a steady pace 3,000 m and by 4.1% ($p < 0.05$) in standing long jumps.

At the end of the pedagogical experiment, in the girls, the most positive changes occurred in the motor test for flexibility, so the average results at the end of the pedagogical experiment improved by 37.2% ($p < 0.05$). The significant changes ($p < 0.05$) also occurred in the indicators of dexterity, the average statistical result improved by 4.7% ($p < 0.05$) and in the indicators characterizing speed-strength qualities by 4.9% ($p < 0.05$).

At the end of the pedagogical experiment, there were no significant changes ($p > 0.05$), in the indicators characterizing the speed and endurance in girls, and speed, dexterity and flexibility in boys. Although, during the fulfilment of the test tasks in both sex and age groups, the average statistical results correspond to the satisfactory and average levels.

Discussion

Modern research and methodological views on health-improving fitness indicate that maintaining health in a person's life can only be achieved with sufficient physical activity. The metabolic value of recreational activities has been considered in recent years as one of the most prominent factors that affect their effectiveness. At the present stage, the fitness industry offers a wide variety of types of physical activity. They all differ in orientation, the needs of the contingent for which they are intended, the features of the training facilities, the conditions for their implementation, and the equipment used in the classes. The development of new health-improving technologies contributes to the continuous updating of varieties of classes. With all the variety of programs, not all of them have the same popularity (Gavrylov, 2006; Chertanovskyi, 2010; Chychkan, 2012; Blagii, 2015).

Based on the study of the tolerance of people with different levels of physical condition to physical exertion today, models have been developed for the optimal ratio of the intensity, duration and frequency of walking and running, swimming, walking on stairs and other cyclic training The determination of regularity between the reaction of the cardiovascular system of the person and the speed of movement, the length of steps, the way of swimming, the amount of inclination of the running surface, made it possible to develop methods for predicting the intensity of loads in the corresponding types of aerobic training. Conducting classes in which acyclic movements are used, in particular, classical and step aerobics, as a result of a wide variety of means that have a complex coordination character and vary in many parameters of movements, it is quite significant to

establish such laws. Differentiation by the capabilities of the person involved is one of the most important in the organization of any process associated with physical education (Zaschuk, 2010; Sapozhnyk, 2012; Korolchuk, 2015; Džibrić, 2017).

As a result of the research, the obtained data:

- confirmed (Korol, 2014; Galan, 2019) the significant health-improving effect of the means of health-improving fitness during the process of students' training at higher educational institutions and the expediency of their use;

- proved the information about the complex effects of health-improving fitness, in particular on indicators of the functional state of the body, of physical fitness and performance.

Conclusions

The criteria for the health effect of health-improving fitness classes were indicators of the physical condition of young men and girls. During the experiment, we detected their positive dynamics.

The decrease in the indicators of the Ruffier index ($p < 0.01$) testified about the reduction in heart rate at rest ($p < 0.01$), an improvement of the functional ability of the heart muscle, and an enhancement in the potential capacity of the cardiovascular system.

The level of physical performance during the pedagogical experiment significantly increased in both sex and age groups.

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