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Original article

IMPROVING PHYSICAL FITNESS OF STUDENTS THROUGH A SWIMMING TRAINING SYSTEM AT THE UNIVERSITY

IVAN Hlukhov[1], MARYAN Pityn [2], KATERINA Drobot [3], HANNA Hlukhova [4]

Abstract.

Means of sport and physical education are among the key to improving the health of young people. Solving the current scientific and applied issue of substantiating a system approach to teaching swimming to students will allow taking into account the existing experience and current requirements, student-centred process and objectivity of criteria of provision in modern physical education at universities.

Purpose: to establish the effectiveness of the swimming training system of university students at different individual and motivational levels by changes in indicators of functional and physical fitness.

Material and methods. Study participants. To our study was involved 18−20 aged students (boys and girls) of Kherson State University. During the 2020−2021 academic year the main tool of their physical education classes was swimming (it was their choose). Students were training in experimental groups at four individual and motivational levels of the swimming training system. Organization of the study. During the first academic semester programmes (experimental and reference) were included 18 classes. This feature was determined in accordance with the minimum regulatory requirements on the side of physical education at the Kherson State University and the possibilities of individual trajectory of students training.

Results. There was confirm the correctness of the methodological approach to differentiation of swimming programmes for boys and girls in which it was taken into account the level of swimming skills. Our study participants was allocated to four individual and motivational levels of swimming training system. The effectiveness of the developed programmes different individual and motivational levels was tested based on students' physical fitness indicators.

Conclusions. There were significantly improved the average group results in dynamic and static strength endurance of different muscle groups, explosive power of most experimental groups and also in the demonstration of flexibility and speed qualities.

Key Words: physical education, swimming training system, university students, physical fitness.

Introduction.

The field of physical education and sports is one of the strategic directions of implementation of the challenges of building a healthy society from the standpoint of physical and psychological aspects (Lee & Oh, 2014; Hruzevych, Bohuslavska, Kropta, Galan, Nakonechnyi, & Pityn, 2017).

The importance of high-quality and effective implementation of system tasks of physical education has been widely developed by leading experts in the field. There is an indisputable influence in the direction of formation and maintenance of health and its basic components (physical development, psycho-emotional state, functional capabilities, socialization, etc.) (Muhamad, Sattar, Abadi, & Haron, 2013; Monteiro, Araújo, Mazzardo, Francisco, Ribas, & Aburachid, 2021).

To date, the scientific substantiation of the physical education structure and content at universities has been carried out in numerous scientific papers (Troup, 1999; Tanaka, 2009). System-forming tasks to ensure physical development, increase functional capabilities, professional and applied physical fitness, factors of formation and pedagogical conditions of health-preserving technologies, support of self-improvement and self-development of student youth are presented at different levels of researcher's inquiry (Hruzevych, Bohuslavska, Kropta, Galan, Nakonechnyi, & Pityn, 2017; Ivanenko, Tyshchenko, Pityn, Hlukhov, Drobot, Dyadechko, Zhuravlov, Omelianenko, & Sokolova, 2020).

For a long time, swimming classes were a compulsory activity in the system of preschool and general educational activities. However, under the influence of changing socio-economic conditions and a set of objective and subjective factors, the continuation of this process at the existing theoretical and methodological level has become impossible (Ceseracciu, Sawacha, Fantozzi, Cortesi, Gatta, Corazza, & Cobelli, 2011; Bergamin, 2013; Callaway, 2015; Chaplinskyy, Briskin, Ostrovska, Sydorko, Ostrovskyy, Pityn, & Polehoiko, 2018).

We assume that solving the current scientific and applied issue of substantiating a system approach to teaching swimming to students will

[1,3,4]Kherson State University, Kherson, UKRAINE
[2]Ivan Bobersky Lviv State University of Physical Culture, Lviv, UKRAINE

allow taking into account the existing experience and current requirements, student-centred process and objectivity of criteria of provision in modern physical education at universities.

*Purpose of the study***:** to establish indicators of functional fitness of university students due to the application of the swimming training system at different individual and motivational levels.

Material and methods.

Study participants. To our study was involved 18−20 aged students (boys and girls) of Kherson State University. During the 2020−2021 academic year the main tool of their physical education classes was swimming (it was their choose). Students were training in experimental groups at four individual and motivational levels of the swimming training system. (Hlukhov, 2021a).

The substantiation of the swimming training system offered by us has statement of purposes with a possibility of formation of several individual trajectories of swimming training depending on an initial level of preparation and individual-motivational direction of activity of university students. The essence of the applied methodological approach is that students who objectively have a different fitness level should have accessible and achievable tasks while undergoing education material. This, of course, applies to the teaching of swimming, where in addition to the knowledge of students we must take into account the existing skills and abilities, the initial level of physical fitness and functional capabilities, individual motivation for the activity, etc.

The application of individual trajectory of statement and achievement of goals should take into account the factors influencing the choice or construction of the very trajectory, decision-making regarding the choice of content (forms and ways, means and methods), basic and additional tools to establish process efficiency. The key issue is to implement planning under the influence of internal needs, goals, motives and requirements of the environment. The presence and content of setting and achievement goals is the basis for to clearly differentiate the content of students' activities within swimming classes in terms of university physical education.

The obtained objective data gave grounds to determine several levels of goal setting, which were organically combined and had a logical transition in terms of complexity and orientation of solving the main tasks within the defined individual and targeted preferences of students.

For the first individual and motivational level, the characteristic difference was that students had a high level of anxiety in the water environment and could not swim (1EG, n=28 young men and 23 women). The second individual and motivational level involved students who were not afraid to be in the water, but could not swim (2EG, n=25 young men and 26 women). The third individual and motivational level was characterized by the fact that students had the ability/skills to stay afloat and swam in an arbitrary way (3EG, n = 21 young men and 23 women). The fourth individual and motivational level included students who had swimming skills and had a desire to engage in and improve their technique in the future (4EG, n = 23 young men and 21 women) (Hlukhov, 2021b).

Organization of the study. During the first academic semester programmes (experimental and reference) were included 18 classes. This feature was determined in accordance with the minimum regulatory requirements on the side of physical education at the Kherson State University and the possibilities of individual trajectory of students training. The duration of classes was 60 minutes.

The indicators of physical fitness that were studied included: handgrip test (dominant and the other hand, kgf), running 100 m (s), shuttle run (4x9 m, s), flexion-extension of the arms in plank position (times), sit-up (times), bent suspension (s), pull-ups (times), long jump (cm), throwing a stuffed ball (cm), squats for 30 s (times), throwing a tennis ball at the target (times), angle body (cm), which were determined by well-known methods (Santhiago, Da Silva, Papoti, & Gobatto, 2011; Roj, Planinšec, & Schmidt, 2016; Chaplinskyy, Briskin, Ostrovska, Sydorko, Ostrovskyy, Pityn, & Polehoiko, 2018).

Statistical analysis. The calculations of the main univariate statistics were performed: arithmetic mean – $\overline{X}$, standard error of mean − m; Student's t-test – 5% level of statistical probability – p (probability not less than 0.95) was considered as the base one to establish the differences between the two samples; when analysing the results within each sample, the t value was used to compare the results of related samples, different groups – for unrelated samples. Based on the comparison of the initial and final testing within the groups, the percentage values of changes in fitness were determined by physical fitness indicators of young men and women of for each individual and motivational level of swimming classes.

Results.

When considering the indicators of these groups, we tried to consider the need for diverse physical and functional training of boys and girls and the need for developmental (supportive) influences within the physical education at the university.

The absolute values of the handgrip test of young male, taking into account the age norms were not too high and were for the dominant hand from 29.28 to 33.78 kgf and of the other hand – 26.92−31.22 kgf. At the beginning of the pedagogical experiment (PE), we found the

advantages in the level of force capabilities of the muscles of the hand of students in 1EG, 3EG and 4EG over 2EG according to the indicators of the dominant hand (31.82, 33.86, 33.78 kgf and 29.28 kgf, p≤0.05 respectively) and the other hand (28.57, 30.81, 31.22 kgf and 26.92 kgf, p≤0.05 respectively). The use of swimming study programmes for all EGs was manifested in a significant statistically improvement of results for the dominant and other hand among students (p≤0.01).

The established results of the test "100 m run" showed quite low baseline values of young men studied EGs (from 14.22 to 14.76 s). Comparison of digital data at the beginning and at the end of the pedagogical experiment showed that the representatives of the first, second and third EGs increased the level of results on this test (p≤0.05).

According to the results of the test "shuttle run (4x9 m)", the differences between the results of the young men during the study was insignificant. Results before the beginning of the pedagogical experiment were 10.30−10.49 s and at the end made 10.33−10.42 s. Thus, no statistically significant changes (p> 0.05) were found at the intergroup and intragroup levels.

The average group results of young men in flexion-extension of the arms in plank position were in the range of 33.31−36.43 times at the beginning of the pedagogical experiment and 34.03−37.54 times at the end of it. During the implementation of the training programmes, the strength endurance of the arm muscles statistically significantly improved (p≤0.05). The most significant changes in this indicator were among the representatives of the second EG and the third EG (4.41% and 4.71%, respectively, from the initial level).

According to the results of the test "squats in 30 seconds" at the beginning of the PE a fairly uniform preparation of students was established, the results ranged from 19.00 to 21.78 times. As a result of the implementation of training programmes at each of the individual and motivational levels of the swimming training system, students demonstrated a positive dynamics of the results, and their values increased to 21.56−23.13 times (p≤0.05).

According to the results of the "squats in 30 seconds" test at the beginning of the study, a uniform preparation of students was established. Digital data fluctuated between 19.00 and 21.78 times. The implementation of educational programmes at certain individual and motivational levels of the swimming education system has led to a positive dynamics of student results. Their values increased to 21.56–23.13 times (p≤0.05) compared to the initial level.

The results of the test "bent suspension" at the beginning of the pedagogical experiment ranged from 25.88 s (2EG) to 37.39 s (4EG). During the PE, all young men from 1–4 EGs managed to improve their results in this test (p≤0.05−0.01). The highest values of improvement were demonstrated by young male of the first individual and motivational level (7.83%, p≤0.01).

The use of the pull-up test until failure indicated that for the most part the students' results did not differ from each other (8.24–10.35 times). In the course of the study, we observed a generally positive dynamics of the results of the pull-up test for EG students. All representatives managed to improve their results up to 10.00−12.04 times (p≤0.01).

When assessing the explosive power of the legs, the result of the "standing long jump" test by the absolute values of young men of all EGs ranged from 210.94 to 220.09 cm. Comparison of indicators at the initial level did not show statistically significant advantages of some group over their colleagues. Finding out the relative values indicated an improvement in the intragroup scores in this test. Upon completion of PE, the results were 218.90−223.52 cm.

As for the test "throwing a stuffed ball", during the implementation of the author's programme of swimming lessons for university students, the representatives of the formed EGs managed to significantly increase the level of its results from 375.48-416.74 cm to 392.18−427.74 cm (p≤0.01).

At the same time, the indicators of the "squat for 30 s" test were noted at an unsatisfactory level at the beginning of the study (12.17-13.67 times). However, after the expiration of the program at different individual and motivational levels, statistically significant changes p≤0.05−0.01 were detected, the absolute results were 15.00−15.81 times.

The results of throwing a tennis ball at the target at the beginning of the pedagogical experiment were 5.88−6.14 times and at the end – 6.24−7.00 times. Thus, at the group and intragroup levels, almost no statistically significant changes were found (p>0.05). Among the exceptions were young men of the fourth EG, who during the implementation of the programm of pedagogical experiment managed to achieve an increase in results by 16.67% (p≤0.05).

The results of angle body test among young men at the beginning of PE were 5.92−6.78 cm and during the implementation of training programmes only in two cases of 4EG, 2EG statistically significant feasible improvements were observed.

Analysis of data among girls showed similar trends in physical fitness as regards most indicators.

In particular, the absolute indicators of the handgrip test of the dominant hand ranged from 22.31 to 26.14 kgf and of the other – 19.69−23.00 kgf at the beginning of the study. Thus realization of author's programmes of swimming training system at various individual and motivational levels showed statistically significant intra-group changes ($p \leq 0.05-0.01$) and improvement of absolute values of results to 24.54−27.90 kgf (dominant hand), and 21.15−24.39 kgf (the other hand).

Establishment of the general initial preparedness level of KSU students, who took part in the study, testified low results in the «100 m run» test (from 15.41 to 15.77 s). According to the results of programmes implementation, the girls of all EGs statistically significantly improved their results to 15.30−15.33 s ($p \leq 0.05$).

The study of dexterity results (shuttle run 4x9m) indicated a below average level of fitness at the beginning of the study (11.53−11.75 s). The implementation of training programmes resulted in a significant improvement of test indicators (11.41−11.60 s) at the end of the study.

According to the strength endurance data (flexion-extension of the arms in plank position), the young women showed results in the range of 14.43−15.62 times at the beginning of the study and 15.61−16.81 times after its completion. This made it possible to show a significant increase in fitness for this component of fitness conditioning (Hlukhov, 2021b).

According to the data on strength endurance (push-ups in plank position) after the study, young women achieved results from 14.61 to 16.81 times. Thus, this component of fitness conditioning also demonstrated an overall increase in the preparedness of the studied girls.

Digital data obtained from the analysis of the test "Squats in 30 s" (strength endurance of the abdominal and torso muscles) at the beginning of PE, showed that the results of girls averaged from 17.52 to 17.74 times. After PE in all without exception EGs, these values were improved to 19.00−19.81 times ($p \leq 0.05-0.01$). Upon completion of PE, none of the EG was able to form a statistically significant advantage over other groups of girls.

In the test "bent suspension" (static strength endurance), the absolute values were significantly lower than the standard ones. The duration of the correct performance of the test for all groups of students ranged from 12.46 to 15.05 s at the start of study. At the same time, after its completion, the situation significantly improved, because the results ranged from 17.04 to 19.67 seconds. This testified to the effectiveness implementation of author's training programs of swimming training system of different individual and motivational levels.

Studying the results of "pull-ups" test on the low bar until failure indicated mostly homogeneity of the results at the start of study (11.23−13.48 times). In the process of conducting a pedagogical experiment, EG participants managed to improve the results. This, in turn, led to the fixing of absolute values of group averages at the level of 12.61-14.71 times.

In results of the "standing long jump" test it was fixed that the absolute values of the average results of students in all groups before the pedagogical experiment ranged from 166.09−168.57 cm. There was a statistically significant improvement in all groups of young female (the average results of the group were 12.61-14.71 times) compared to baseline (Hlukhov, 2021b).

Analysis of special strength endurance (according to the results of the squat test for 30 s) indicated a general low level, the absolute values ranged from 12.09 to 14.14 times. During PE, all EG girls managed to improve their results at a significant level ($p \leq 0.05$) and demonstrated the values at the level of 13.46−15.33 times.

Determination of coordination abilities (throwing a tennis ball at a target) made it possible to establish similarities in the results of girls at the beginning of the study (5.03−5.13 times) and after it (5.21−6.00 times). At the same time, we did not record statistically significant changes ($p > 0.05$) in the studied groups.

Relative homogeneity was observed in the established results of spinal mobility of girls of all groups (8.09−9.00 cm) in the initial testing ("forward bend"). During PE, the results significantly ($p \leq 0.05$) improved in all groups of girls and ranged from 9.39 to 10.29 cm.

Due to the application of author's training programmes of the swimming training system in physical education at the university, we received the following percentage changes in the results of muscular endurance tests (Fig. 1−4).

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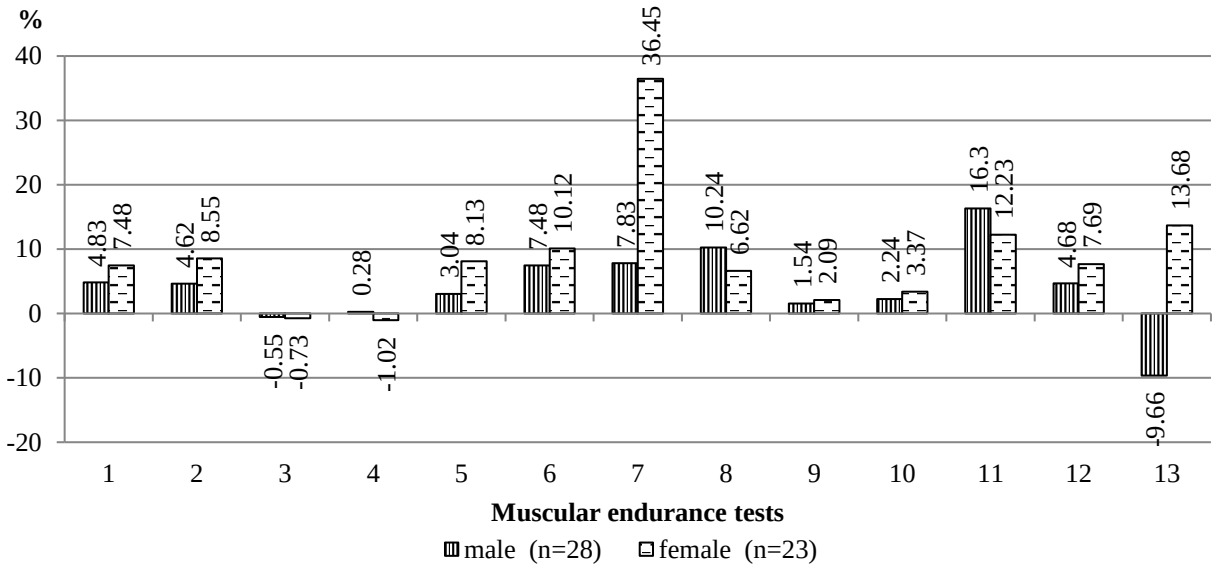

Fig. 1. Percentage changes in the results of muscular endurance tests at the first individual and motivational level of the swimming training system of university students: 1 – handgrip test dominant hand; 2 – handgrip test other hand; 3 - 100 m run; 4 - shuttle run (4x9 m); 5 – flexion-extension of the arms in plank position; 6 – sit-up; 7 – bent suspension; 8 – pull-ups; 9 – long jump; 10 – throwing a stuffed ball; 11 – squats for 30 s; 12 – throwing a tennis ball at the target; 13 – angle body.

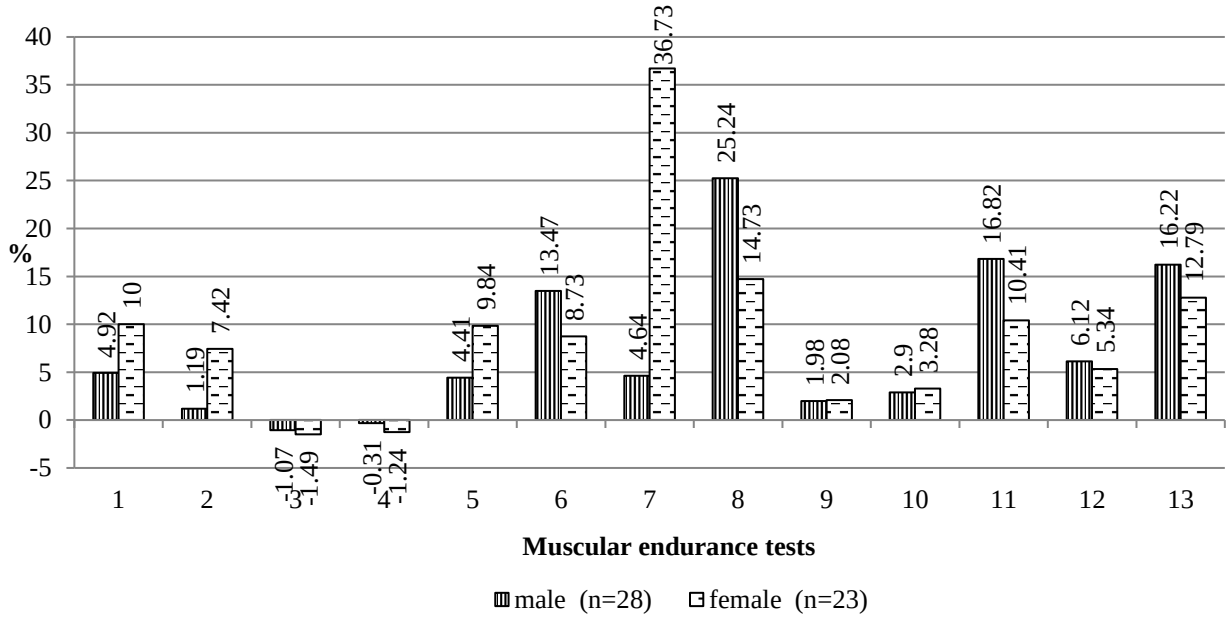

Fig. 2. Percentage changes in the results of muscular endurance tests at the second individual and motivational level of the swimming training system of university students: 1 – handgrip test dominant hand; 2 – handgrip test other hand; 3 - 100 m run; 4 - shuttle run (4x9 m); 5 – flexion-extension of the arms in plank position; 6 – sit-up; 7 – bent suspension; 8 – pull-ups; 9 – long jump; 10 – throwing a stuffed ball; 11 – squats for 30 s; 12 – throwing a tennis ball at the target; 13 – angle body.

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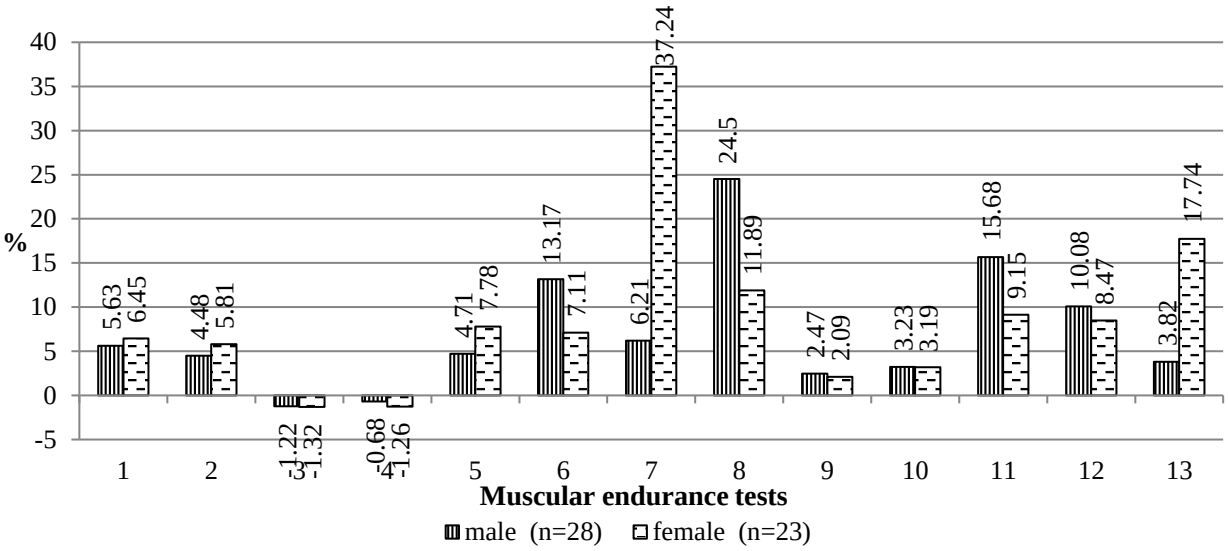

Fig. 3. Percentage changes in the results of muscular endurance tests at the third individual and motivational level of the swimming training system of university students: 1 – handgrip test dominant hand; 2 – handgrip test other hand; 3 - 100 m run; 4 - shuttle run (4x9 m); 5 – flexion-extension of the arms in plank position; 6 – sit-up; 7 – bent suspension; 8 – pull-ups; 9 – long jump; 10 – throwing a stuffed ball; 11 – squats for 30 s; 12 – throwing a tennis ball at the target; 13 – angle body.

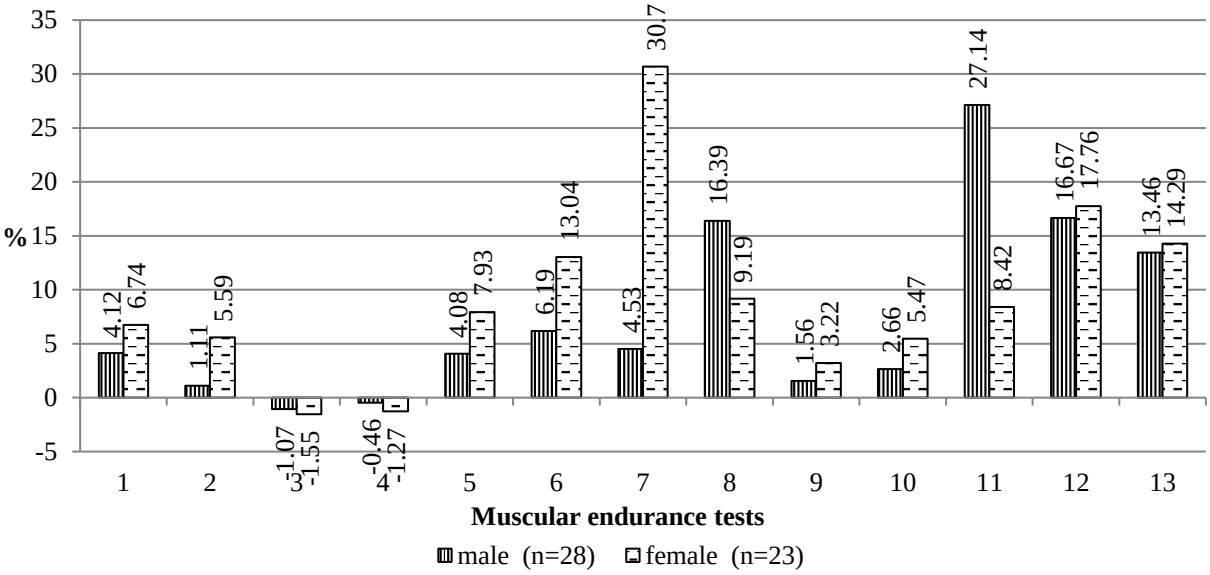

Fig. 4. Percentage changes in the results of muscular endurance tests at the fourth individual and motivational level of the swimming training system of university students: 1 – handgrip test dominant hand; 2 – handgrip test other hand; 3 - 100 m run; 4 - shuttle run (4x9 m); 5 – flexion-extension of the arms in plank position; 6 – sit-up; 7 – bent suspension; 8 – pull-ups; 9 – long jump; 10 – throwing a stuffed ball; 11 – squats for 30 s; 12 – throwing a tennis ball at the target; 13 – angle body.

Discussion

The most topical issue in the educational process is the lack of scientific and methodological support for teaching swimming to students. Mastering the basic skills of swimming makes it possible to reduce the incidence of diseases among students, increase motor activity, encourage physical exercise, etc. (Tanaka, 2009; Roj, Planinšec, & Schmidt, 2016; Monteiro, Araújo, Mazzardo, Francisco, Ribas, & Aburachid, 2021).

The formation of a proper system of swimming motor actions depends on the development of functional capabilities, state of physical and psychological readiness (Bergamin, 2013, Callaway, 2015; Chaplinskyy, Briskin, Ostrovska, Sydorko, Ostrovskyy, Pityn, & Polehoiko, 2018).

Information search revealed many options and algorithms for building the process of teaching swimming techniques. This indicates the lack of a possible unified methodological approach and the need to empirically find the optimal ratio of the combination of teaching swimming to students with different initial capabilities (functional and physical) when studying at the university (Ceseracciu, Sawacha, Fantozzi, Cortesi, Gatta, Corazza, & Cobelli, 2011; Callaway, 2015).

Applying a differentiated approach to swimming training requires a quality selection of tools and methods. When applying this technique, it was noticed that in the presence of an unsatisfactory level of functional state, physical fitness and the presence of certain diseases during immersion in water, many students experienced increased heart rate, respiration rate, etc. This, in turn, led to dangerous situations (cases of loss of balance, falls, spluttering) (Hruzevych, Bohuslavska, Kropta, Galan, Nakonechnyi, & Pityn, 2017).

What is more, the ability to swim is determined by the inborn abilities of an individual, manifested in the ability to adapt to the aquatic environment, quickly learn the peculiarities of exhalation into the water, "feeling" of the water, the ability to rearrange the structure of movements in unfamiliar aquatic environment, etc. (Troup, 1999; Tanaka, 2009; Roj, Planinšec, & Schmidt, 2016).

Other scientists suggest considering the individual characteristics of representatives of different groups of population in promoting the motor development, ensuring the mastery of swimming movements. This involves a certain step-by-step acquaintance with the system of movements in general, demonstration of elements of swimming technique with a brief analysis of the technique of movement performance, explanation of motor tasks and possible errors, direct practical performance, etc. (Bergamin, 2013; Hlukhov, 2021a, 2021b).

We believe that the improvement of the results of handgrip test of young men and women in most experimental groups indicates the implementation of means and tasks of university physical education, the involvement of these muscle groups in the exercise, regardless of the specifics of the study programme. This testifies to the observance of the basic direction within the programmes of classes at different individual and motivational levels of the swimming training system of university students. It has been proved that in the process of implementation of one stage (individual and motivational level) of the swimming training system, significant shifts of the results of handgrip test could be achieved only at the intragroup level. Longer developmental influences were probably needed to achieve higher efficiency at the intergroup level (Tanaka, 2009; Roj, Planinšec, & Schmidt, 2016).

The detected changes in the speed demonstrations of students of different groups were quite predictable. This is due to the fact that the initial level of fitness was low, and systematic developmental influences allowed the neuromuscular system to adapt qualitatively to the load of this type.

It is also not worth expecting significant changes due to the applied programmes in the development of dexterity. Probably this quality requires more concentrated developmental influences, as indicated by physical education specialists (Tanaka, 2009). However, under the influence of author's programmes we note normalization and growth to the standard average level.

The study shows a pronounced effectiveness of the proposed training programs for swimming university students, but at the same time, students' results were closely intertwined with their initial level of fitness and partially and gradually adjusted in the process of succeeding along the hierarchy of the proposed stages of training.

We insist on the effectiveness of research tools (based on swimming characteristics) for the development of strength endurance in the muscles of young men's hands. It is because of most of the specific exercises suggested within the training programmes involved performing motor activities in the water, i.e. with the resistance.

We consider it positive and expected that during the period of the pedagogical experiment the boys and girls of all without exception EGs managed to statistically significantly improve their results by the test "standing long jump". This, in our opinion, indicates the soundness of the applied muscle loading both within the framework of the traditional program of physical education and within the framework of author's programs, which took into account individual and motivational levels of the swimming training system for university students.

The content of the experimental programs of the swimming training system of the university students on the manifestations of spinal mobility in girls proved to be more effective in comparison with the traditional curriculum according to the results of pedagogical experiment.

Conclusions.

The data obtained during the study testify to the effectiveness of the methodological approach, which provides for the differentiation of swimming programs for boys and girls according to the level of swimming skills based on four individual and motivational levels of swimming in university physical education.

The effectiveness of the author's swimming programs for university students is confirmed by the growth of their physical fitness. The highest

level of growth in the studied groups obtained by the indicators of tests that characterize the level of manifestation of strength qualities (dynamic and static strength endurance of different muscle groups, explosive power). Significant changes have also taken place in demonstration of flexibility and speed qualities.

Conflict of interests

The authors declare no conflicts of interests with respect to the research, authorship and publication of this article.

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