ORIGINAL ARTICLE

CONTENTS

Improvement of the functional and psycho-emotional state of female students in the process of their swimming training sessions

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ABSTRACT

Aim: To investigate the impact of swimming training sessions on the functional and psycho-emotional state of female students in the process of their studying under martial law.

Materials and Methods: The research, conducted in 2024-2025, involved 85 female students aged 17-18 in the first year of study. The experimental (EG, n = 42) and the control (CG, n = 43) groups were formed. The EG female students attended a swimming sports club; the CG female students were engaged in a traditional physical education program. Methods: analysis and generalization of literary sources; Harvard step test; methodology for assessing adaptive potential; body mass index; stress level test; methods of mathematical statistics.

Results: It has been found that during the research period, the EG female students improved the adaptive potential of the cardiovascular system (by 0.09 c. u.), increased their Harvard step test indicators of the speed of recovery processes in the body after physical exertion (by 4.3 c. u.), and reduced the level of stress (by 3.0 points), while in the CG female students no changes in the studied indicators were recorded. At the end of the research, most of the studied indicators of the EG female students were significantly ($p \leq 0.05$) better than in the CG.

Conclusions: After orienteering training sessions, the EG high schoolers showed a significant improvement in physical health indicators, which confirms the enhanced health-improving effect of this type of motor activity in the natural environment.

KEY WORDS: female students, motor activity, swimming, functional state, psycho-emotional state, stress, health, martial law

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INTRODUCTION

The difficult realities of modern life in Ukraine under martial law lead to the accumulation of negative emotions and feelings, increasing the psycho-emotional pressure on students' personalities. The intensification and application of various forms of organizing the educational process at universities, the emergence of a lack of motor activity during study, worsens the functional state of students, significantly reducing the physiological resources of the body. The first year of studying at higher educational institutions is difficult, causing a change in the usual household and motor regime, excessive stress on the cognitive functions and mental sphere of students, and therefore causes the manifestation of academic stress, which can negatively affect their physical and mental health [1, 2].

The biological aspect of students' learning activities in the conditions of martial law stressors involves the economical use of the body's functional reserves to preserve health, which ensures the full functioning of the body's major systems and maintaining optimal performance in the face of increased energy consumption during study, independent work, and examination sessions. The proper level of performance of educational activities in the conditions of increased stressfulness of the educational environment is associated with the adaptive capabilities of the students' body [3, 4]. The power of regulatory systems and mobilization of functional reserves determines the adaptive potential of the body. The role of the cardiovascular system in adapting the human body to the negative effects of the stressful environment

has been proven, and the informativeness of heart rate variability indicators in diagnosing the adaptive capabilities of the students' body in learning has been confirmed [5]. Scientists [6] consider the level of functioning of the circulatory system as a leading indicator of the balance between the body and the environment. The heart's functional reserve impacts the body's resistance to physical and psycho-emotional stress. Since functional reserves include the range of activation of the capabilities of physiological systems, and their depletion leads to a failure of the adaptive mechanism, the level of vegetative changes in the parameters of the cardiovascular system, taking into account morphological data, can be used to assess the adaptive potential of the body [7]. Scientists [8] point to the importance of the functional capabilities of the cardiovascular system in the adaptation process and resistance to stressors.

Therefore, the implementation of health-improving tasks in the process of physical education in the system of higher education of Ukraine should be approached from the standpoint of the theory of adaptation, since the adaptive capabilities of the body determine the degree of individual health of students, which has deteriorated greatly in recent years, especially during the war [9-12]. It is known that the most effective and rational means of improving the adaptive capacity of the human body is aerobic motor activity, which affects all physiological systems of the body, especially the cardiovascular system. At the same time, it is important to assess the effectiveness of the exercise in reducing stress levels. This is of strategic importance and actualizes the use of such types of motor activity that can simultaneously maintain and improve students' functional and psycho-emotional state.

AIM

The aim is to investigate the impact of swimming training sessions on the functional and psycho-emotional state of female students in the process of their studying under martial law.

MATERIALS AND METHODS

The research, conducted in 2024-2025, involved 85 female students aged 17-18 years of the 1st academic year at the Ukrainian State Dragomanov University (USDU, Kyiv, Ukraine), specialty: 015 Vocational Education and 035 Philology. To test the effectiveness of physical exercises on maintaining and improving female students' functional and psycho-emotional state, we formed the experimental (EG) and the control (CG) groups solely at their own will. The experimental group included 42 female students, the control group – 43 female students, all of whom had no significant health problems. The EG girls attended the swimming training sessions twice a week for 2 academic hours; all involved female students knew how to swim. The girls of the CG were engaged in the traditional physical education program in the same amount. At the same time, the level of their weekly motor activity in extracurricular time was not studied.

Research methods: analysis and generalization of literary sources; Harvard step test; R. M. Bayevsky's methodology; body mass index; stress level test; methods of mathematical statistics. The Harvard step test was used to study the physical performance of the cardiovascular system by measuring the speed of recovery processes in the body after aerobic exercise. The step test is based on climbing a 50-centimeter-high bench with a frequency of 30 cycles per minute (120 steps) for 5 minutes. The formula determined the Harvard step test index (HSTI): HSTI = 100 x t / 5.5 x n, where t is the time of ascent in seconds; n is the heart rate for the first 30 seconds of the second minute of recovery. The level of physical performance was assessed as low if the HSTI was less than 55 c. u., below average – 55-64 c. u., average – 65-79 c. u., above average – 80-89 c. u., high – 90 c. u. and more. The methodology of R. M. Bayevsky was used to assess the adaptive potential of the cardiovascular system, based on the consideration of prognostically significant morphological parameters. The length (L, cm) and body mass (m, kg), heart rate (bpm), systolic (SBP, mm Hg) and diastolic blood pressure (DBP, mm Hg), and age (years) of the studied female students were determined. The formula calculated the value of adaptive potential (AP): AP = 0.011 x HR + 0.014 x SBP + 0.008 x DBP + 0.014 x age + 0.009 x m + 0.009 x L – 0.27. The state of functional adaptability of female students' body was evaluated according to a certain gradation: sufficient functional capabilities of the body with satisfactory adaptation to environmental conditions (1.50-2.59 c. u.), functional tension of the body with increased activation of adaptation mechanisms (2.60-3.09 c. u.), decrease in functional capabilities of the body with unsatisfactory adaptation of functional systems to environmental conditions (3.1-3.6 c. u.), sharp decrease in functional capabilities of the body on the verge of failure of adaptation mechanisms (3.6 and more c. u.). To assess the risk of cardiovascular disease, the body mass index (BMI) was used, which was calculated by the formula: BMI = m / L^2 [kg/m^2]. Norms of BMI: if BMI < 18.5, then body

Table 1. Characteristics of the indicators of the functional and psycho-emotional state of the EG and the CG female students at the beginning of the pedagogical experiment (M ± m)

Indicators under study	EG (n = 42)	Level under the norm	CG (n = 43)	Level under the norm	The difference	t / p
HSTI, c. u.	67.5 ± 1.61	average level	66.8 ± 1.55	average level	1.1	0.49 / > 0.05
AP, c. u.	2.12 ± 0.08	satisfactory adaptation	2.14 ± 0.09	satisfactory adaptation	0.02	0.17 / > 0.05
BMI, kg/m^2	21.6 ± 0.37	normal body mass	21.7 ± 0.41	normal body mass	0.1	0.18 / > 0.05
SL, points	13.5 ± 1.14	severe stress	14.1 ± 1.21	severe stress	0.6	0.36 / > 0.05

Legend: M – arithmetic mean, m – error of the arithmetic mean, t – Student's t-test value, p – statistical significance indicator
Source: compiled by the authors of this study

Table 2. Characteristics of the indicators of the functional and psycho-emotional state of the EG and the CG female students after the pedagogical experiment (M ± m)

Indicators under study	EG (n = 42)	Level under the norm	CG (n = 43)	Level under the norm	The difference	t / p
HSTI, c. u.	71.8 ± 1.65	average level	66.9 ± 1.57	average level	4.9	2.15 / ≤ 0.05
AP, c. u.	2.03 ± 0.07	satisfactory adaptation	2.13 ± 0.08	satisfactory adaptation	0.1	0.94 / > 0.05
BMI, kg/m^2	21.2 ± 0.31	normal body mass	21.9 ± 0.45	normal body mass	0.7	1.28 / > 0.05
SL, points	10.5 ± 1.16	moderate stress	13.9 ± 1.18	severe stress	3.4	2.05 / ≤ 0.05

Legend: M – arithmetic mean, m – error of the arithmetic mean, t – Student's t-test value, p – statistical significance indicator
Source: compiled by the authors of this study

mass is insufficient, BMI is in the range from 18.5 to 24.9 – body mass is normal; BMI is in the range from 25.0 to 29.9 – body mass is overweight, which is a risk of cardiovascular disease; BMI > 30 is a sign of obesity. To determine the stress level (SL), we used the methodology of Yu. V. Shcherbatykh, which is a questionnaire that allows you to explore various signs of stress – intellectual, behavioral, emotional and physiological and determine the overall level of stress. A female student could receive from 0 to 66 points based on the answers to the questions. The data obtained as a result of the survey indicate absence of stress at this point in life (0-5 points); the fact that the female student is experiencing moderate stress, which can be compensated for in the process of rational use of time, healthy rest and finding a rational way out of a problem situation (6-12 points); rather severe stress that could not be compensated for, and the resulting severe psycho-emotional stress of the body, which arose in response to it and determines the need for special methods of overcoming stress (13-24 points); a state of severe stress, for the successful overcoming of which psychological assistance is desirable (25-40 points). The latter level (over 40 points) indicates that the body is already having difficulty resisting stress, or that the body is moving to the third, most dangerous stage of stress – depletion of adaptive energy reserves.

The statistical processing of the results was performed using the methods of variation statistics. Before the experiment, both groups of girls were tested for normality of distribution using the Kolmogorov-Smirnov test in IBM SPSS Statistics 23.0. The samples were found to be subject to the normal distribution law, which allows for statistical calculations using Student's t-test. The digital data of the studied indicators were presented in the form (M ± m), where M is the arithmetic mean and m is the error of the arithmetic mean. The reliability of the difference between the indicators of students of the studied groups was determined using Student's t-test. The level of statistical significance of the research results was chosen as 5 %, that is, the reliability of the difference between the studied indicators is p ≤ 0.05. Girls' EG and CG groups were homogeneous (p > 0.05), which was confirmed by the absence of a significant difference between the studied indicators of the functional and psycho-emotional state at the beginning of the experiment.

The research implementation process is built following the requirements of scientific ethics. The USDU Academic Ethics Commission approved the research. The pedagogical experiment lasted 9 months of the

2024/2025 academic year (September-May), was open, female students were informed about its aim and tasks, and they voluntarily participated in it.

RESULTS

The results of the study of the functional and psycho-emotional state level of the EG and the CG female students in terms of their HSTI, AP, and BMI, and SL at the beginning of the experiment are presented in Table 1.

It has been established that at the beginning of the experiment, there was no significant difference between the EG and the CG female students in terms of indicators of the body's functional state ($p > 0.05$). The average group data of the studied indicators in the girls of both groups indicate satisfactory adaptation of the cardiovascular system, an average level of physical performance, and normal body mass under the defined norms. It has been found that the 1st year female students are characterized by severe stress and the resulting pronounced psycho-emotional stress of the body, which arises in response to it and determines the need for special methods of overcoming stress, particularly organized motor activity.

To maintain and improve the functional and psycho-emotional state of the EG girls, swimming training sessions were offered as a fairly popular type of motor activity. Swimming training sessions were held in the USDU indoor pool, 25 meters long, containing 6 lanes. Swimming is a cyclic type of aerobic motor activity. Since the volume and intensity of muscle activity in the process of swimming can vary widely (from a stationary position in the water to performing exercises at maximum speed, at which the HR can increase to 160-180 beats per minute), it can be used for female students with different levels of physical health and fitness. Musical accompaniment contributes to a high emotional level of training sessions, a huge arsenal of tools and methods for performing exercises in water provides opportunities for exercising both individual muscles and various muscle groups.

The swimming training session consisted of three parts: preparatory (warm-up on land – 10-15 minutes), main (aqua fitness exercises 15-20 minutes + distance swimming 35-40 minutes), and final (5-15 minutes), each of which has its purpose. The preparatory part was aimed at preparing the body for the main load. It included general developmental exercises to warm up the working muscles and joints on land (exercises for the muscles of the neck, shoulder girdle, torso, legs, exercises for mobility of the shoulder, hip, and ankle joints, etc.). The main part of aqua fitness exercises planning included mainly aqua aerobics and aqua power exercises. It involved the performance of cyclic and acyclic aerobic and strength exercises with and without additional equipment or weights to develop speed, strength of coordination muscles. Different starting positions, intensity of performance, use of additional weight, etc., provide the variability of pedagogical influence. Distance swimming included swimming exercises using sports, mixed and original methods in different training modes, with full coordination of movements and coherence with breathing, and by elements (swimming with a board on hands or feet, swimming with blades, swimming in flippers, and swimming under water). The goal of distance swimming was to increase aerobic, speed, and strength endurance, as well as coordination and strength endurance. The swimming intensity for female students was planned to be moderate (at a heart rate of 130-170 beats per minute), with the distance segments of 50-400 m. Swimming at a moderate pace was planned to be of a greater volume and vice versa. With the growth of training in the process of systematic training sessions, they tried to increase the total distance. The final part contained exercises that promote the recovery of the body after physical exertion: breathing exercises, relaxation exercises, stretching, hydromassage, sliding, and lying on the water.

At the end of the experiment, a follow-up assessment of the functional and psycho-emotional state indicators was conducted among the EG and the CG female students, and their homogeneity was examined (Table 2).

A significant improvement in physical performance (by 4.3 c. u., $p \leq 0.05$), adaptive potential (by 0.09 c. u., $p > 0.05$), reduction of stress level (by 3.0 points, $p \leq 0.05$) and body mass index (by 0.4 kg/m^2, $p > 0.05$) was found in female students who were engaged in swimming during the academic year. There were no significant changes in any studied indicators in the CG female students ($p > 0.05$).

It has been found that after the experiment, the EG female students have significantly better indicators of physical performance (by 4.9 c. u.) and lower indicators of stress level (by 3.4 points) than the CG female students ($p \leq 0.05$). At the same time, the differences between the indicators of adaptive potential of the cardiovascular system and body mass index in the EG and the CG female students were not significant ($p > 0.05$). It should be noted that swimming training sessions contribute to a significant reduction in stress levels, in particular, the differences in stress levels in the EG and the CG female students were significant: the stress level of the girls who were involved in swimming training sessions decreased to a moderate level, and in

the girls who were involved in the traditional physical education program remained at the level of severe stress. Thus, the results of our research showed that swimming training sessions have a high health effect, contribute to the maintenance and improvement of the functional and psycho-emotional state of female students during their studies at higher educational institutions under martial law.

DISCUSSION

The academic stress of the 1st year students and the challenges of martial law significantly impact physical and mental health, accelerating the consumption of energy resources, depleting the body's functional reserves. The stock of functional reserves of the body measures its adaptive capabilities, which ensure the adaptation of physiological systems to changes in the usual motor regime, increased neuropsychic stress, overload of the cognitive and volitional spheres in the educational environment [2, 13].

The cardiovascular system, with its regulatory apparatus, is considered the most sensitive indicator of an individual's adaptive capabilities to physical and psycho-emotional stress. Adaptive capacities and physical performance are interrelated and characterize the body's ability to quickly and efficiently restore functional resources and compensate for energy expenditure [5, 14, 15]. It is generally recognized that the level of physical performance is one of the most important criteria for assessing somatic health, characterizing the state of the cardiovascular system as the basis of life support [16, 17]. Scientists [18] have proven that the level of cardiovascular system functioning depends on stress and body weight. Stress, especially prolonged stress, can lead to increased blood pressure, changes in heart rate, and an increased risk of developing cardiovascular disease, and being overweight has an increased impact on the functioning of the heart, depleting it more quickly. Therefore, to assess the adaptive capabilities of students' bodies to academic stress, we chose indicators that characterize physical performance, the speed of recovery processes, stress levels, and body mass as a marker of cardiovascular disease risk.

Among the various types of motor activity that positively affect the cardiovascular system's functioning, aerobic exercise has the highest effect – it helps to strengthen the heart muscle, increase the volume of stroke output, reduce resting heart rate, and improve blood circulation. Swimming refers to aerobic exercise of relatively low intensity, performed for a long time with the same heart rate and respiration rate [19]. The effectiveness of swimming training sessions in improving the health of people of different ages and genders has been studied by many scientists [20-22]. The results of our research confirmed these conclusions and expanded them based on studies of the health-improving effect of swimming training sessions for the 1st year female students during the war in Ukraine.

In the course of the pedagogical experiment before distance swimming aimed at the development of general and special types of endurance – aerobic, speed and strength, and coordination, we additionally introduced elements of aqua fitness to develop speed and strength of muscles, coordination of movements, and mobility in joints. At the same time, the training sessions provided musical accompaniment. The effectiveness of the proposed content of the training sessions was confirmed by a significant increase in the physical performance of the cardiovascular system, a decrease in the level of stress of the EG female students, and a significant improvement in their adaptive potential and a decrease in body mass.

CONCLUSIONS

It has been found that during the research period, the EG female students improved the adaptive potential of the cardiovascular system (by 0.09 c. u.), increased the Harvard step test indicators by the speed of recovery processes in the body after physical exertion (by 4.3 c. u.), and decreased the level of stress (by 3.0 points) and body mass index (by 0.4 kg/m^2), while the CG female students did not show any changes in the studied indicators.

At the end of the experiment, the EG female students showed significantly better indicators of physical performance (by 4.9 c. u.) and lower stress levels (by 3.4 points) than the CG female students ($p \leq 0.05$). At the same time, the differences between the indicators of the adaptive potential of the cardiovascular system and body mass index in the EG and the CG female students were not significant ($p > 0.05$). Herewith, the stress level in the EG female students decreased to a moderate level, and the CG remained at the severe stress level.

The research results indicate that systematic swimming training sessions as a cyclic and aerobic type of motor activity have a high health-improving effect, contributing to the improvement of the functional and psycho-emotional state of female students during their studies under martial law.

PROSPECTS FOR FURTHER RESEARCH

Prospects for further research will be aimed at studying the impact of non-traditional types of motor activity on maintaining and improving the functional and psycho-emotional state of students under martial law.

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CONFLICT OF INTEREST
The Authors declare no conflict of interest

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