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Physical Education Methods of Various Directions Application for Female University Students with Cardiorespiratory Diseases

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Abstract: *Background: The effectiveness of physical exercise in treating cardiorespiratory diseases is well established. Systematic training can lead to changes in morphofunctional markers; however, the degree of effectiveness varies based on the type of exercise, the intensity of the activity, as well as the age, gender, and overall health of the individual. The purpose of the research: To determine and to develop the impact of fitness activities and specialized breathing exercises on the morphofunctional state of female students with cardiorespiratory diseases. Materials and Methods: The study involved 53 female students from Lviv University of Trade and Economics, aged 18 to 19, who had cardiorespiratory diseases. Participants were randomly assigned to two groups: the experimental group (nEG=25) and the control group (nCG=28). The control group followed the traditional physical education (PE) program designed for students in special medical groups. This program included physical therapy classes, recreational walking, running, and gymnastics. The experimental group participated in individualized fitness programs that combined basic aerobics with breathing exercises for oriental martial arts. The primary markers for assessment included anthropometric measurements, indicators of the cardiovascular and respiratory systems, levels of physical development, and self-evaluations of psycho-emotional wellbeing. The experimental group was engaged in performance of the developed individualized fitness programs using basic aerobics combined with sets of breathing exercises for oriental martial arts. The main markers were anthropometric ones, those of the cardiovascular and respiratory system, physical development and self-assessment of the psycho-emotional state. Results: The results indicate that the experimental program significantly improves various health markers, including body mass index, circumferential measurements, thoracic excursion, heart rate, blood pressure, Robinson index, lung vital capacity, respiratory rate, vital index, and recovery time following a functional test. Conclusion: The recorded and statistically analyzed results indicate that a basic aerobics program combined with specific breathing exercises for oriental martial arts is effective. This program improves the studied markers and contributes to positive changes in the morphofunctional profile. These changes are significant for enhancing the health status of female students with cardiorespiratory diseases.*

Keywords: *university, female students; cardiorespiratory diseases; exercise program; morpho-functional and physical condition.*

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Introduction

Cardiovascular diseases (CVDs) are the most prevalent health issue worldwide. In the United States alone, around 84 million people are affected by CVDs (Lackland et al., 2014; Tsao et al., 2023). These diseases are a major cause of disability, and healthcare costs associated with them are rising in many European countries. As a result, preventing cardiovascular diseases has become a key priority in today's social development (Pearson et al., 2002). An analysis of the health of the population in Ukraine reveals a decline in life expectancy and an increase in the prevalence of diseases, with cardiovascular diseases having the highest rates among European countries. In 2015, circulatory system diseases accounted for 31% of all diseases in Ukraine. Among adults aged 18 and older, this figure rose to 37%, while it was 24% among the working-age population and reached 51% among those over the working age, (Dyachuk et al., 2018). Cardiovascular diseases (CVDs) are recognized as a significant global health issue that imposes a substantial economic burden on society, (Kaminsky et al., 2019). It is concerning that a considerable number of individuals in the student-age population are affected by these conditions (Lukovska & Sologubova, 2011; Barasa et al., 2014).

A study (Pans et al., 2021) showed that the level of physical activity of students does not meet the recommendations of the World Health Organization. The American College Health Association (2019) reported that approximately 38% of college students reported being overweight (Body mass index at least 25 or higher). The high body mass index is a predictor of many diseases, including cardio-respiratory ones. Besides, the number of students with disabilities pursuing higher education has been increasing over the past years. Especially relevant in this respect are the settings in which people with disabilities participate and can be effectively targeted. Potentially, one of the suitable settings to tailor physical activity promotion strategies is the university. University settings are socio-psychological context that can reduce health disparities in students with disabilities. Students with multiple disabilities, chronic illnesses, acquired disabilities, older students and women are less active. Some studies have found that gender is an important correlate of physical activity among people with disabilities, because women frequently report less physical activity than men (Valis & Gonzalez, 2017). Therefore, the relevance of the study is due to the need to

develop and implement in universities effective means of physical education of various directions, which in terms of physical load would be adequate to the nosological characteristics of students and positively affect their morpho-functional state.

Recent studies have demonstrated that physical exercise is effective for both the primary and secondary prevention of cardiovascular disease (CVD) (Lindgren et al., 2021). Observational studies have shown a link between regular exercise and a reduced risk of CVD, particularly in populations that previously did not have this condition (McKinney et al., 2016). Additionally, data on secondary prevention indicate that engaging in physical activity can lead to a lower relapse rate for individuals recovering from CVD (Alter et al., 2009).

Regular physical exercise has been proven effective in reducing risks associated with cardiovascular diseases. It helps lower blood pressure (Grace et al., 2018), regulate blood glucose levels (Higgins et al., 2015), manage body fat, and promote weight loss (Maillard et al., 2018). Additionally, physical exercise can enhance the body's cardiorespiratory function (Kessler et al., 2012). Physical exercise can help reduce the incidence of cardiovascular disease (CVD) and enhance overall quality of life, mood, activity level, and wellbeing (Pelliccia et al., 2021; Szabo, 2021). During adolescence, cardiorespiratory fitness is a key predictor of both physical and mental health, and it also contributes to improved academic performance (Agostinis-Sobrinho et al., 2022).

Training programs primarily focus on endurance, as well as static and aerobic exercises. Aerobic exercises can be performed at low, medium, or high intensity. However, there is currently no international consensus among scientists on the best choice of exercise intensity. The United States and Canada tend to favor moderate to high-intensity sports training, while Australia and Japan prefer low- or moderate-intensity training (Price et al., 2016). European guidelines for preventing cardiovascular disease and managing patients with cardiovascular conditions recommend moderate-intensity continuous aerobic training, emphasizing a high level of safety (Piepoli et al., 2016). Recent research has highlighted the advantages of high-intensity aerobic training, which is often more effective and requires less time compared to longer, monotonous moderate-intensity aerobic training (Weston et al., 2014; Conraads et al., 2015; Aksovic et al., 2020). This approach necessitates continuous monitoring of the duration and intensity of exercise, as well as an individualized strategy for developing training programs (Palerm et

al., 2017).

The impact of physical exercises on biomarkers is most pronounced during late adolescence. Generally, the effectiveness of physical exercises varies based on exercise type, age, gender, and individual health status (Aksovic et al., 2020).

Randomized controlled studies and meta-analyses have indicated that both high and moderate exercise intensity can enhance cardiopulmonary function in individuals with cardiovascular disease, increase physical activity tolerance, and improve their quality of life (Zheng et al., 2022).

The cardiorespiratory function is the best indicator of the body's physiological state, and studying it often leads to new methods and forms of preventing cardiovascular diseases (Lee et al., 2010).

However, there are many arguments about the choice of techniques, methods, PE programs, training technologies, and effectiveness and safety of exercise performance, that would be adapted for students with cardiorespiratory diseases. This is in terms of their various directions and intensity, and use of modern programs in the process of physical education (PE) in higher education institutions.

Purpose of the research is to develop and to determine the impact of fitness activities and specialized breathing exercises on the morphofunctional state of female students with cardiorespiratory diseases.

Materials & methods

Subjects: The study involved 53 female students from Lviv University of Trade and Economics, aged 18 to 19, who had cardiorespiratory diseases. Among them, 79.2% were diagnosed with cardiovascular diseases, while 20.8% had respiratory conditions. The majority of students with cardiovascular issues were diagnosed with vegetative-vascular dystonia of mixed and cardiac types, accounting for 75.5% of that group. The doctor diagnosed all students based on data from medical control cards (form 061/O). All examined individuals were in remission and had medical clearance to participate in physical education within special medical groups.

The study participants (53) were randomly assigned to two groups: the experimental group (nEG = 25) and the control group (nCG = 28). The control group followed a traditional physical education program designed for students in special medical groups. This program

included physical therapy classes, recreational walking, running, and gymnastics. The experimental group (EG) participated in individualized fitness programs that incorporated basic aerobics along with elements of oriental martial arts (Exercise Program). Each training session lasted between 60 and 90 minutes and occurred twice a week.

The studies took place at Lviv University of Trade and Economics (Ukraine) during one academic year in the period from September 2020 to June 2021.

All classes followed the curriculum approved by university administration and were conducted with the oversight of the doctor. All female students who participated in the study were evaluated by a medical-educational committee, composed of cardiologists and a psychologist. Students agreed to participate in the study and were informed that they could refuse to take part without facing any consequences. The research conducted adheres to the requirements outlined in the Law of Ukraine "On Scientific and Scientific-Technical Activities" dated November 26, 2015, No. 88-VII and aligns with international ethical guidelines for health-related research involving humans (CIOMS, 2016). The research was conducted in accordance with basic bioethical norms WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Participants. Each of the participants was informed about the possibility of refusing to participate in the experiment without any consequences for herself.

Procedure: The study utilized the following research methods: theoretical analysis and synthesis of scientific and methodological literature, medical and biological methods (measurement of blood pressure, respiratory rate, pulse oximetry, spirometry and dynamometry), an anthropometric standards method, an index method and a method of sigma deviations to assess physical development, a test of differentiated self-assessment of functional state by V. Doskin's methodology (Zlyvkov et al., 2016). It was based on a questionnaire consisting of 30 bipolar scales grouped into three categories: 'wellbeing,' 'activity,' and 'mood.' Pedagogical observations and a comparative pedagogical experiment were conducted. Statistical methods were used for data collection, processing, and analysis, particularly, descriptive and analytical statistics.

Exercise Program. Individualized fitness programs that combine basic aerobics with elements of oriental martial arts offer a differentiated approach to exercising, utilizing low and medium impact

movements on the musculoskeletal system. They were performed to music without pauses for rest (stream work). The health-improving fitness programs differed in the workload, which was regulated by the duration of training sessions, as well as the number of exercise series and their repetitions. The intensity of the exercises was adjusted based on HRmax indicators. The program also included breathing exercises associated with oriental martial arts. It has been demonstrated that physical activity involves significant energy expenditure. Because there are limited anaerobic energy sources in the body, aerobic processes play the primary role in supplying energy. The intensity of these processes largely depends on the efficiency of the oxygen supply systems, i.e. the respiratory and circulatory systems. Involuntary control of breathing occurs through reflex mechanisms that help maintain homeostasis. Voluntary (targeted) changes in breathing can disrupt this homeostasis, allowing for training effects that expand the body's ability to adapt. Breathing influences the central nervous system, cardiovascular system, metabolic processes, and the organs in the abdominal cavity. Scientific research has shown that almost all physiological systems can be impacted by targeted changes in breathing (Solomen & Aaron, 2015; Zou et al., 2018). The review of scientific literature on the effects of specific breathing exercises from oriental martial arts on the cardiorespiratory system of female students during fitness classes with basic aerobics reveals a limited number of them available. At the same time, finding the positive effects of these empirically selected exercises would help justify their inclusion in the aerobics routine. This would aim to optimize both the physical and mental wellbeing of the participants. Focusing on intentional controlled breathing and the ability to change one's physical and emotional state through breathing manipulation demonstrates principles used in oriental martial arts as well as in breathwork practices. It is here where the convergence of these two seemingly different practices can be clearly observed. Breathing exercises such as hatha yoga exercises; 'nogare' breathing system and 'ibuki (breath)' specific breathing system - karate; breathing (energy) formal kata complexes - Tensho, Sanchin, Yantzu - Kyokushinkai karate, were utilized for 12 to15 minutes during each lesson, (Hamasaki, 2020). The program content was updated every three months. A heart rate monitor tracked throughout the class, allowing adjustments to the exercise load and intensity. When developing health-improving fitness programs, factors such as the disease's nature and extent,

morphofunctional indices, and the regulation of aerobic choreography and music, and etc. were also considered. Stretching exercises, autotraining techniques, and breathing exercises for oriental martial arts (considering traditional use of the above-listed breathing exercises) were incorporated into the final part of the classes.

Results

Anthropometric measurements and functional tests were performed to assess the impact of fitness classes on female students' bodies. These classes included basic aerobics with breathing exercises for martial arts. The study examined various indicators such as height, body weight, chest, buttocks, waist, shoulder, hip, and shin circumferences, as well as heart rate, blood pressure, vital lung capacity, respiratory rate, and dynamometry for students with cardiorespiratory system diseases (see Table 1).

When comparing the height of female students before and after the pedagogical experiment, no significant changes were observed in both the control group (CG) and the experimental group (EG). The heights were 168 ± 5.45 cm and 166 ± 6.40 cm, respectively, with p-values greater than 0.05 ($p > 0.05$). Additionally, the analysis of body weight before and after the pedagogical experiment revealed a decrease in body weight by an average of 5.67% ($p > 0.05$) in EG female students and by 3.34% ($p > 0.05$) in CG female students.

The changes in body weight resulted in changes in body circumferences. The waist circumference of CG female students decreased by an average of 1.26% ($p > 0.05$), while the waist circumference of EG female students decreased by 6.51% ($p < 0.05$). Additionally, the buttock circumference decreased by 1,11% ($p > 0.05$) for CG students and by 4,89% ($p > 0.05$) for EG students.

Some changes were also observed in the indicators of chest circumference, which can be explained by the effect of physical activity on the body. Thus, CG female students showed an unreliable increase in chest circumference ($p > 0.05$), namely, circumference of the chest at rest increased by 1.15%: (inspiration) - by 1.68%; (expiration) - by 1.01%, thoracic excursion significantly increased by 19.69% ($p < 0.05$). The following changes were found in EG female students: circumference of the chest at rest increased by 4.81% ($p < 0.05$): (inspiration) - by 4.93% ($p < 0.05$), (expiration) by 2.78% ($p < 0.05$), thoracic excursion significantly increased by 111.72% ($p < 0.001$). Slight

changes were observed in the indicators of shoulder, hip and shin circumferences, but all of them were unreliable ($p > 0.05$).

The resting heart rate (RHR) indicators in female students who participated in the traditional program showed an unreliable decrease by 6.87% ($p > 0.05$). However, in the female students who participated in the EG program, this indicator showed a significant decrease by 11.72% ($p < 0.01$). These results suggest that the cardiovascular system training of the female students in the EG program is better.

Based on the blood pressure indicators before and after the pedagogical experiment, the following changes were observed: in the control group (CG), the systolic pressure decreased by 6.34% ($p> 0.05$) and diastolic by 1.31% ($p> 0.05$); in the experimental group (EG), these indicators decreased by 11.61% ($p < 0.05$) and 11.31% ($p < 0.05$), respectively. After the pedagogical experiment, a reliable change in the indicators of respiratory function of the body was revealed. EG female students showed a significant increase in vital lung capacity by 25.57% ($p < 0.01$), while CG female students showed three times less vital lung capacity, amounting to 6.77% ($p < 0.05$). Additionally, there was also a decrease in respiratory rate indicators observed. This marker decreased by 2.11 ($p < 0.05$) in CG female students, while the same marker in EG students - by 23.68 ($p < 0.01$).

Table 1. Dynamics of anthropometric and functional markers of CG and EG students before and after a pedagogical experiment

Indicators	CG (n = 28) $\bar{X}$		p	EG (n = 25) $\bar{X}$		p
	Before PE	After PE		Before PE	After PE	
The height (cm)	168.0±5.45	168.10±5.45	>0.05	166.00±6.42	166.40±6.42	>0.05
The body weight (kg)	62.29±6.62	60.21±5.82	>0.05	61.49±4.25	58.00±4.54	<0.05
Waist circumference (cm)	67.86±4.31	67.00±3.51	>0.05	69.44±4.2	64.92±3.13	<0.05
Circumference of the buttocks (cm)	93.21±3.63	92.18±2.53	>0.05	96.56±2.52	91.84±1.52	<0.05
Circumference of the chest at rest (cm)	89.29±3.42	90.32±2.06	>0.05	93.96±3.14	89.44±1.94	<0.05
Circumference of the chest (breath) (cm)	91.07±3.36	92.60±2.14	>0.05	98.88±3.26	94.00±1.85	<0.05
Circumference of the chest (exhalation) (cm)	87.82±3.41	88.71±2.05	<0.05	90.52±3.24	88.00±1.8	<0.001
Thoracic excursion (cm)	3.25±0.52	3.89±0.62	<0.05	3.24±0.52	6.86±0.44	<0.05
Circumference of the shoulder of the right (cm)	27.43±3.84	27.40±3.71	>0.05	26.44±2.84	26.44±2.84	>0.05
Circumference of the left shoulder (cm)	26.82±3.991	26.79±3.83	>0.05	25.96±2.81	25.95±2.74	>0.05
Circumference of the right hip (cm)	54.07±3.52	53.39±2.84	>0.05	52.72±3.16	52.40±2.26	>0.05
Circumference of the left hip (cm)	53.89±3.41	53.36±2.81	>0.05	53.40±3.18	52.12±2.37	>0.05
Circumference of the right shin (cm)	34.89±2.84	34.79±2.63	>0.05	33.84±1.84	33.76±1.73	>0.05
Circumference of the left shin (cm)	34.68±3.02	34.57±2.91	>0.05	33.56±1.91	33.52±1.82	>0.05
Heart rate (HR, beats per minute)	88.64±8.91	82.55±6.07	>0.05	88.36±8.61	78.00±6.07	<0.01
Systolic pressure (SP, mm Hg)	135.00±9.73	126.43±6.82	>0.05	135.43±7.34	122.00±4.65	<0.05
Diastolic pressure (DP, mm Hg)	82.14±8.05	81.07±6.36	>0.05	83.21±7.93	73.80±5.52	<0.05
Vital capacity of the lungs (VC, ml)	2614.00±255.32	2791.00±262.52	<0.05	2612.00±259.15	3280.00±245.32	<0.01
Right-hand dynamometer (kg)	22.79±3.92	23.82±3.56	>0.05	23.41±4.42	25.36±3.25	<0.05
Left-hand dynamometer (kg)	21.29±3.31	22.11±3.25	>0.05	21.96±4.24	23.89±3.46	<0.05
Respiratory quotient (RQ, breaths per minute)	21.29±3.35	20.84±3.28	<0.05	21.96±4.21	16.76±3.47	<0.01

Note: $t_{cr} = 2.064$

Indicators of hand dynamometry in EG significantly differ from the initial values and exceed the CG indicators after the pedagogical experiment: the increase was by 8.33% (right hand) ($p < 0.05$) in EG and by 8.79% (left hand) ($p < 0.05$), and this indicator was 4.52% ($p > 0.05$) and 3.85% ($p > 0.05$) in CG female students, respectively.

In general, the data obtained during the study showed reliable changes in the indicators of functional systems of the body and unreliable changes in anthropometric indicators of female students participating in a fitness program combining basic aerobics with breathing exercises from oriental martial arts.

Table 2 shows differences in the markers of the average values of physical development indices of female students in the experimental and control groups.

Table 2. Indicators of physical development of CG and EG female students before and after the pedagogical experiment

Indicators	Groups			
	CG		EG	
	Before PE	After PE	Before PE	After PE
	X ± σ	X ± σ	X ± σ	X ± σ
Body mass index, CG/m²	22.08±3.24	21.35±2.81	22.36±2.75	21.01±2.15
Vital index, ml/kg	41.96±5.53	46.35±5.56	42.47±5.92	56.55±6.17
Robinson index, c. u.	119.66±13.44	104.36±8.30	119.66±10.82	93.36±7.46
HR recovery, sec	128.57±26.90	117.71±23.40	126.62±24.37	92.25±13.08

Based on the body mass index, no reliable changes were found in CG students before and after the pedagogical experiment (22.08±3.24 CG/m² and 21.35±2.81 CG/m², respectively), while EG students showed reliable ($p < 0.05$) changes on this indicator: 22.36±2.75 CG/m² and 21.01±2.15 CG/m² respectively. In general, body mass indices in both groups correspond to the norm.

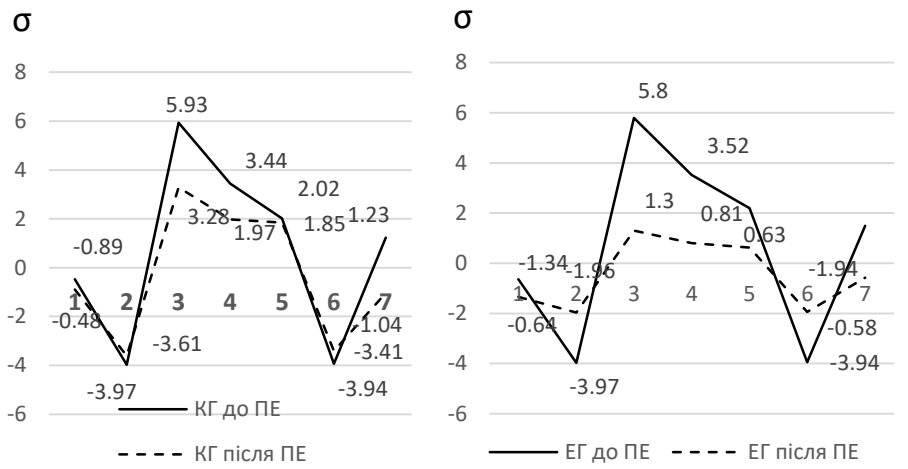
The vital index reflects the proportion of vital lung capacity per 1 kg of body weight. Based on this index, data that indicate the values below the norm which is 50 ml/kg were recorded both at the beginning and at the end of the pedagogical experiment and in both groups. At the same time, the results obtained indicate a significant increase in the values of this index (by 33.15%) in EG.

Base on the Robinson index and an energy metabolism-related marker in the myocardium, the following data were obtained: in CG – 119.66±13.44 before the experiment and 104.36±8.30 after it; in EG – 119.66±10.82 and 93.36±7.46, respectively.

After a standard physical activity - 20 squats for 30 seconds, a heart rate recovery took place: in CG before the experiment and after it - within 128.57±26.90 seconds and insignificantly increased to 117.71±23.40, respectively, whereas in EG – 126.62±24.37 seconds before the participation in the experimental program and significantly improved to 92.25±13.08 seconds after the experiment.

Productogenic indicators (Lukovska & Sologubova, 2011), reflecting the physical development and functional state of female students, namely: body weight; thoracic excursion; heart rate; blood pressure (systolic and diastolic); vital capacity of the lungs; breathing frequency and their values before and after the experiment formed the basis for developing morphofunctional profiles to develop the profile of CG and EG participants (Fig. 1).

The profiles clearly demonstrate significant positive changes in most studied markers in female students with cardiorespiratory diseases under the influence of the experimental program and show which ones are getting closer or deviate from the standard values of healthy students. In the EG, there is a trend towards the normal limits of healthy students' heart rate (+1.30 σ); blood pressure, both systolic (+0.81 σ) and diastolic (+0.63 σ); and breathing frequency (-0.58σ). The indicators of lung vital capacity in both groups are far from the standards of healthy students, but in the experimental group, there was a significant increase in VC values to (-1.94σ), while in the CG, this indicator is significantly lower (-3.41 σ). Among EG students with cardiorespiratory diseases, the indicators of thoracic excursion after the pedagogical experiment approach the standards (-1.96σ), while in the control group, they remained practically unchanged with a deviation in the negative direction from the standards (-3.61 σ).



1 – Body weight; 2 – Thoracic excursion; 3 – Heart rate; 4 – Blood pressure (systolic); 5 – Blood pressure (diastolic); 6 – Vital capacity of the lungs; 7 – Breathing frequency.

Figure 1. Morphofunctional profiles of students of CG and EG before and after the pedagogical experiment

The study using the methodology of differentiated assessment of the functional state on 'wellbeing', 'activity' and 'mood' scales allowed us to obtain the following results. On the 'wellbeing' scale: it was indicated as satisfactory by 49.4% of CG before the pedagogical experiment and by 96.4% after it; in EG, by 52.0% respondents before the experiment by 56.0% after it; it was indicated as good by 14.2% and 3.6% CG female students before and after the pedagogical experiment, respectively; in EG, this indicator was 16.0% and 44.0%; In the CG, the number of respondents who indicated poor wellbeing before the experiment comprised 36.4%, and in the EG, it was 32.0%. After the experiment, no students in either group reported poor wellbeing.

On the 'activity' scale, before and after the experiment, most CG female students indicated an average level of activity (50.0% and 65.0%, respectively); in EG, this indicator remained unchanged before and after participation in the program (52.0%); 48.0% of EG students had a low level of activity before the experiment, while - none after the experiment; in CG, there was also a decrease from 46.4% to 17.9% in the number of female students with low activity after the experiment; the number of EG participants with high activity before and after the

use of the experimental program is indicative: the increase by 48.0% occurred.

The following results were found on the 'mood' scale: the same number of respondents in CG and EG indicated a bad mood before the experiment (35.7% and 36.0%), while after the experiment, there were no students in both groups who rated their mood as bad; the same number of CG respondents (25.0%) rated their mood as good before and after the experiment, the number of EG female students with a good mood increased significantly from 28.0% to 64.0%; after the experiment, the number of CG female students with a satisfactory mood significantly increased from 39.3% to 75.0%, while the number of EG respondents with such an assessment remained unchanged (36.0%).

Discussion

The factual study of the morphofunctional state of female students with cardiovascular disease has revealed that most indicators are primarily below average and average. This finding aligns with the results of the similar studies (Lukovska & Sologubova, 2011).

One of the study objectives was to compare the effects of various physical education (PE) techniques on female students with cardiovascular disease in higher education institutions. The implementation of individualized fitness programs that consider the physical condition of female students and incorporate basic aerobics with elements of oriental martial arts resulted in positive changes in the *anthropometric indices* of the female students in the experimental group. Consequently, there were reliable changes in the body mass index. However, this indicator does not account for body fat distribution, which is an important predictor of disease risk. Therefore, more informative indicators include body weight and the relationship between circumferences. Based on these indicators, EG showed positive significant differences from those in CG.

A positive improvement in the *cardiovascular indicators* of female students was observed due to the experimental program, particularly, in heart rate, which is associated with the functioning of the cardiovascular system and overall work capacity. In addition to heart rate indicators, blood pressure and the Robinson index should also be considered, as researchers highlight the close relationship between these indicators (Galan et al., 2019). Positive changes in these indicators were observed among the EG students. These improvements were likely due to the

adaptive effects of fitness programs on the cardiovascular system, rather than solely the specific impact of the breathing exercises from oriental martial arts used in the EG. Nevertheless, the data obtained indicate a below-average level of somatic health among female students in both the control and experimental groups.

When analyzing the results of the study based on indicators of the *respiratory system*, it is important to note the significant increase in vital lung capacity and the decrease in respiratory rate among students in the experimental group (EG). The positive effects of specific breathing exercises in oriental martial arts on respiratory health are reflected in these indicator values. The improvement of these indicators is noticeably less pronounced in CG. The effectiveness of breathing exercises during EG classes is further supported by a significant increase in the vital index.

After a dynamic functional test (20 squats), the recovery time for female students in the control group (CG), who participated in physical education classes designed for special medical groups, increased slightly (8.45%). This change is considered insignificant, suggesting that their recovery time remained essentially unchanged. In the experimental group, the recovery time to a relative rest state decreased by 27.14%, which confirms the effectiveness of the influence of the experimental program on the female students' physical development. A comparative analysis of the dynamics of morphofunctional profiles of CG and EG female students before and after the experiment indicates an increase in the functional capabilities of participants in the experimental group. The morphofunctional changes observed in the EG participants reflect the complex effects of the training sessions. The combination of statodynamic exercises, which enhance muscle strength, and aerobic exercises, which improve the oxidative capacity of the muscles, in a single session - along with breathing exercises from oriental martial arts - resulted in an increased adaptive potential of the cardiovascular and respiratory systems among the participants in the experimental program.

When discussing the impact of motor activity on the *psycho-emotional state* of female students, it is important to recognize that their internal state is always shaped by several characteristics: *wellbeing* - consisting of a complex of subjective feelings and health status; *activity* - from mobility, the speed of the course of functions; *mood* - emotional background, in which emotional experiences of varying intensity can manifest themselves. The tests helped to assess students' overall health,

mobility, and emotional well-being. The results of the study examining the impact of various physical culture techniques on the psycho-emotional state of female students with cardiorespiratory diseases indicate that the 'well-being' scale, which measures physiological and psychological comfort, showed higher rates in the experimental group. As a result, 16% more female students in the experimental group (EG) reported feeling well after participating in the experiment. In contrast, the percentage of female students in the control group (CG) who rated their sense of well-being as good decreased by 10.6% compared to the initial data. However, the number of students who rated their well-being as satisfactory increased by 47%. Such a low score self-assessment of their wellbeing in the control group can be explained by the use of trivial approaches to the choice of physical culture techniques in PE programs in higher education institutions for special groups, not taking into account the interests of female students, the lack of a differentiated approach, low emotional level, monotony during classes and a subjective feeling of fatigue, certain health problems of female students.

Contradictory data was obtained on the 'activity' scale in CG. As a rule, a low score in wellbeing correlates with the similar score in activity, (Zlyvkov et al., 2016). However, during the experiment, the activity of female students in CG group actually increased. In contrast, 30.9% more students in EG rated their activity as high compared to the female students in CG.

The low wellbeing scores in the CG group are balanced out by their higher mood scores. Overall, the mood of female students in both groups improved during the experiment. This suggests that regular physical activity has a positive impact on the emotional state of female students with cardiorespiratory diseases.

Summarizing the results of self-assessment of psycho-emotional state in both groups, their average scores (CG – 35.43 points and EG – 44.36 points) still do not reach the norm, which is between 50 and 55 points. This confirms the research findings of S. Liu (Liu et al., 2019) regarding changes in self-assessment of personality based on the physical condition and morbidity.

Conclusion

The effectiveness of the program of basic aerobics combined with specialized breathing complexes from martial arts has been proven based on anthropometric indicators, cardiovascular, and respiratory

system indicators. The program not only improves morphofunctional markers but also the emotional state of female students, leading to positive changes in their morphofunctional profile, which is an important element for comparison with standards and further correction of physical development and functional state of female students with cardiorespiratory diseases.

Conflict of interest

The authors of this study, as well as their family members, do not have any membership or relationship with a scientific or medical committee that could create a potential conflict of interest. They do not hold any consultancy roles, possess expertise related to any company, and have employment status with any company, own shares, or have similar situations that might lead to conflicts of interest.

References

Agostinis-Sobrinho, C., Kievišienė, J., Rauckienė-Michaelsson, A., Dubey, V. P., Norkiene, S., Moreira, C., Lopes, L., & Santos, R. (2022). Cardiovascular health behavior and cardiorespiratory fitness in adolescents: a longitudinal study. *European Journal of Pediatrics*, *181*(12), 4091–4099. https://doi.org/10.1007/s00431-022-04623-4

Aksovic, N., Bjelica, B, Joksimovic, M., Skrypchenko, I., Filipovic, S., Milanovic, F., Pavlovic, B., Corluka, B., Przulj, R. (2020). Effects of aerobic physical activity to cardio-respiratory fitness of the elderly population: systematic overview. *Pedagogy of Physical Culture and Sports*, *24*(5), 208–218. https://doi.org/10.15561/26649837.2020.0501

Alter, D. A., Oh, P. I., & Chong, A. (2009). Relationship between cardiac rehabilitation and survival after acute cardiac hospitalization within a universal health care system. *European journal of cardiovascular prevention and rehabilitation: official journal of the European Society of Cardiology, Working Groups on Epidemiology & Prevention and Cardiac Rehabilitation and Exercise Physiology*, *16*(1), 102–113. https://doi.org/10.1097/HJR.0b013e328325d662

American College Health Association (2019) American College Health Association-National College Health Assessment II: Reference Group Executive Summary, Issue. https://www.acha.org/documents/ncha/NCHAII_SPRING_2019_US_REFERENCE_GROUP_EXECUTIVE_SUMMARY.pdf

Barasa, A., Schaufelberger, M., Lappas, G., Swedberg, K., Dellborg, M., & Rosengren, A. (2014). Heart failure in young adults: 20-year trends in hospitalization, aetiology, and case fatality in Sweden. *European Heart Journal*, *35*(1), 25–32. https://doi.org/10.1093/eurheartj/

Tsao, C. W., Aday, A. W., Almarzooq, Z. I., Anderson, C. A. M., Arora, P., Avery, C. L., Baker-Smith, C. M., Beaton, A. Z., Boehme, A. K., Buxton, A. E., Commodore-Mensah, Y., Elkind, M. S. V.,

Evenson, K. R., Eze-Nliam, C., Fugar, S., Generoso, G., Heard, D. G., Hiremath, S., Ho, J. E., ... Martin, S. S. (2023). Heart Disease and Stroke Statistics - 2023 Update: A Report from the American Heart Association. *Circulation*, *147*(8), E93-E621. https://doi.org/10.1161/CIR.0000000000001123

Conraads, V. M., Pattyn, N., De Maeyer, C., Beckers, P. J., Coeckelberghs, E., Cornelissen, V. A., Denollet, J., Frederix, G., Goetschalckx, K., Hoymans, V. Y., Possemiers, N., Schepers, D., Shivalkar, B., Voigt, J. U., Van Craenenbroeck, E. M., & Vanhees, L. (2015). Aerobic interval training and continuous training equally improve aerobic exercise capacity in patients with coronary artery disease: the SAINTEX-CAD study. *International Journal of Cardiology*, *179*, 203–210. https://doi.org/10.1016/j.ijcard.2014.10.155

Diachuk, D.,D., Moroz, H.,Z., Hidzynska, I.,M., Lasytsia, T.,S. (2018). Poshyrenist faktoriv ryzyku sertsevo-sudynnykh zakhvoriuvan v Ukraini: suchasnyi pohliad na problemu. *Ukrainskyi kardiolohichnyi zhurnal, 1,* 91-101. [Dyachuk, D., D., Moroz, G.,Z., Gidzinska, I.,M., Lasitsia, T.,S. (2018) Prevalence of cardiovascular disease risk factors in Ukraine: a modern view of the problem. *Ukrainian Journal of Cardiology. 1,* 91-101]. http://nbuv.gov.ua/UJRN/Ukzh_2018_1_12

Galan Y., Andriieva O., Yarmak O. (2019). The relationship between the indicators of morphofunctional state, physical development, physical fitness and health level of girls aged 12-13 years. *Journal of Physical Education and Sport*, *19* (2), 1158 – 1163. https://doi.org/ 10.7752/jpes.2019.02168

Grace, F., Herbert, P., Elliott, A. D., Richards, J., Beaumont, A., & Sculthorpe N. F. (2018). High intensity interval training (HIIT) improves resting blood pressure, metabolic (MET) capacity and heart rate reserve without compromising cardiac function in sedentary aging men *Experimental gerontology*, *109*, 75–81. https://doi.org/10.1016/j.exger.2017.05.010

Hamasaki H. (2020). Effects of diaphragmatic breathing on health: A narrative review. *Medicines (Basel, Switzerland)*, *7*(10), 65. https://doi.org/10.3390/medicines7100065

Higgins, T. P., Baker, M. D., Evans, S. A., Adams, R. A., & Cobbold, C. (2015). Heterogeneous responses of personalised high intensity interval training on type 2 diabetes mellitus and cardiovascular disease risk in young healthy adults. *Clinical hemorheology and microcirculation*, *59*(4), 365–377. https://doi.org/10.3233/CH-141857

Council for International Organizations of Medical Sciences (CIOMS) (2016). *International ethical guidelines for health-related research involving humans,* 4th ed. Geneva. https://doi.org/10.56759/rgxl7405

Kaminsky, L. A., Arena, R., Ellingsen, Ø., Harber, M. P., Myers, J., Ozemek, C., & Ross, R. (2019). Cardiorespiratory fitness and cardiovascular disease - The past, present, and future. *Progress in Cardiovascular Diseases*, *62*(2), 86–93. https://doi.org/10.1016/j.pcad.2019.01.002

Kessler, H. S., Sisson, S. B., & Short, K. R. (2012). The potential for high-intensity interval training to reduce cardiometabolic disease risk. *Sports medicine (Auckland, N.Z.)*, *42*(6), 489–509. https://doi.org/10.2165/11630910-000000000-00000

Lackland, D. T., Roccella, E. J., Deutsch, A. F., Fornage, M., George, M. G., Howard, G., Kissela, B. M., Kittner, S. J., Lichtman, J. H., Lisabeth, L. D., Schwamm, L. H., Smith, E. E., Towfighi, A., American Heart Association Stroke Council, Council on Cardiovascular and Stroke Nursing, Council on Quality of Care and Outcomes Research, & Council on Functional Genomics and Translational Biology (2014). Factors influencing the decline in stroke mortality: a statement from the American Heart Association/American Stroke Association. *Stroke*, *45*(1), 315–353. https://doi.org/10.1161/01.str.0000437068.30550.cf

Lee, D. C., Artero, E. G., Sui, X., & Blair, S. N. (2010). Mortality trends in the general population: the importance of cardiorespiratory

fitness. *Journal of Psychopharmacology (Oxford, England)*, *24*(4 Suppl), 27–35. https://doi.org/10.1177/1359786810382057

Lindgren, M., & Börjesson, M. (2021). The importance of physical activity and cardiorespiratory fitness for patients with heart failure. *Diabetes research and clinical practice*, *176*, 108833. https://doi.org/10.1016/j.diabres.2021.108833

Lukovska, O.,L., Solohubova, S.,V. (2011). Faktory morfo-funktsionalnoho stanu orhanizmu zhinok pershoho zriloho viku, znachushchi dlia pobudovy kondytsiinoho trenuvannia. *Pedahohika, psykholohiia ta medyko-biolohichni problemy fizychnoho vykhovannia i sportu*, *5,* 46-50. [Lukovska, O., L., Sologubova, S., V. (2011). Factors of the morphofunctional state of the body of women of the first mature age, significant for the construction of conditioning training. *Pedagogy, psychology and medical and biological problems of physical education and sports, 5*, 46–50].

Liu, S. Y., Wrosch, C., Morin, A. J. S., Quesnel-Vallée, A., & Pruessner, J. C. (2019). Changes in self-esteem and chronic disease across adulthood: A 16-year longitudinal analysis. *Social Science & Medicine (1982)*, *242*, 112600. https://doi.org/10.1016/j.socscimed.2019.112600

Maillard, F., Pereira, B., & Boisseau, N. (2018). Effect of High-Intensity Interval Training on Total, Abdominal and Visceral Fat Mass: A Meta-Analysis. *Sports medicine (Auckland, N.Z.)*, *48*(2), 269–288. https://doi.org/10.1007/s40279-017-0807-y

McKinney, J., Lithwick, D. J., Morrison, B. N., Nazzari, H., Isserow, S. H., Heilbron, B., & Krahn, A. D. (2016). The health benefits of physical activity and cardiorespiratory fitness. *British Columbia Medical Journal*, *58*(3), 131-137.https://www.sportscardiologybc.org/wp-content/uploads/2016/03/BCMJ_Vol58_No_3_cardiorespiratory_fitness.pdf

Palermo, P., & Corrà, U. (2017). Exercise Prescriptions for Training and Rehabilitation in Patients with Heart and Lung Disease. *Annals of*

the American Thoracic Society, *14*(Supplement_1), S59–S66. https://doi.org/10.1513/AnnalsATS.201702-160FR

Pans, M., Úbeda-Colomer, J., Monforte, J., & Devís-Devís, J. (2021). Physical activity and accomplishment of recommendations in university students with disabilities: A longitudinal study. *International journal of environmental research and public health*, *18*(11), 5540. https://doi.org/10.3390/ijerph18115540

Pearson, T. A., Blair, S. N., Daniels, S. R., Eckel, R. H., Fair, J. M., Fortmann, S. P., Franklin, B. A., Goldstein, L. B., Greenland, P., Grundy, S. M., Hong, Y., Miller, N. H., Lauer, R. M., Ockene, I. S., Sacco, R. L., Sallis, J. F., Jr, Smith, S. C., Jr, Stone, N. J., & Taubert, K. A. (2002). AHA guidelines for primary prevention of cardiovascular disease and stroke: 2002 update: Consensus panel guide to comprehensive risk reduction for adult patients without coronary or other atherosclerotic vascular diseases. American Heart Association Science Advisory and Coordinating Committee. *Circulation*, *106*(3), 388–391. https://doi.org/10.1161/01.cir.0000020190.45892.75

Pelliccia, A., Sharma, S., Gati, S., Bäck, M., Börjesson, M., Caselli, S., Collet, J. P., Corrado, D., Drezner, J. A., Halle, M., Hansen, D., Heidbuchel, H., Myers, J., Niebauer, J., Papadakis, M., Piepoli, M. F., Prescott, E., Roos-Hesselink, J. W., Graham Stuart, A., Taylor, R. S., … ESC Scientific Document Group (2021). 2020 ESC Guidelines on sports cardiology and exercise in patients with cardiovascular disease. *European heart journal*, *42*(1), 17–96. https://doi.org/10.1093/eurheartj/ehaa605

Piepoli, M. F., Hoes, A. W., Agewall, S., Albus, C., Brotons, C., Catapano, A. L., Cooney, M. T., Corrà, U., Cosyns, B., Deaton, C., Graham, I., Hall, M. S., Hobbs, F. D. R., Løchen, M. L., Löllgen, H., Marques-Vidal, P., Perk, J., Prescott, E., Redon, J., Richter, D. J., ESC Scientific Document Group (2016). 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular

Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts) Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). *European Heart Journal*, *37*(29), 2315–2381. https://doi.org/10.1093/eurheartj/ehw106

Price, K. J., Gordon, B. A., Bird, S. R., & Benson, A. C. (2016). A review of guidelines for cardiac rehabilitation exercise programs: Is there an international consensus?, *European Journal of Preventive Cardiology*, *23*(16), 1715–1733. https://doi.org/10.1177/2047487316657669

Solomen, S., Aaron, P. (2015). Breathing techniques - A review. *International Journal of Physical Education, Sports and Health, 2*(2), 237-241. https://www.kheljournal.com/archives/2015/vol2issue2/PartE/2-2-13.pdf

Szabo, D., A. (2021). The importance of cardiorespiratory fitness and physical activity among adulthood stages—review, *Studia Universitatis Babeş-Bolyai Educatio Artis Gymnasticae, 66*(4), 85–101. https://doi.org/10.24193/subbeag.66(4).35

Valis, J., & Gonzalez, M. (2017). Physical activity differences for college students with disabilities. *Disability and health journal*, *10*(1), 87–92. https://doi.org/10.1016/j.dhjo.2016.09.003

Weston, K. S., Wisløff, U., & Coombes, J. S. (2014). High-intensity interval training in patients with lifestyle-induced cardiometabolic disease: a systematic review and meta-analysis. *British Journal of Sports Medicine*, *48*(16), 1227–1234. https://doi.org/10.1136/bjsports-2013-092576

Zheng, L., Pan, D., Gu, Y., Wang, R., Wu, Y., & Xue, M. (2022). Effects of high-intensity and moderate-intensity exercise training on cardiopulmonary function in patients with coronary artery disease: A meta-analysis. *Frontiers in cardiovascular medicine*, *9*, 961414. https://doi.org/10.3389/fcvm.2022.961414

Zlyvkov, V.L., Lukomska, S.O., Fedan, O. V. (2016) *Psykhodiahnostyka osobystosti u kryzovykh zhyttievykh sytuatsiiakh.* Pedahohichna dumka. [Zlyvkov, V., L., Lukomska, S.O., Fedan, O.V. (2016). *Psychodiagnostics of personality in crisis life situations*. Pedagogical thought].

Zou, L., Sasaki, J. E., Wei, G. X., Huang, T., Yeung, A. S., Neto, O. B., Chen, K. W., & Hui, S. S. (2018). Effects of mind body exercises (Tai Chi/Yoga) on heart rate variability parameters and perceived stress: a systematic review with meta-analysis of randomized controlled trials. *Journal of Clinical Medicine*, *7*(11), 404. https://doi.org/10.3390/jcm7110404