The influence of aerobics exercise to cardiovascular functional parameters of 30–40 year old women

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Key words: *functional indices of cardiovascular system, bicycle ergometry work, women.*

Summary. *The aim of this study was to evaluate the cardiovascular functional parameter changes for 30–40 year old women following the aerobics exercise program.*

The material consisted of 14 women, who participated in aerobics exercise 3 times per week (the average age 33.71±1.28 years). The following methods were used in this work: arterial blood pressure measuring, electrocardiogram analysis and bicycle ergometry work. System of ECG analysis "Kaunas-Krūvis" was used for the monitoring of cardiovascular system reactions. 12 ECG standard derivations were synchronically recorded. Physical work method of provocative incremental bicycle ergometry exercise was used. The bicycle ergometry work was performed applying 50 W intensity in the beginning and increasing the power every minute by 25 W. The following functional parameters were estimated in this study: heart rate, arterial blood pressure, JT interval, ST segment depression at rest and in each level of functional load.

Results. It was established that heart beat rate of participants statistically significantly decreased ($p<0.05$) at rest and in each level of functional load after one year of regular aerobics exercise. Although JT interval values of participating women were higher during the second examination than during the first one, only in one level of functional load (at 75 W power) there was statistically significant ($p<0.05$) increase of this parameter. Statistically significant decrease ($p<0.05$) at 50 W and 75 W intensity of ST segment depression was observed in the examination. The systolic blood pressure of women, who were engaged in the aerobics exercise, did not change; the diastolic blood pressure statistically significantly decreased ($p<0.05$), when participant achieved 75 W and 100 W intensity.

Conclusion. Aerobics exercise is the proper physical activity form for 30–40 year old women for the developing of cardiovascular functional parameters.

Introduction

The adaptation of organism to the physical work related with the health strengthening and preservation as well as life quality improvement is a constant sphere of scientific research. There are many evidences confirming that the changes, which occur due to the regular physical work, not only increase the functional capacity of organism, but also decrease the risk of various diseases (1–3).

Nowadays society is aware of importance of physical activity, therefore systematical physical work for many people is an inseparable part of their lives. It is confirmed by the increasing forms of physical activity as well as establishing of modern health and sport clubs. According to the research most women go to aerobics exercise to control their body mass, to improve their fitness, while another impact of training such as an increase in the physical and the functional capacity or an improvement of psychological state is "discovered" later (4–6).

The aerobics exercise is a system of acyclic exercises, which improves the capacity of cardiovascular functions, develops the toughness of muscles and the coordination of movement. A regular participation in aerobics exercise program, as in other endurance exercises, increases the capacity of cardiovascular system (7–9). The physical work carried out in the aerobics program has many advantages: they are emotional, accessible and attractive. The practice of different purposes of physical work in the aerobics exercise has an impact on the development of important to the human's health physical

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features. However, there are certain drawbacks observed in organizing of these forms of physical activity. Organizing the sectional aerobics exercise difficulties emerge in the individualization of physical load. Moreover, the music, which provides the training with special glamour and emotional color, arouses a lot of positive emotions smothering the signals of fatigue sent by the organism (5, 10). In such exercise the functional capacities of organism are often exceeded, besides, certain health problems emerge. Therefore, it is important to assign and estimate the changes aroused by such physical work in human organism and also to prepare methodological recommendations.

The interest in the peculiarity of organism adaptation to the aerobics exercise arose only in the last years in Lithuania (10–12). Most researches involving the assessment of physical capacity and body design were performed with pupils and students. This research is meant to estimate the impact of aerobics acyclic exercise on the cardiovascular system, analyzing less studied parameters, reflecting the processes of heart ischemia and metabolism.

The objective of this research was to evaluate the changes of functional parameters of 30 -40 year old women following aerobics exercise program.

Material and methods

Study group included 14 women without clinical disorders (average age – 33.71±1.28 years, body mass index – 21.57±0.33 kg/m^2). Women participated in the one-hour aerobics exercises 3 times a week. The examinations for measurement the functional condition of the cardiovascular system were performed before and after 11.57±1.68 months of physical exercise. Following the results of the first examination, the individual functional load range, determined by heart rate (HR), was recommended for each participant. The HR of investigated females was estimated in order to evaluate physical work intensity in the aerobics part. HR of women during the aerobic acyclic exercise was on average 144.26±4.03 b/min.

The system of ECG analysis "Kaunas-Krûvis" was used for the monitoring of cardiovascular system reactions. 12 ECG standard derivations were synchronically recorded. Physical work methodic of provocative incremental bicycle ergometry exercise was used. The bicycle ergometry work was started with 50 W intensity in the beginning and the power was increased every minute by 25 W. The arterial blood pressure was measured by the methodic of Korotkov in the area of left upper arm.

The following functional parameters were estimated in this work: heart rate, arterial blood pressure, JT interval, ST segment depression at rest and in each level of functional load.

EKG JT interval corresponds to the electric systole of heart and the shortening of JT interval is associated with intensity of metabolic reactions. Minimal duration of JT interval was approximately 0.16 s, maximal – 0.36 s.

The negative amplitude of ST was measured in the chosen point of ST interval, in our case – 40 ms after JT point, in dislocation of polarization wave, when it embraced right and left ventricles at the same time. ST segment was registered on isolate.

The functional parameters of cardiovascular system state were registered during the examination and processed using the "Microsoft Excel 97/2000" computer program. The quantities were presented as arithmetical means (M) ± the standard error of arithmetical mean (SEM). The reliability of statistical distinction was counted by Student's t test for independent and dependent samples. The difference between error possibility less then 0.05 was evaluated as statistically significant.

Results

Comparison of HR meanings in both examinations revealed a statistically significant decrease ($p<0.05$) of this parameter, which comprised to 5.14±2.36 b/min (Fig. 1). While the physical load was increasing, the activity of parasympathetic system was decreasing. However, the HR was also increasing. Such dynamics of HR was observed in both examinations. Almost a year following the aerobics exercise program a statistically significant decrease ($p<0.05$) of this parameter in all levels of functional load was determined. The biggest statistically significant change ($p<0.05$) of HR was registered in 75 W level of functional load. In 75 W load HR decreased by 6.64±2.48 b/min.

In the first examination systolic blood pressure (SBP) of women following the aerobics exercise at rest was 111.54±2.31 mmHg (Fig. 2). SBP was growing with increase of intensity of functional load. At maximum intensity of 125 W, SBP reached 161.67±3.07 mmHg. In the repeated examination SBP meanings of the women at rest and in all levels of functional load were insignificantly lower ($p<0.05$) than before physical exercise.

Diastolic blood pressure (DBP) of women at rest was 74.23±1.47 mmHg (Fig. 3) in the first examination. During the second examination statistically significant difference was not determined ($p<0.05$).

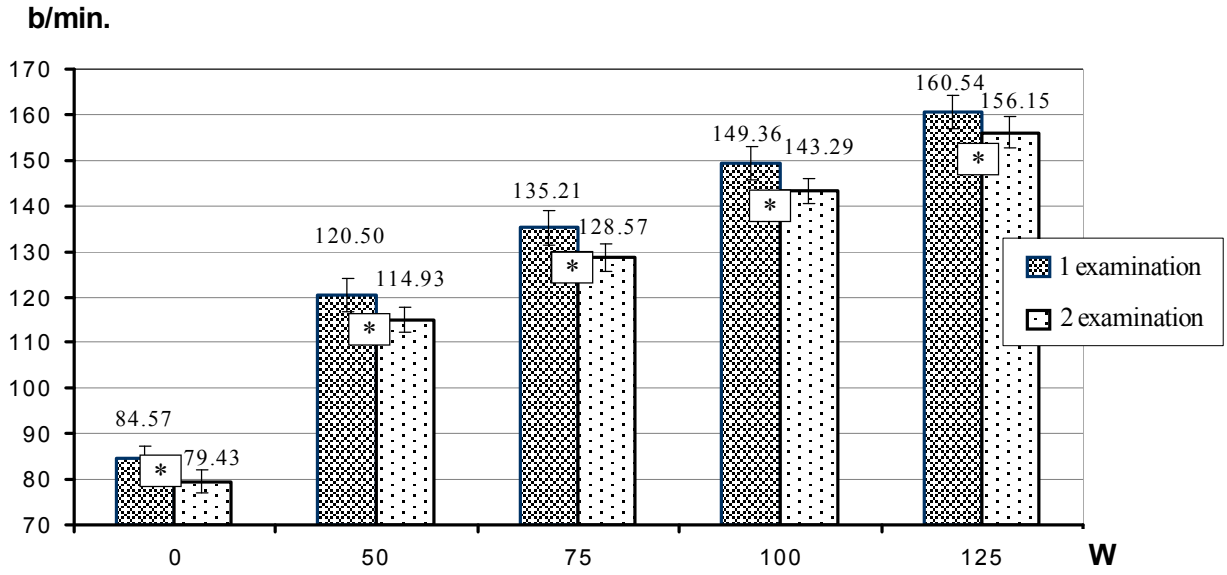

Fig. 1. **The meanings of heart beat rate before and after purposeful physical load**

[*] – the mean of II exercise test differs from the mean of I exercise test with $p < 0,05$.

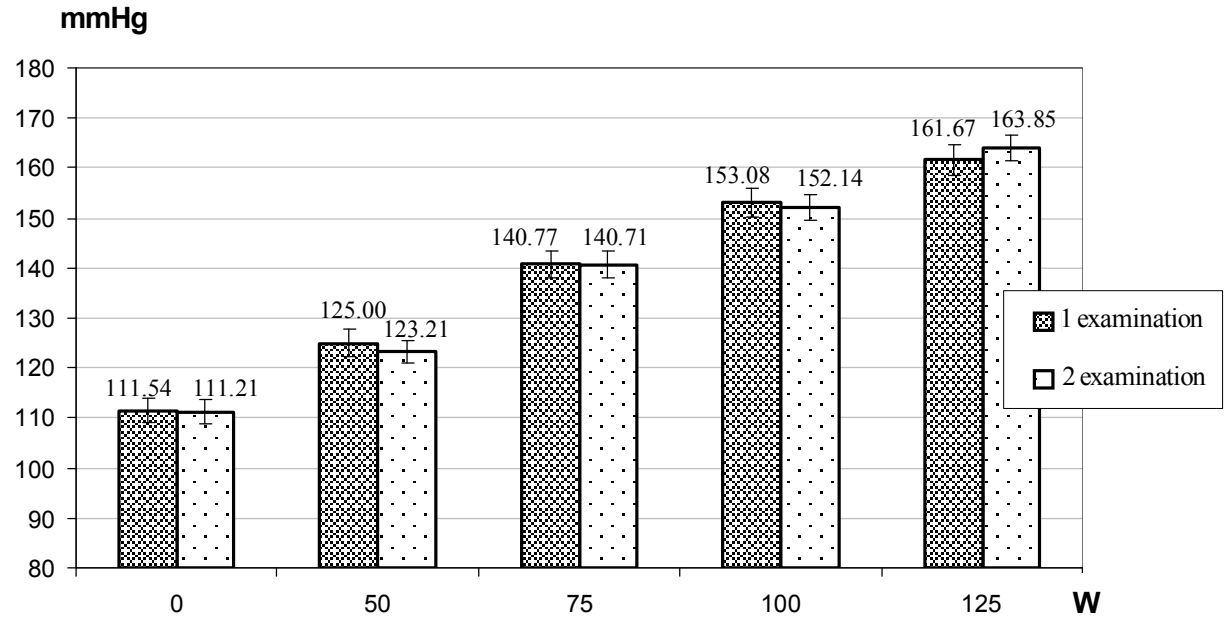

Fig. 2. **Dynamics of systolic blood pressure indices during the bicycle ergometry test**

Evaluating dynamics of DBP at the functional load an insignificant decrease of this index at the first level of the functional load (50 W) was observed. Further, when physical load was gradually increasing, DBP was growing equally. Those tendencies of DBP variation at the bicycle ergometry work were observed in both examinations (Fig. 3). Comparing the meaning of DBP in both examinations a statistically significant decrease ($p<0.05$) of this quantity was registered at 75 W and 100 W intensity (4.48±1.23 mmHg and 5.44±2.50 mmHg, correspondingly). At other levels of physical load a statistically significant difference between the meanings of DBP was not determined.

Evaluating JT interval index at rest it was determined that the duration of JT interval index lengthened after a year of practicing physical exercise, however the difference between the results of the first and the second examinations was statistically non-significant ($p<0.05$) (Fig. 4).

With the increase of the workload duration of ECG JT interval index had the tendency to shorten (Fig.

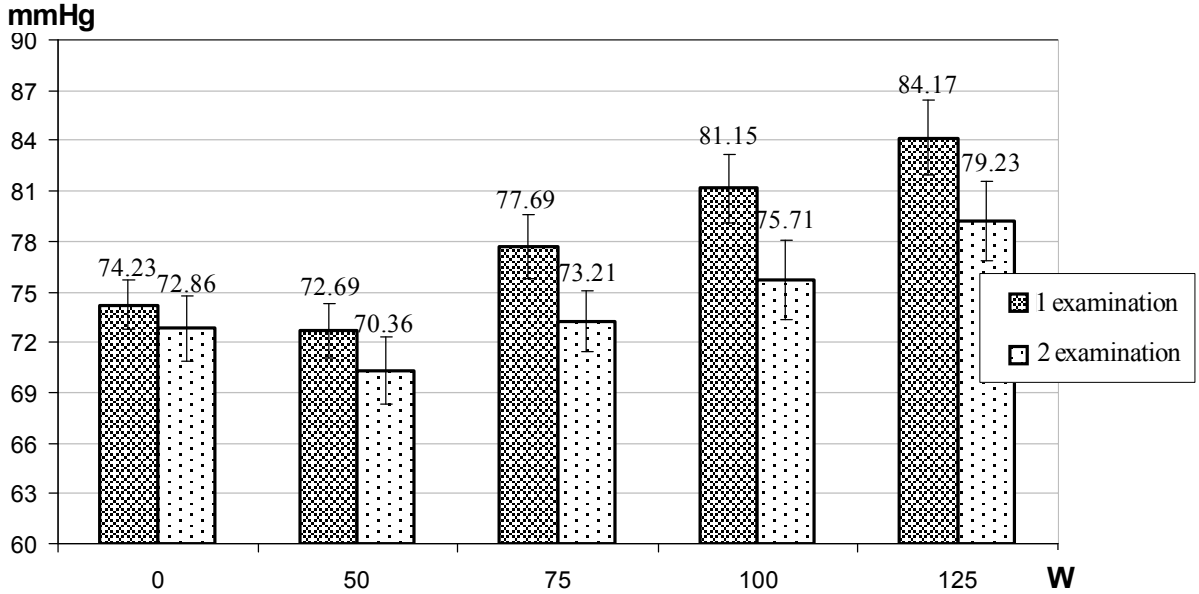

Fig. 3. **Dynamics of diastolic blood pressure indices in both researches**

[*] – the mean of II exercise test differs from the mean of I exercise test with $p < 0.05$.

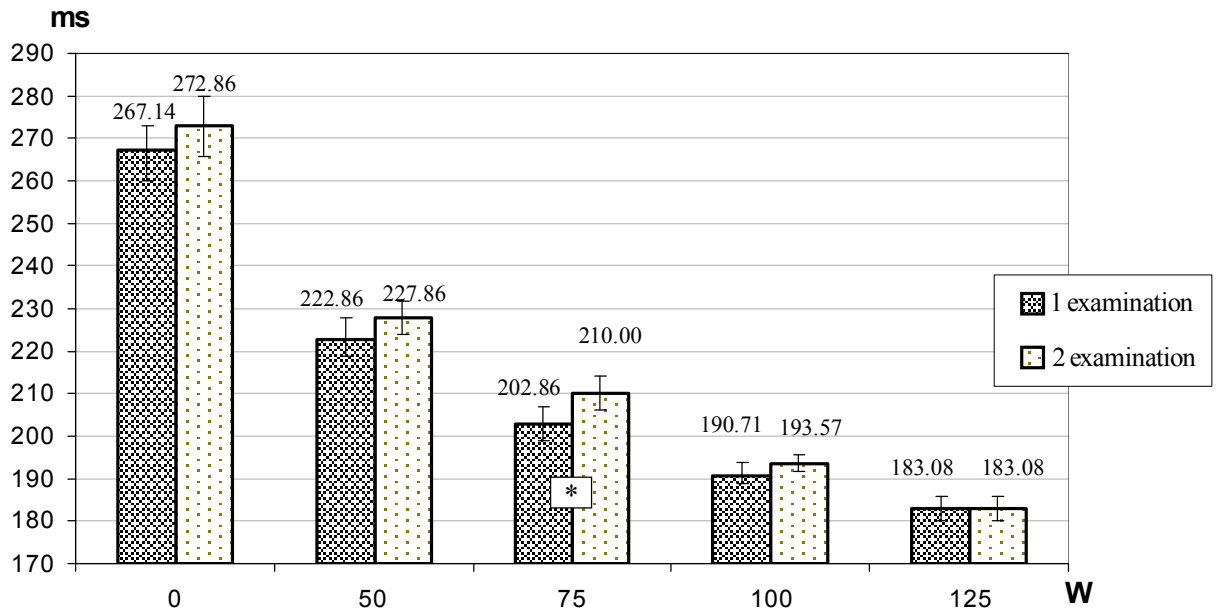

Fig. 4. **Dynamics of JT interval before and after the influence of aerobics exercise**

[*] – the mean of II exercise test differs from the mean of I exercise test with $p < 0.05$.

4). A statistically significant change ($p<0.05$) was registered at 75 W intensity, while evaluating the change of JT interval index meaning in different levels of functional load. In other levels of functional load the tendency of elongation of JT interval index was observed.

During the first examination the ECG ST segment depression at rest was -0.052±0.009 mV, but after a year of longitudinal physical exercise it decreased up to -0.050±0.010 mV (Fig. 6) and the difference was statistically non-significant ($p>0.05$) (Fig. 5).

Increasing the intensity of load the ST segment depression gradually increased. At 50 W intensity the ST segment depression was –0.207±0.029 mV during the first examination, while during the second one a decrease of this index up to –0.167±0.029 mV ($p<0.05$) was observed. A statistically significant decrease of ST segment depression ($p<0.05$) was estimated at 75 W intensity –0.0837±0.034 mV (Fig. 5).

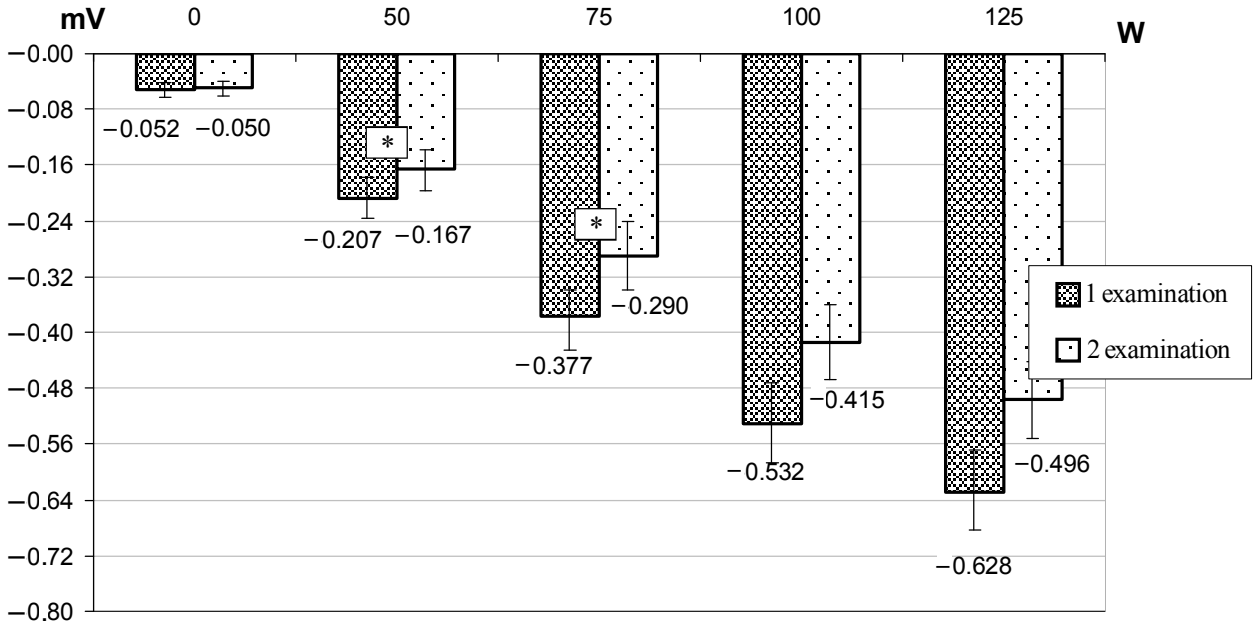

Fig. 5. **Dynamics of ST segment depression indices before and after one year the purposeful physical load**

[*] – the mean of II exercise test differs from the mean of I exercise test with $p < 0.05$.

Discussion

The essence of physiological adaptation of organism is acquisition of such functionality of organism, which distinguishes for increased tolerance to physical load, bigger quantity of power and improved regulative mechanisms (8, 13). The morphological and functional changes, occurring during the adaptation to physical load, greatly depend on the character of exercise (3, 14). Regular participation in aerobics exercise as well as in other exercises developing endurance improves the cardiovascular system capacity (7–9). The cardiovascular system supply inside the system plays a major role and understanding of its processes is important for analysis of organism adaptation.

One of the most frequently and extensively analyzed functional parameters of cardiovascular system is the heart rate (5, 9, 15). The HR is increasing from the beginning of physical load. Initial rapidity occurs due to the interruption of *nervus vagus* influence (16). Increasing the intensity of exercise the HR is growing upright till reaches its maximal meaning. Intensifying the physical load the HR is becoming more rapid due to increase in the activity of sympathetic nervous system (17–19). Such dynamic of HR was observed in the bicycle ergometry work in both examinations.

The results of examinations showed that the HR of participants statistically decreased ($p<0.05$) at rest and in each level of functional load after a year of regular aerobics exercise. The obtained results are explained by literature data, which indicates, that longitudinal adaptation of organism to physical load increases the activity of parasympathic nervous system and at the same time decrease the HR (3, 13). A decreased reaction of HR to the same physical load shows improved function and contraction of myocardium (9, 20, 21).

Based on the estimation of arterial blood pressure reactions to the physical load the functional ability of cardiovascular system and overstrain processes of organism can be established (22). The arterial blood pressure (ABP) changes have their peculiarities during the physical load. Throughout the increasing dynamical physical load the ABP is rising due to growing cardiac output (23). Such consistency of women ABP changes were observed during the functional load. The increase of systolic blood pressure shows a powerful contraction of heart muscle and strong expulsion of blood (11, 22).

During the small and moderate intensity physical load the diastolic ABP did not change, while during the high intensity work it could increase (19, 24). When 50 W intensity was reached the DBP decreased; however this parameter increased at 75 W intensity up till the end of functional load.

Comparison of the meanings of ABP revealed the marked decrease ($p<0.05$) of diastolic blood pres-

sure during the submaximal load (75 W). The changes of DBP show the decreased tone of arterioles and their improved dilatation characteristics.

Satisfactory heart supply with blood is an important parameter of its productivity. The intensity of organ supply with blood is established at the level of its metabolism. The heart metabolic changes are related with JT interval (25). At normal metabolism when the maximal load is reached during the physical work, JT interval is decreasing to the point of 0.16. This minimal continuance of JT interval reflects maximal speed of metabolism to the person and after it is reached, the JT interval does not change to the end of physical load, while the HR still increases (25). The aerobics exercise is known to activate the heart myocardium, that is why the more human heart mitochondria has the better it is supplied with energy (19, 20). The speed of glycolic processes in the trained heart decrease at rest and energetic products are being depleted more economically. Although the meanings of JT interval of women were higher during the first examination than during the second one, only at one level of functional load (at 75 W intensity) the marked change ($p<0.05$) was registered. These results can be explained with the decreased metabolism level of heart and increased economy of myocardium work.

When there is an insufficient blood flow in the coronary vessels during the physical load the electrical potentials of myocytes change and some changes are also registered in the ECG. The decrease of ST segment depression is related with the origination of ischemic phenomenon in the myocardium (19, 26). It is related with the balance disorder between the myocardium oxygen demand and the intensity of myocardium circulatory system caused by the physical load (27). Due to this the evaluation of ischemic phenomenon during the physical load has its significance and shows the functional capacity of heart (25, 27). At the repeated examination a statistically significant decrease of meanings of ST segment depression at 50 W and 75 W intensity was observed and it could be influenced by the improved myocardium nutrition as well as by more effective oxygen delivery to the supply system.

Summarizing the results it can be noted, that parameters of cardiovascular system changes approached in this research were different. The longitudinal exercise of aerobics had an impact on the improvement of regulation system functions both at rest and during the physical load. The changes of regulation system adaptation are reflected by the changes of heart rate. The improved hemodynamics of heart evaluated according to the meanings of ST segment depression was established during the middle intensity physical load.

It is interesting, that statistically significant changes of all the investigated parameters, except systolic blood pressure, have been established at the level of 75 W functional load. This conveys that applied means of physical activity mostly increased women's cardiovascular system functionality during the middle intensity physical load.

Conclusions

The longitudinal purposeful physical exercises statistically significantly decreased ($p<0.05$) the women's heart rate at rest and during physical load. The systolic blood pressure of women, who were engaged in the aerobics exercise, did not change, the diastolic blood pressure statistically significantly decreased ($p<0.05$), when participant achieved 75 W and 100 W intensity. Statistically significant JT interval increase ($p<0.05$) and ST segment decrease ($p<0.05$) were determined in the repeated examination, when there the moderate intensity physical load was achieved. Aerobics exercise is the proper physical activity form for 30–40 year old women for developing of cardiovascular system capacity.

Sveikatingumo aerobikos pratybų poveikis 30–40 metų moterų širdies ir kraujagyslių sistemos funkciniams rodikliams

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Raktažodžiai: širdies ir kraujagyslių sistemos funkciniai rodikliai, funkcinis mėginys, moterys.

Santrauka. Darbo tikslas. Įvertinti 30–40 metų moterų širdies ir kraujagyslių sistemos funkcinių rodiklių pokyčius taikant ilgalaikį aerobinį krūvį.

Tiriamųjų kontingentą sudarė 14 moterų, kurios tris kartus per savaitę lankė aerobikos pratybas (amžiaus

vidurkis – 33,71±1,28 metų). Širdies funkciniams rodikliams vertinti naudota elektrokardiogramos analizės sistema ,,Kaunas-Krūvis“. Sinchroniškai buvo registruojama elektrokardiograma 12-kos standartinių derivacijų. Taikyta veloergometrinio pakopomis didėjančio provokacinio fizinio krūvio metodika. Veloergometrija atlikta parinkus pradinį 50 W krūvį ir didinant jį kas minutę 25 W. Buvo vertinami šie funkciniai rodikliai: širdies susitraukimo dažnis, arterinis kraujospūdis, JT intervalas, ST neigiama amplitudė ramybės būsenoje bei funkcinio mėginio metu kiekvienos krūvio pakopos metu.

Rezultatai. Nustatyta, kad po vienerių metų reguliarių aerobikos pratybų tiriamųjų širdies susitraukimo dažnis tiek ramybės būsenoje, tiek ir viso funkcinio mėginio metu buvo statistiškai patikimai mažesnis ($p<0,05$). Nors tiriamųjų moterų JT intervalo reikšmės antrojo tyrimo metu buvo didesnės už pirmojo, tačiau tik vienoje funkcinio mėginio pakopoje, t. y. kai galingumas buvo 75 W, užfiksuotas ryškus ($p<0,05$) šio rodiklio pokytis. Tyrimo metu užfiksuotas statistiškai patikimas ST neigiamų amplitudžių reikšmės mažėjimas esant 50 W ir 75 W galingumui. Moterų, lankiusių sveikatingumo aerobikos pratybas, sistolinis kraujospūdis nepakito, diastolinis kraujospūdis reikšmingai sumažėjo ($p<0,05$), kai moterys pasiekė 75 W ir 100 W galingumą.

Išvada. 30–40 metų moterims sveikatingumo aerobika yra tinkama fizinio aktyvumo forma širdies ir kraujagyslių sistemos funkciniam pajėgumui didinti.

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