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RESEARCH OF THE INFLUENCE OF EXERCISES ON CABLE MACHINES AND GROUP FUNCTIONAL TRAINING ON THE FUNCTIONAL STATE OF PEOPLE WITH BORDERLINE HYPERTENSION

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Annotation. The aim of this study: to evaluate the influence of standard interval exercise methods using cable machines and the method of circuit training with weights on the functional state of the cardiovascular system of people with borderline hypertension at the outpatient rehabilitation stage. The effectiveness of strength training is represented by an improvement in the functional state of the cardiovascular system, determined by the normalization of blood pressure, the Robinson index, and an increase in the level of adaptive resources of the body according to the R.M. Baevskij's method and the Romberg's test. The data obtained can be used in the development of physical rehabilitation programs for borderline hypertension in fitness clubs.
Keywords: physical rehabilitation, borderline arterial hypertension, strength training, circuit training, standard interval exercise method.

Introduction. Initial prevention of hypertensive disease is one of the most relevant tasks of the Russian Healthcare due to its high incidence and severity. The borderline hypertension (BH), synonyms of which include "high normal pressure" and "pre-hypertension" draws attention of many scientists, since it subsequently leads to hypertensive disease (HD) for a quarter of patients [1-4].

In this case, an increase in systolic blood pressure (sBP) from 120 to 139 mm of Hg and in diastolic blood pressure (dBP) from 80 to 89 mm of Hg is registered. Slightly increased and normal values of blood pressure alternate, and normalization of blood pressure occurs spontaneously [2].

When planning preventive measures for patients with BH, physical activity optimization should be recommended as a prerequisite [5].

Physical rehabilitation of a patient with BH is aimed towards recovering functional state of the body and is attributed to a number of basic practical tasks, which should be solved by experts in rehabilitation in accordance with active developmental trends and rehabilitation medicine standards [6].

Some studies have data on recovery methods based on the use of traditional measures and methods of physical rehabilitation. Some works reflect a positive role of anabolic training as a method of prevention and treatment of the 1-2 stage HD [7-9]. According to Ivanova, "strength training of mild intensity is completely safe and provides an increase in muscle power and ability to perform aerobic physical loads, especially in patients with weaker skeletal muscles" [10]. A number of literature references have data on decreased systolic and diastolic BP in patients with AH when applying athletic gymnastics combined with walking or gentle running [11].

These works reflect a positive effect of strength exercises on the course of 1-2 stage HD. However, there were no data on effect of group functional training with small strength training equipment, free weights (pumps, body bars, dumbbells) in rehabilitation of people with BH.

Objective of the study – to compare effect of a set of exercises on pull machines and group functional training with small strength training equipment on the functional state of people with BH, who work out in a fitness club.

Methods and organization. The study took place in the "Fitnes Tochka" fitness club located in Moscow and was 3 months long.

The study included 20 people aged 40-50 years, who were diagnosed with BH. The participants were randomly divided into 2 groups 10 people each, which were also divided by gender: 5 men and 5 women in each group.

To assess the program's effectiveness, we applied following methods:

– measurement of body mass index (BMI) as one of the factors associated with arterial hypertension;

– identification of hemodynamic parameters (heart rate (HR), sBP and dBP);

– calculation of the double product index – the Robinson index to evaluate functional state of the cardiovascular system;

– the adaptive resources' level was assessed according to the adaptive potential (AP) method by R.M. Baevskij [3];

– to assess balance function and general state of proprioceptive capabilities, the Romberg's test (the tandem position) was used.

The statistical data processing was made with the Statistica 6.0 software package. We calculated the mean (M) and standard deviation (SD) of the received indices. The distribution normalcy was identified with the Pearson's chi-squared test (χ^2). Reliability of differences between mean values of indices, calculated according to the formula for dependent and independent samples, was assessed using the Student's t-test and Wilcoxon signed-rank test (the level of statistical significance – $p \leq 0.05$).

Duration of the strength training course was 3 months. In both groups the training sessions were held 3 times a week, the duration of the session was 60 minutes.

For the group 1 (G1) we conducted classes using the standard interval exercise method on mainly cable machines. In the introductory and final parts of the session, bicycle ergometry was performed for 10 minutes with a pulse of 60% of the maximum allowable, which corresponds with aerobic and recreative intensity zone. In the main part of the session, the time of each exercise was 30-40 s corresponding with 8-12 repetitions with an intensity of 60-70% of calculated values of one-repetition maximum. In order to identify the level of intensity in both groups, we applied the M. Brzycki's modified method [9].

Following exercises were included: seated leg press, front pulldowns, forward press, extension, hamstring curls.

For the group 2 (G2) we used the circuit training method, which included 7 exercises for major muscle groups. Duration of one exercise was 40-50 s, which corresponds with 15-20 repetitions with an intensity of 30-40% of calculated values of one-repetition maximum.

The set of exercises included back squats, bent-over barbell row, dumbbell presses, dumbbell Lunge, Romanian deadlift, sit-ups, lateral raise.

The volume of training load in both groups varied from 1 lap (approach) per session in the first 2 weeks of training, 2 laps (approaches) during 3-4 weeks of training and 3 laps (approaches) from the 5th week of training and further.

During the session in both groups we alternated exercises for leg muscles and shoulder girdle muscles. To avoid maximum physical and mental stress, the following attempts included 2-3 minute pauses or pauses until full recovery.

Results and discussion. After 3 months of strength training sessions we found that both groups had positive shifts in the studied indices (tables 1, 2). At the same time, while examining changes in both groups, we can note parity in most evaluation criteria.

Table 1

Results of the studied indices in the group 1 (dependent samples)

Indices	Initial values	Final values	Difference		P≤
	(M±SD)	(M±SD)	Absolute	%	
BMI, kg/m^2	32.4±1.6	31.3±1.3	1.1	3.4	0.001
sBP, mm of Hg	144.2±10.1	133.1±7.9	13.1	7.7	0.05
dBP, mm of Hg	90.6±5.7	85.4±5.6	5.2	5.7	0.05
Robinson index, c.u.	129.5±9.8	106.8±6.1	22.7	17.5	0.05
AP according to Baevskij, c.u.	3.3±0.01	3.01±0.02	0.29	8.8	0.05
Romberg test, s	24.1±4.9	28.3±8.1	4.2	17.4	0.001

Note (hereinafter): BMI – body mass index; sBP – systolic blood pressure; dBP – diastolic blood pressure; AP – adaptive potential

Table 2

Results of the studied indices in the group 2 (dependent samples)

Indices	Initial values	Final values	Difference		P≤
	(M±SD)	(M±SD)	Absolute	%	
BMI, kg/m^2	31.3±1.2	28.6±1.3	2.7	8.6	0.05
sBP, mm of Hg	143.5±11.7	132.8±7.4	10.7	8.7	0.05
dBP, mm of Hg	90.1±4.9	84.8±6.1	5.3	5.8	0.05
Robinson index, c.u.	131.8±8.7	108.5±5.7	23.3	17.7	0.05
AP according to Baevskij, c.u.	3.25±0.04	2.97±0.03	0.28	8.6	0.05
Romberg test, s	23.4±5.1	35.3±7.3	11.9	50.8	0.05

According to the presented data, BMI changed by 2.7 units in G2 ($p\leq0.05$), while in G1 the change amounted to 1,1 units ($p\leq0.001$).

After the experiment, sBP improved by 7.7% ($p\leq0.05$) in G1 and by 8.7 ($p\leq0.05$) in G2. dBP also improved significantly by 5.7% ($p\leq0.05$) in G1 and by 5.8% ($p\leq0,05$) in G2.

In the course of sessions, the Robinson index reduced by 22.7 c.u. ($p\leq0.05$) in G1, in G2 – by 23,3 c.u. ($p\leq0.05$), which is lower than the initial value in both groups by 17.6%.

When examining the adaptive potential level according to the Baevskij's method, the results in both groups demonstrated an increase by 8.7%: G1 – 0.29 c.u. ($p\leq0.05$), G2 – 0,28 c.u. ($p\leq0.05$).

Results of the Romberg test that evaluates the state of proprioceptive abilities show that G2 had substantial improvements: the difference in the indices before and after the experiment was 11.9 s ($p\leq0.05$). At the same time changes were insignificant in G1 and amounted to 4.2 s ($p\leq0.01$) at the end of the experiment.

As it was noted before, in most of the studied indices, such as sBP, dBP, Robinson index, adaptive potential according to Baevskij, similar results in both groups were identified, and there were no statistically significant differences ($p\leq0.001$) (table 3). However, there was a substantial discrepancy in BMI: a difference between the groups amounted to 9% ($p\leq0.05$) having higher results in G2, as well as the Romberg test's results, where a difference was 22% ($p\leq0.05$) also having higher values in G2.

Table 3

Comparison of the studied indices after 3 months of sessions (independent samples)

Indices	Group 1	Group 2	Difference		P≤
	(M±SD)	(M±SD)	Absolute	%	
BMI, kg/m^2	31.3±1.6	28.6±1.3	2.7	9	0.05
sBP, mm of Hg	133.1±7.9	132.8±7.4	0.3	0.03	0.01
dBP, mm of Hg	85.4±5.6	84.9±6.1	0.5	0.6	0.01
Robinson index, c.u.	106.8±6.1	108.5±5.7	1.7	1.5	0.01
AP according to Baevskij, c.u.	3.01±0.2	2.97±0.3	0.08	1.4	0.01
Romberg test, s	28.3±8.1	35.4±7.3	7.1	22	0.05

Therefore, application of the set of exercises on cable machines and group functional training with small strength training equipment is effective in rehabilitation of people with BH. However, results in G2 that had the circuit training method and exercises with free weights revealed better changes in two studied indices (Romberg test, BMI). In our opinion, this effect was achieved due to higher intensity of the session and application free weights, which contributed to reduced body mass and better trained vestibular system.

Conclusion. Taking into account the results, we may conclude that the use of the strength training program for treating borderline hypertension contributed to the improved functional state and maintained stabile BP reduction in both groups.

The group with the group circuit training format also had their body mass reduced and their motor control improved aside from the normalized state of the cardiovascular system.

The aforementioned allows us to recommend using a set of strength exercises in physical rehabilitation of patients with borderline hypertension at the outpatient stage.

Conflict of interest. The authors declare no conflict of interest.

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