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Research paper

Dynamics of Bodybuild Indices in the Process of Complex Aerobic And Power Training Program

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Abstract

The aim of the article is to study the dynamics of the physique of girls involved in the program of complex physical training.
The study involved 48 female university students who studied twice a week during 12 weeks. Running was chosen for aerobic exercise (6 hours), for power loads exercises with the overcoming of the weight of the body were used (12 hours). Anthropometric indices of the body were determined according to V.V. Bunak's method using a standard set of instruments. We used analytical formulas were used by J. Matiegka to study the component composition of the body. The subjective evaluation of the impact of the training program was studied via a questionnaire.
Results. The absolute fat content of the body decreased by 2.4 kg and the relative fat content – by 4.7%. We revealed: 1) a decrease in the total thickness of skin-fat folds from 91.6 ± 5.0 mm to 74.2 ± 4.3 mm; 2) approximately the same rate of decrease in the thickness of skin-fat folds - 17.5 ± 0.16%, in different parts of the body; 3) the level of development of muscle mass has not changed, there is a tendency for its increase; 4) changes in the size of body girths did not occur, a tendency for their decrease was noted; 5) the body mass index remained at the same level. Positive subjective assessments of a significant number of the girls engaged (81.3%) about the effect of the training program on the physique have been found.
The training program of complex physical training allowed achieving a positive effect on the physique: to reduce the fat content, to maintain the level of development of muscle mass, body weight, body girths, gain muscle tone, positive affect on the emotional state and subjective assessments of changes in the state of physique.

Keywords: *Training program, aerobic and power load, body fat, muscle mass, skin-fat folds, body girths.*

1. Introduction

The comprehensive evaluation of training programs includes studying their influence not only on physical fitness, but also on indicators of physical development, in particular, physique. Improving the physique is one of the significant motivational factors that ensure the systematic involvement of girls in the training process.
Despite the presence of numerous studies on the problem of improving the physique in the process of applying regular physical loads[1-5], it remains relevant to assess the impact of specific training programs for complex physical training that contain both aerobic and power exercises.
The purpose of the study was to study the dynamics of the physique of girls aged 17-20 engaged in 12-week program of complex physical training.

2. Methods

48 students aged 17-20 of Naberezhnye Chelny Institute of Kazan Federal University took part in the study. Girls were supposed to perform a specially designed training program during the process of physical education classes 2 times a week from October to December. It included physical exercises of aerobic and power character.
The content and parameters of the training program are presented in Table 1. A uniform fifteen-minute run through the sports hall was used for the aerobic load in the preparatory part of the class which was aimed at developing general endurance. For power loads exercises fir overcoming the weight of one's own body were used for developing different muscle groups.

Table 1:. Parameters of the training program

№	Parameters of the training program	Results of parameters	
		Within one lesson	Within 24 lessons
1	Time spent on running loads, min:	15	360 (6 hours) – 27,3%
2	Time spent on power exercises (with rest pauses between sets), min:	20-40	720 (12 hours) – 54,5%
3	Time spent on warm-up exercises, min	10	240 (4 hours) – 18%
4	Total time spent on physical exercises, min	55	1320 (22 hours)
5	Number of repetitions in power exercises:	174 (on average)	1490
6	Number of training weeks	12	
7	Number of training classes	24	

The use of power loads was carried out to develop the strength of the muscles, both the upper and lower parts of the body (Table 2).

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The program of power training of muscles of the upper body was aimed primarily at increasing the level of power training in the test exercise – flexion-extension of the hands in the position of lying on the floor. This was due to the fact that the results of this test were lower than the results of other tests of general physical fitness among the girls [6, 7]. The task of enhancing the test result was solved on the basis of a complex development of the power abilities of the muscles that perform a certain role in the test exercise. A system of 20 exercises in overcoming the weight of one's own body and a separate set of exercises for the muscles of the abdominal press was used as a means of power training. In general, the relative distribution of the volume of dynamic force load by muscle groups was the following: for pectoral muscles – 29.3%; for abdominal muscles – 26.5%; for triceps – 20.3%, for back muscles – 14.5% (for the muscles of the upper part of the back – 3.1%, for the lower part – 11.4%); for the thigh muscles –10%.

Table 2:. Parameters of the power training program

№	Groups of exercises	Target muscle groups	Number of repetitions			
			1st month	2nd month	3rd month	Total
1	Test exercise - flexion and extension of the arms in the position of lying on the floor	For pectoral muscles	0	22	119	141
2	Special preliminary exercises to the test (various variations of flexion-extension of the arms in the position of lying on the floor)	For pectoral muscles	341	440	292	1073
3	Special developing exercises for the muscles participating in the test exercise	For triceps	258	292	241	840
		For the muscles o the upper part of the back	54	58	18	130
		For the muscles of the lower part of the back	162	216	99	477
		Static exercises, sec	452	496	455	1403
4	General Developmental Exercises	For abdominal muscles	420	366	327	1113
		For thigh muscles	128	160	128	416
5	Total force load	Total retention time of static positions	452	496	455	1403 (23 min. 23 sec)
		Total number of repetitions in power training	1363	1554	1224	4141

In order to study the dynamics of body parameters the participants of the experiment were subjected to a two-fold anthropometric examination before and after the completion of the training program.

Anthropometric indices of the body were determined according to the standard method by V. V. Bunak [8, 9] using a standard set of anthropometric instruments (centimeter tape, caliper, medical scales, and height meter). With the help of a centimeter tape the girths were defined: the chest in a pause, with the maximum inhalation and exhalation; waist, shoulder in a relaxed and tensed state, forearm, buttocks, thigh, calf. Using the caliper, the thickness of the skin-fat folds was measured in seven places: on the shoulder in front, on the shoulder behind, on the forearm, on the abdomen, on the back, on the thigh in front, on the calf.

To study the dynamics of the component composition of the body, analytical formulas by J. Matiegka (1921) were used[10]:

D=1,3×d×S, where D is the absolute mass of the body fat component (kg), S is the surface area of the body (m^2) = (100 + body weight + height - 160) / 100, d - (average thickness of skin-fat folds (mm), on the right side of the body, on the shoulder in the front, on the shoulder behind, on the forearm, on the abdomen, on the back, on the thigh in front, on the calf) / 2.

$M = 6{,}5 \times L \times r^2$, where M is the absolute mass of the muscle component (kg), L is the length of the body (cm), r = (the sum of the girths (cm) on the right side (the shoulder of the relaxed, forearm, hip, calf) / 25,12) – (total thickness of fat folds (mm) on the shoulder (front and back), forearm, thigh, calf / 100).

To analyze the results and to reveal their reliable change methods of mathematical-statistical processing were used. The arithmetic average value (X), the average square deviation (σ), the average error of the arithmetic average (m), the reliability of the dynamics of the results (p) were calculated according to Student's t-test.

To study the subjective evaluation of the impact of the training program a questionnaire was used. The questionnaire included questions about how the performance of the training program affected the physique and physical fitness indicators, the emotional state.

3. Results and Discussion

Table 3 presents the results of the level and dynamics of absolute and relative parameters of fat and muscle components in the body before and after the completion of the training program for complex physical training. It can be seen from this table that significant changes occur both in absolute ($p<0,05$) and in relative indicators of the fat component in the body of girls ($p<0,01$). However, despite the fact that in absolute and relative indicators of muscle mass of the body there is a tendency for increase, there was no significant increase in these indicators ($p>0,05$).

Of considerable interest is the analysis of the results showing the effect of the training program on the dynamics of the girth indicators of different parts of the body. It can be seen from Table 3 that there is a general tendency for reduction except for the shoulder circumference. The size of the girth of the shoulder practically does not change during the training program. The average value of the decrease rates of 6 body girths was 1.3%. The total value of 6 body girths decreased by 3.8 cm. However, there was no significant decrease in body girth, $p>0.05$. It is noteworthy that according to the tempo of the tendency for the body girths to decrease, the waist, chest, buttocks and thighs girths occupy the leading positions. The shoulder girth indicator unlike the other girths remained practically unchanged at the end of the experiment, which appears to be related to the increase in muscle mass due to the most intensive inclusion during the performance of the training program.

Table 3". Dynamics of indicators of the physique of girls within the period of the training program

№	Parameters	At the beginning of the semester n=48	At the end of the semester n=48	Dynamics, %	Reliability of differences (p), according to Student's t-test
		X±m	X±m		
1	Body fat mass, kg	13,1± 0,9	10,7± 0,6	-18,32	p<0,05
2	Relative body fat mass, %	25,1 ±1,0	20,4± 1,1	-18,73	p<0,01
3	Muscle body mass, kg	21,3±3,08	22,1±0,8	3,76	p>0,05
4	Relative muscle body	40,9±0,84	42,4±0,96	3,70	p>0,05

	mass, %				
5	Chest girth, cm	82,8±0,85	81,8±0,88	-1,21	p>0,05
6	Waist girth, cm	68,0± 2,2	67,0± 1,0	-1,47	p>0,05
7	Hip girth, cm	51,4 ±0,9	50,9±0,8	-0,97	p>0,05
8	Calf girth, cm	32,6±0,5	32,3±0,5	-0,93	p>0,05
9	Shoulder girth, cm	23,5±0,5	23,5±0,35	0	p>0,05
10	Forearm girth, cm	22,0±0,28	21,8±0,28	-0,92	p>0,05
11	Thigh girth, cm	84,7±2,1	83,7±1,9	-1,18	p>0,05
12	Total sum of the girths, cm	343,0± 4,3	339,2± 3,7	-1,11	p>0,05
13	Body weight, kg	52,01±1,4	51,96±1,3	-0,10	p>0,05

It is important to analyze the features of the dynamics of the thickness of different skin-fat folds. The average rate of significant decrease ($p<0,01$) of the thickness of the skin-fat folds in different parts of the body is close to one for all values – 17.5% ± 0.16, except for the dynamics of reduction of the skin-fat fold on the calf (table 4). In general, the dynamics of reducing the thickness of
subcutaneous fat layer in different parts of the body is close to the same value, in spite of the fact that the absolute amount of fat layer in these parts of the body is different.

Analysis of the dynamics of body weight, in general, shows that its value does not change during the period of the training program. To a large extent this is due to the improvement of the body composition – with a decrease in fat and an increase in muscle.

Table 4:. Features of the dynamics of the indices of thickness of skin-fat folds within the period of the training program

№	Skin-fat folds	At the beginning of the semester n=48	At the end of the semester n=48	Dynamics, %	Reliability of differences (p), according to Student's t-test
		X±m	X±m		
1	On the shoulder in the front (biceps), mm	8,2±0,51	6,9±0,71	-15,9	p>0,05
2	On the shoulder behind the triceps, mm	15,1±0,86	12,8±0,67	-15,2	p<0,05
3	On the forearm, mm	6,8±0,43	5,6±0,43	-17,6	p>0,05
4	On the abdomen, mm	17,4±0,68	13,9±0,83	-20,1	p<0,01
5	On the shoulder blade, mm	9,1±0,98	7,4±0,59	-18,7	p<0,01
6	On the thigh, mm	22,8±0,47	18,8±1,1	-17,5	p<0,01
7	On the calf, mm	12,2±0,75	8,9±0,83	-27,0	p<0,01
8	Total sum of skin-fat folds, mm	91,6±5,0	74,2±4,3	-19,00	p<0,01

To establish a more complete picture of the effect of the training program on girls, the results of a questionnaire survey were analyzed. They contained answers to questions reflecting a subjective evaluation of the results of the training program. The analysis of the questionnaire data revealed a positive influence on both the emotional and the physical state for a significant number of those involved in the training program (Table 5).

Table 5:. Subjective evaluation of girls about the influence of the training program

Types of assess-ments	Assessment of the impact on emotions,%	Assessment of the effect on the phy-sique,%	Assessment of the effect on the level of physical fitness,%
positive	81,3	81,3	96,9
neutral	18,7	15,6	3,1
negative	0	3,1	0

A significant number of positive reviews from girls (94%) of different years of study were given in the diaries of the training program. It can be seen from the above subjective assessments that the training program allowed the girls to improve their physique, to increase the level of physical fitness and to form a positive subjective assessment of its impact on the physical and emotional side of those who were involved in the experiment.

4. Summary

Thus, the obtained results indicate that the implementation of the training program allowed to reduce the fat layer in the body of girls. The absolute fat layer of the body decreased by 2.4 kg (from 13.1 ± 0.9 to 10.7 ± 0.6). The relative fat layer of the body decreased by 4.7% (from 25.1 ± 1.0 to 20.4 ± 1.1). The level of decrease in the parameters of the fat component is approximately similar to the data presented in Buikov's work, achieved with the use of power aerobics[4]. However, according to the rate indicator, the decrease in the absolute and relative parameters of body fat in our study occurred for a period 2 times shorter. Such differences, apparently, can be explained by the presence of a higher share in the training program of energy-consuming power load, the completion of which according to research allows to increase the level of metabolism during the recovery period after training and to increase the body's ability to expend fat reserves after the training of [11, 12, 13].

It was revealed that the combination of aerobic and power loads programmed in the presented training program contributed to a reduction in the total thickness of skin-fat folds from 91.6 ± 5.0 mm to 74.2 ± 4.3 mm. There is approximately the same rate of decrease in the thickness of the skin-fat folds - 17.5% ± 0.16, despite the fact that the volume of force load for different muscle groups in the measured areas of the body was different. The results obtained on the features of reducing the thickness of skin-fat folds in different parts of the body are confirmed by data from other studies [11, 12, 13].

The training program helped to maintain the level of development of muscle mass in the body of girls. There was an unreliably significant tendency for its increase within the training cycle by 3.76% (from 21.3 ± 3.08 to 22.1 ± 0.8 kg). This suggests that the power load which lasts 1 hour per week on average, allows to maintain the available muscle mass with a tendency for its increase. Analysis of the results of other studies [Bukova] shows that classes of traditional physical education program at the university also lead to the preservation of muscle mass, but the relative muscle mass decreases reliably by 2% within a year.

During the implementation of the training program, there was noted a general tendency for reduction of the body girth by 3.8 cm in the total of six body girths from 343.0 ± 4.3 to 339.2 ± 3.7 cm, but there was no significant reduction in their size. The training program also allowed to keep the body weight unchanged. This is largely due to the improvement of the body composition.

Analysis of subjective evaluations of the results of the training process allowed to establish positive assessments of a significant number of those involved (81.3%) on the impact of the training program. Both the emotional and physical condition of girls have

improved. In evaluative judgments the girls mostly noted that the physique has tightened, the muscles acquired tone and relief.
Thus, the completion of the training program of complex physical training allowed to achieve a positive effect on the physique of girls: to reduce the fat layer, to maintain the level of muscle mass, body weight, body girths, gain muscle tone, positively affect the emotional state and subjective assessments of the dynamics of their physique.

5. Conclusions

The problem of assessing the impact of training programs on the dynamics of bodybuild indices requires further study and improvement in accordance with modern requirements and methods.
The completed study on the evaluation of the impact of the integrated training program allows to make a detailed description of the program effect used on the physique of girls, to predict the results of its use, to make further adjustments depending on the goals of physical improvement.

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