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EFFECT OF CIRCULAR WORKOUT ON MUSCLE STRENGTH OF FEMALE STUDENT

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ABSTRACT

The testing was conducted during the winter semester of the academic year 2016/2017. The study contingent consists of 69 female students from the Faculty of Agriculture, the Faculty of Veterinary Medicine and the Faculty of Economics at the Trakia University of Stara Zagora. They were divided into two groups - experimental and control. The purpose of this study is to determine the effect of circular workouts on the level of physical quality of muscle strength of Trakia University female students. To achieve our goal, we set out the following tasks - researching literature sources, developing and testing a specialized fitness model, developing a test battery, processing and analyzing the data from the testing. The following methods were used - pedagogical experiment, testing, variational analysis, comparative analysis, graphical method. A test battery has been developed. The results and analysis show that the experiment is successful and the developed fitness program is effective. Effectiveness of developed authors fitness model, based on circular workout, as part of the overall fitness training of the female students, for priority development of motor quality "strength" is experimentally justified.

Key words: university, students, experiment

INTRODUCTION

In the recent decades people have witnessed an extremely negative trend of declining physical activity of humanity and young people in particular. The technical revolution and the rapid development of technology are affecting the quality of life. Man eats less and less proper food and moves less and less. Many scientific publications address the issue of reviewing and correcting the levels of physical activity of adolescents and students, taking into account the results of recent research on their physical condition. The data are indisputable and show a decrease in human motor activity.

The years spent in high school are an important stage in the formation of future professionals and citizens of our society. The student years are a period when the foundations of a person's creative longevity are laid, but this is a period in which he is characterized by immobilization of the body and increased emotional and neuro-psychological tension. The diseases of the various systems in the body, anomalies, allergies, etc. are increasing. The deterioration of the working capacity and vitality of the student youth requires the mass introduction of physical education and sports in the daily educational process at the university and its optimization. The nature and content of physical education in higher education is determined by the characteristics of this category of students, the conditions of the classes and the nature of their future profession (1). The purpose of physical education in higher education is to assist in the training of harmoniously developed and highly qualified specialists (2).

Man's physical capacity and the issues associated with it have excited generations. Strength as a physical quality of man is the basis of motor activity. Thanks to the force, to its development, we are able to perform both daily work and to react in an extreme situation for the body. Man's strength can be defined as his ability to overcome external resistance or to counteract it at the expense of muscular effort (3). The functional features of the strength

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capabilities (of the musculature) are reduced to the functional state of the neuromuscular apparatus of the practitioners and the innervation of the muscular muscles.

A number of studies have been conducted on students about the influence of different motor activities on physical qualities and in particular on muscle strength (4 - 6). Modern research in the field of sports shows that in order to improve muscle strength in terms of factors and mechanisms of energy metabolism and autonomic systems, there are serious reservations.

The aim of the present study is to determine the influence of circuit training on the level of physical quality and muscle strength of female students at the Trakia University.

METHODS

To achieve this goal the following *tasks* are set:

- to make a literature study of the problem.
- to develop and test a specialized fitness model.
- to develop a test battery.
- to conduct a pedagogical experiment.
- to process and analyze the data from the conducted testing.

Research methods:

- Pedagogical experiment
- Testing
- Variation analysis
- Comparative analysis
- Graphic method

The contingent of the study are 69 female students with an average age of 20.04 years old from the first and second year of three different faculties of the Trakia University - Faculty of Economics, Faculty of Agriculture and Faculty of Veterinary Medicine. They were divided into two groups. Experimental group of 36 students - with her were conducted circuit training on a particular fitness model twice a week for 30 weeks. A control group of 33 students, who studied according to an approved curriculum for the discipline "Physical Education and Sports". The testing was conducted in the 2016/2017 school year.

The test battery includes the following tests:

Test - Jump length from a place

It is performed on a hard surface. The jump is preceded by preparatory actions, including the execution of a half-squat with a swing of the upper limbs down and back. When bouncing, the arms swing back and forth. It is measured in centimeters to the nearest 1 cm. Two experiments are performed, entering the better of them. Test

Test - Dynamometry

The dynamometer is placed comfortably in the hand with the scale outside. Without resting his hand on the body or elsewhere, the face squeezes the dynamometer sharply, quickly and as hard as possible. The test is repeated 2 times with a pause every 1 minute and the obtained higher value is read. The measurement accuracy is 2 kg.

Test - Throwing a medical ball 3 kg forward

Starting position standing with slightly open legs and the ball held with both hands above the head. After a swing backwards, the subject throws the ball forward and upward. Three experiments are performed, which are read with an accuracy of 10 cm. Enter the best result.

Test - Throwing a medical ball 3 kg backwards

Starting position standing with slightly open legs and the ball caught with both hands between the legs. The legs are bent at the knees. The body is turned with its back in the direction of the throw. The heels are on the throw line. The body straightens quickly and sharply, the knees unbend and the arms throw the ball back and up over the head. Three experiments are performed, which are read with an accuracy of 10 cm. Enter the best result.

RESULTS

Table 1. *Comparison of the arithmetic mean values of the attribute long jump from the place - before and after applying the specialized fitness model*

Jump length from one place	n	First		Second		d	d%	Cohen's d	t	α
			S_1		S_2					
Experimental	36	139,72	16,53	156,47	13,63	16,75	11,99	1,87	11,23	0,000
Control	33	143,39	16,93	143,94	18,15	0,55	0,38	0,07	0,38	0,710
d		-3,67		12,53		16,20				
Cohen's d		-0,220		0,735		1,37				
Eta^2		0,111		-0,370		0,69				
t		0,91		3,26		7,76				
α		0,365		0,002		0,000				

The results in the test "jump in length from place" of the two groups in the first study varied between 100 and 170 cm, with an average value of the experimental group is 139.7 cm, and the control group - slightly higher - 143.4 cm. The coefficients of variation are around 11%, which shows a similar level of variability of the results. In the second study, a concentration of the experimental group results was observed around the average value of 156.47 cm, with the variation of the values decreasing (V = 8.7%). The achievements of the subjects from the control group have approximately the same average value - 143.94 cm and variability (V = 12.61%), as in the initial testing. The calculated values of the coefficients of asymmetry (As is between 0.53 and 0.97) and excess (Ex is between 0.04 and 0.91) are within the critical range, which shows that the distribution of the results is normal.

The results of the experiment in the test "jump in length from the place" are presented in **Table 1** and illustrated in **Figure 1**. The students from the experimental group showed an average value of 139.72 cm in the entrance tests, and in the outgoing - an average value of 156.47 cm. The students from the control group showed the following results in the first study - average value 143.39 cm, in the second study 143.94 cm. The growth of the experimental group was 16.75 cm (11.99%). It is statistically significant ($t = 11.23$, $\alpha = 0.000$) and large from a practical point of view (Cohen's d = 1.87). The control group performed little from a practical point of view (d = 0.55 cm, Cohen's d = 0.07) and unreliable ($t = 0.38$, $\alpha = 0.71$) improvement of the results. The difference between the increments of the two groups is 16.20 cm, which shows a large (Cohen's d = 1.37) and statistically significant ($t = 7.76$, $\alpha = 0.00$) effect of the conducted fitness model. The Eta2 coefficient shows that 69% of the differences in the growth rates of the speed-force capabilities of the lower extremities in the experimental period are due to the applied means. This further emphasizes their high efficiency.

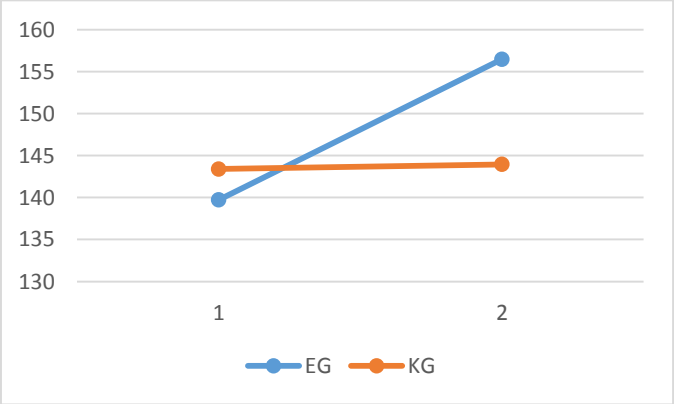

Figure 1. Jump length from one place

Table 2. *Comparison of the arithmetic mean values of the sign of dynamometry (non-dominant hand) - before and after the application of the specialized fitness model*

Dynamometry (left hand)	n	I research		II research		d	d%	Cohen's d	t	α
			S_1		S_2					
Experimental	36	11,36	4,44	13,25	4,07	1,89	16,63	0,61	3,68	0,001
Control	33	12,06	3,74	12,67	3,10	0,61	5,03	0,22	1,25	0,220
d		-0,70		0,58		1,28				
Cohen's d		-0,170		0,161		0,43				
Eta^2		0,086		-0,081		0,22				
t		0,70		0,66		1,81				
α		0,484		0,508		0,075				

The results in the test "dynamometry - unsteady arm" of the two groups in the first study varied between 3 and 20 kg, with an average value of the experimental group is 11.36 kg, and the control group - slightly higher - 12.06 kg. The coefficients of variation are over 30%, which shows a high level of variability of the results. In the second study, a concentration of the experimental group results was observed around the average value of

13.25 kg, with the variation of the values decreasing (V = 30%). The achievements of the subjects from the control group have approximately the same average value - 12.67 kg and variability (V = 24.47%), less than the initial testing. The calculated values of the coefficients of asymmetry (As is between 0.53 and 0.97) and excess (Ex is between 0.04 and 0.91) are within the critical range, which shows that the distribution of the results is normal.

The results of the experiment on the test "dynamometry (non-dominant hand)" are presented in **Table 2** and illustrated in **Figure 2.** The students from the experimental group showed an average value of 11.36 kg in the entrance tests, and in the outgoing - an average value of 13.25 kg. The students from the control group showed the following results in the first study - average value 12.06 kg, in the second study 12.67 kg. The gain of the experimental group was 1.89 kg (16.63%). It is statistically significant (t = 3.68, α = 0.00) and significant from a practical point of view (Cohen's d = 0.61). The control group performed little from a practical point of view (d = 0.61 kg, Cohen's d = 0.22) and unreliable (t = 1.25, α = 0.22) improvement of the results. The difference between the gains of the two groups is 1.28 kg, which shows a moderate (Cohen's d = 0.43) and statistically insignificant (t = 1.81, α = 0.07) effect of the conducted fitness model. The Eta2 coefficient shows that 22% of the differences in the growth rates of the strength capabilities of the upper extremities in the experimental period are due to the training tools applied by us. This shows that the fitness model does not have a great influence on the grip strength of the non-dominant hand.

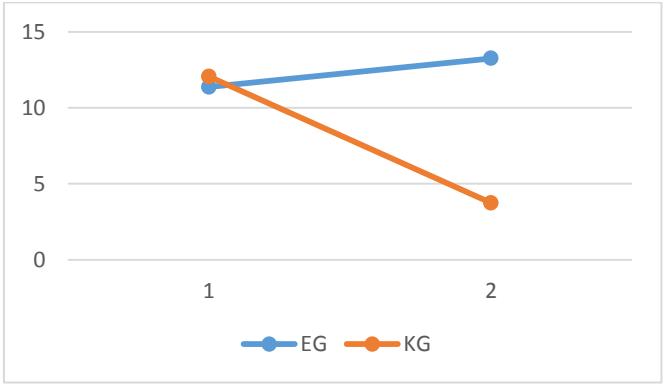

Figure 2. Dynamometry (non-dominant hand)

Table 3. *Comparison of the arithmetic mean values of the sign of dynamometry (dominant hand) - before and after the application of the specialized fitness model*

Dynamometry (right hand)	n	I research		II research		d	d%	Cohen's d	t	α
			S_1		S_2					
Experimental	36	14,22	4,21	15,36	4,63	1,14	8,01	0,34	2,01	0,052
Control	33	14,91	3,91	15,15	3,66	0,24	1,63	0,14	0,80	0,427
d		-0,69		0,21		0,90				
Cohen's d		-0,169		0,050		0,33				
Eta^2		0,085		-0,025		0,16				
t		0,70		0,21		1,40				
α		0,486		0,836		0,167				

The results in the test "dynamometry - dominant arm" of the two groups in the first study varied between 9 and 22 kg, with an average value of the experimental group is 14.22 kg, and the control group - slightly higher - 14.91 kg. The coefficients of variation are about 27%, which shows a similar level of variability of the results. In the second study, the results of the experimental group were observed for the average value of 15.36 kg, with the variation of the values increasing slightly (V = 30%). The achievements of the subjects from the control group have approximately the same average value - 15.15 kg and variability (V = 24.14%), less than the initial testing. The calculated values of the

coefficients of asymmetry (As is between 0.53 and 0.97) and excess (Ex is between 0.04 and 0.91) are within the critical range, which shows that the distribution of the results is normal. There is an exception in the second study of the experimental group, where the values are higher.

The results of the experiment in the test "dynamometry (dominant hand)" are presented in **Table 3** and illustrated in **Figure 3**. The experimental group students showed an average value of 14.22 kg in the entrance tests, and in the outgoing - an average value of 15.36 kg. The students from the control showed the following results in the first study - average value 14.91 kg, in the second study 15.15 kg. The gain of the experimental group was 1.14 kg (8.01%). It is statistically significant (t = 2.01, α = 0.05) and moderate from a practical point of view (Cohen's d = 0.34). The control group performed little from a practical point of view (d = 0.24 kg, Cohen's d = 0.14) and unreliable (t = 0.80, α = 0.43) improvement of the results.

The difference between the gains of the two groups is 0.90 kg, which shows a moderate (Cohen's d = 0.33) and statistically insignificant (t = 1.40, α = 0.17) effect of the conducted fitness model. The Eta2 coefficient shows that 16% of the differences in the growth rates of the strength capabilities of the upper extremities in the experimental period are due to the training tools applied by us. This shows that the conducted fitness model does not have a great influence on the grip strength of the dominant hand.

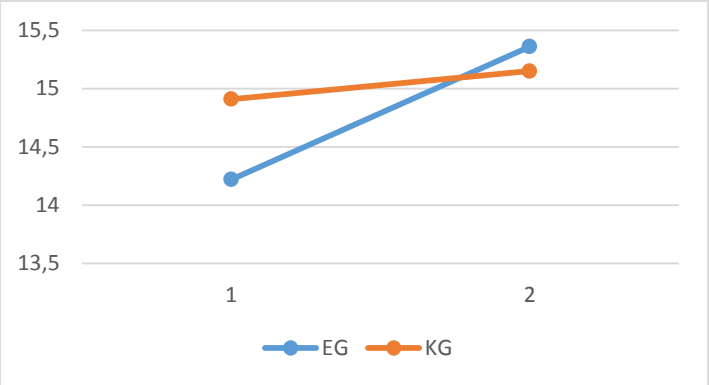

Figure 3. Dynamometry (dominant arm)

Table 4. *Comparison of the arithmetic mean values of the throwing sign medical ball forward - before and after applying the specialized fitness model*

Throwing a medical ball forward	n	I research		II research		d	d%	Cohen's d	t	α
			S_1		S_2					
Experimental	36	413,61	43,04	452,50	51,73	38,89	9,40	1,26	7,56	0,000
Control	33	423,33	40,98	424,55	40,78	1,21	0,29	0,04	0,23	0,818
d		-9,72		27,95		37,68				
Cohen's d		-0,231		0,576		1,06				
Eta^2		0,116		-0,290		0,53				
t		0,96		2,48		5,13				
α		0,341		0,016		0,000				

The results in the test "throwing a medical ball forward" of the two groups in the first study varied between 330 and 550 cm, as the average value of the experimental group is 413.61 cm, and the control group - slightly higher - 423 cm. The coefficients of variation for the experimental group are 10.41% and for the control group is 9.68%, which shows a low level of variability of the results. In the second study, average values of the experimental group 452.50 cm were observed, as the variation of the values slightly increased (V = 11.43%). The achievements of the subjects from the control group have approximately the same average value - 424.55 cm and variability (V = 9.61%), lower than in the initial testing. The calculated values of the coefficients of asymmetry (As is between 0.53 and 0.97) and excess (Ex is between 0.04 and 0.91) are within the critical range, which shows that the distribution of the results is normal.

The results of the experiment in the test "throwing a medical ball forward" are presented in **Table 4** and illustrated in **Figure 4.** The experimental group students showed an average value of 413.61 cm in the entrance tests, and in the outgoing tests - an average value of 452.50 cm. The students from the experimental group showed the following results in the first study - average value 423.33 cm, in the second study - 424.55 cm. The growth of the experimental group was 38.89 cm (9.40%). It is statistically significant (t = 7.56, α = 0.000) and large from a practical point of view (Cohen's d = 1.26). The control group performed little from a practical point of view (d = 1.21 cm, Cohen's d = 0.04) and unreliable (t = 0.23, α = 0.82) improvement of the results.

The difference between the increments of the two groups is 37.68 cm, which shows a large (Cohen's d = 1.06) and statistically significant (t = 5.13, α = 0.00) effect of the conducted fitness model. The Eta2 coefficient shows that 53% of the differences in the growth rates of the speed-strength capabilities of the arm muscles in the experimental period are due to the applied means. This emphasizes their high efficiency.

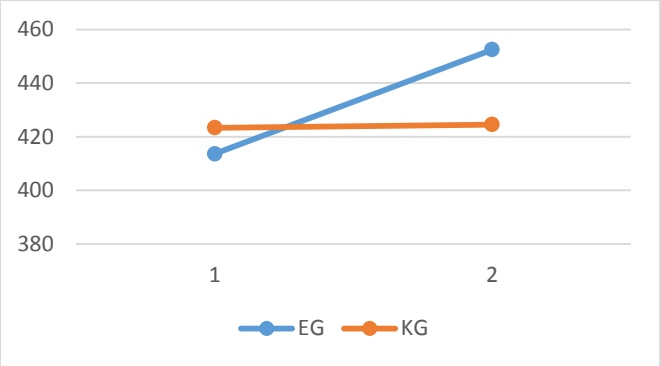

Figure 4. Throwing a medical ball forward

Table 5. *Comparison of the arithmetic mean values of the throwing sign medical ball back - before and after applying the specialized fitness model*

Throwing a medical ball backwards	n	I research		II research		d	d%	Cohen's d	t	α
			S_1		S_2					
Experimental	36	443,06	78,11	493,89	70,28	50,83	11,47	0,86	5,18	0,000
Control	33	432,12	51,65	435,45	46,31	3,33	0,77	0,13	0,76	0,451
d		10,93		58,43		47,5				
Cohen's d		0,164		0,879		0,92				
Eta^2		-0,083		-0,442		0,46				
t		0,68		4,04		4,42				
α		0,499		0,000		0,000				

The results in the test "throwing a medical ball backwards" of the two groups in the first study vary between 300 and 700 cm, with an average value of the experimental group is 443.06 cm, and the control group - slightly lower - 432. The coefficients of variation are 17.63%, and for the control group is 11.95%, which shows a similar level of variability of the experimental results and low level of variability of the control group. In the second study, average values of the experimental group 493.89 cm were observed, as the variation of the values slightly decreased (V = 14.23%). The achievements of the control group subjects have approximately the same average value of 435.45 cm and variability (V = 10.63%), lower than in the initial testing. The calculated values of the coefficients of asymmetry (As is between 0.53 and 0.97) and excess (Ex is between 0.04 and 0.91) are within the critical range, which shows that the distribution of the results is normal.

The results of the experiment in the test "throwing a medical ball back" are presented in **Table 5** and illustrated in **Figure 5.** The students from the experimental group showed an average value of 443.06 cm in the entrance tests, and in the outgoing tests - an average

value of 493.89 cm. The students from the control group showed the following results in the first study - average value 432.12 cm, in the second study 435.45 cm. The growth of the experimental group was 50.83 cm (11.47%). It is statistically significant ($t = 5.18$, $\alpha = 0.000$) and large from a practical point of view (Cohen's $d = 0.86$). The control group performed little from a practical point of view ($d = 3.33$ cm, Cohen's $d = 0.13$) and unreliable ($t = 0.76$, $\alpha = 0.45$) improvement of the results. The difference between the increments of the two groups is 47.50 cm, which shows a large (Cohen's $d = 0.92$) and statistically significant ($t = 4.42$, $\alpha = 0.00$) effect of the conducted fitness model. The Eta2 coefficient shows that 46% of the differences in the growth rates of the speed-strength capabilities of the muscles of the arms and back in the experimental period are due to the applied means. This emphasizes their high efficiency.

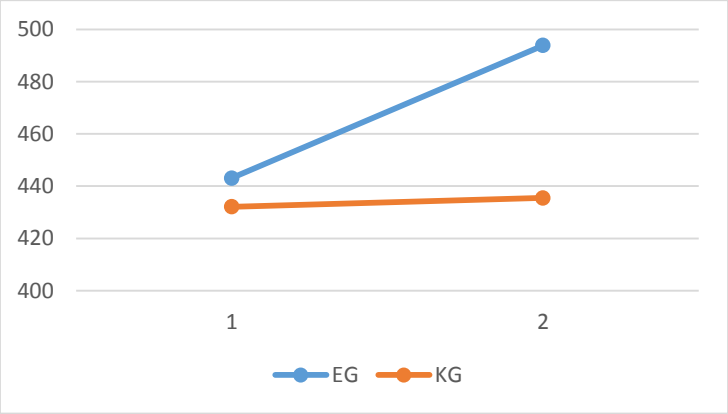

Figure 5. Throwing a medical ball backwards

CONCLUSIONS

The effectiveness of the developed author's fitness model, based on a circular training, as part of the overall fitness training of the students, is a priority for development.

RECOMMENDATIONS

- Application of circuit training to develop the physical quality of muscle strength.
- Conducting educational work to convince female students that the level of muscle strength is directly related to health and level of performance.
- Activation of female students for the development of the quality of muscular strength in the classes of Physical Education and Sports.

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