INFLUENCE OF THE CIRCULAR TRAINING ON STRENGTH ENDURANCE OF FEMALE STUDENTS

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ABSTRACT
The contingent of the study are 69 female students with an average age of 20.04 years from the first and second year of three faculties of the Thracian University - Economics, Agriculture and Veterinary Medicine. They were divided into two groups. Experimental group of 36 students - with it were conducted circuit training 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 aim of the study is to determine the influence of circuit training on the level of physical strength strength endurance of female students from Thracian University. To achieve this goal we used the following methods: testing, pedagogical experiment, variation analysis, comparative analysis, graphical analysis. The developed test battery includes five tests. After using mathematical methods of analysis, we can draw the following conclusion: circuit training improves the strength endurance of female students.

Key words: special endurance, university, experiment

INTRODUCTION
The constant development of science, technical progress, the growing amount of information used by students and other factors affect the nature of the learning process in university. For their successful realization in life during their studies, they must seriously and thoroughly master the professional knowledge and skills they need. Their daily life becomes more and more intense and tense, and their educational employment is constantly increasing. The educational and labor activity of the students takes place in a uniform posture and insufficient locomotor mode (1-5). This in turn leads to immobility, emotional and mental stress, chronic fatigue, stress, lowering the level of physical capacity and increasing the risk of various diseases (6).

The issue of the health of the young generation, their locomotor activity and physical capacity is

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becoming more and more relevant. Exercise appears as an alternative to these harmful phenomena. They stimulate mental performance, work activity, metabolic processes in the body and are a factor in strengthening the health and increasing resistance to disease in students (7, Yankova).

The Aim of the research is to establish the influence of the circular training on the level of physical quality, strength endurance of female students from Trakia University.

METHODOLOGY
To achieve this goal we set the following tasks:
1.   To make a literary study of the problem.
2.   To develop and approbation a specialized fitness model.
3.   To develop test battery .
4.   To conduct a scientific experiment .
5.   To process and analyze the data from the conducted testing.

Research methods:
1. Testing
2. Pedagogical experiment

3. Variation analysis
4. Comparative analysis
5. Graphic analysis

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

The test battery includes the following tests:
    Test 1**:** Height to failure
Stepping on a chair or bench and grasping the lever at shoulder width. At the "Start!" Signal, the chair is moved and the chronometer is started. The chronometer stops when the lever is released. The test is performed until canceled. Time is measured to the nearest 1s.
    Test 2: Dumbbell retention 2 kg

Raise your arms sideways to a horizontal position. The palms are turned down holding the dumbbells. One attempt is performed until it fails. Time is measured to the nearest 1 s.
    Test 3: Plank
Standing in a push-up position. Fold your elbows at a right angle, placing them on the ground and transferring the weight of your body to them and the forearms. The elbows should be just below the shoulders, and the body should be straight, forming a straight line from head to toe. Retention until failure. Time is measured to the nearest 1s.
    Test 4: Knee push ups until failure
Knee support is taken, the arms are wider than the width of the shoulders. The arms are folded and unfolded, with the arms parallel to the floor, the elbows facing outwards. The test is performed until canceled
    Test 5: Sit ups to failure
The student stands in the starting position with the back of the head, hands behind the head, with the legs in the knees pressed by another student so that they do not bend. Straighten the body to a right angle (90°) and return to the starting position. The test is performed until canceled.

RESULTS ANALYSIS

Table 1. *Comparison of the arithmetic mean values of the attribute Height to failure- before and after applying the specialized fitness model*

Height to failure	n	First		Second		d	d%	Cohen's d	t	Sig
		$\overline{X_1}$	S₁	$\overline{X_2}$	S₂					
Experimental	36	31,72	16,04	43,94	23,37	12,22	38,53	0,72	4,34	0,000
Control	33	32,39	16,17	32,61	13,89	0,21	0,65	0,03	0,17	0,863
d		-0,67		11,34		12,01				
Cohen's d		-0,042		0,564		0,84				
Eta2		0,021		-0,284		0,42				
t		0,17		2,47		3,91				

The results in the test „Height to failure" of the two groups in the first study varied between 3 and 71 s, as the average value of EG is 31.72 s, and of KG - slightly higher - 32.39 s. The coefficients of variation are about 50%, which shows a high level of variability of the results. In the second study, average values of EG 43.94 s were observed, as the variation of the values increased (V = 53.17%). The achievements of the subjects from CG have approximately the same average value - 32.61 s and variability (V = 42.61%), slightly 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. There is an exception in the second study of EG, where the values are higher.

The results of the experiment in the test "to failure" are presented in **Table 1** and illustrated in **Figure 1.** EG students showed an average value of 31.72 s in the entrance tests, and an average value of 43.94 s in the outgoing tests. The students from KG showed the following results in the first study - average value 32.39 s, in the second study 32.61 s. The growth of the experimental group is 12.22 s (38.53%). It is statistically significant (t = 4.34, α = 0.000) and significant from a practical point of view (Cohen's d = 0.72). The control group performed little from a practical point of view (d = 0.21 s,

Cohen's d = 0.03) and unreliable (t = 0.17, α = 0.86) improvement of the results.

The difference between the increments of two groups is 12.01 s. which shows a large (Cohen's d = 0.84) and statistically significant (t = 3.91, α = 0.00) effect of the conducted fitness model. The Eta2 coefficient shows that 42% of the differences in the growth rates of the strength capabilities of the arm muscles in the experimental period are due to the training aids used by us. This emphasizes their effectiveness.
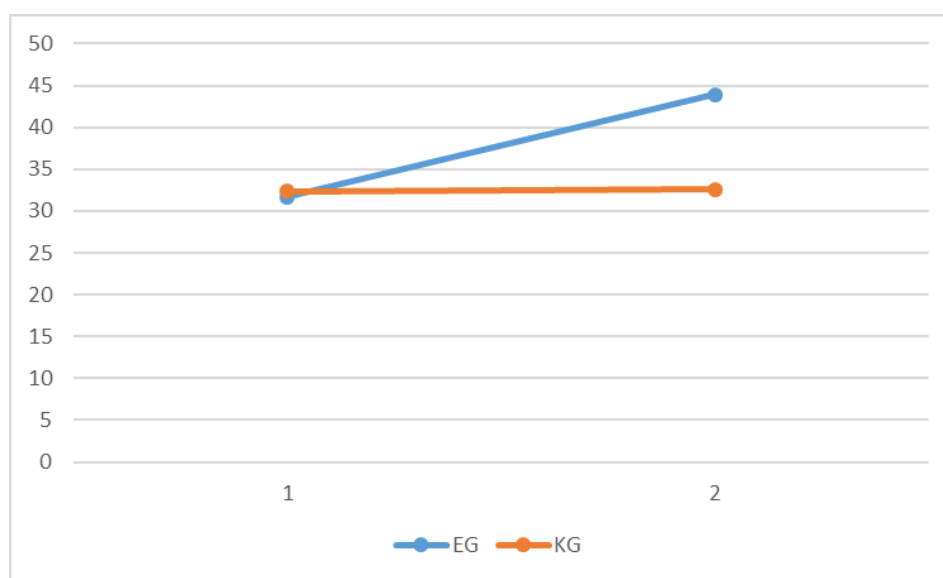

Figure 1. Height to failure

Table 2. Comparison of the arithmetic mean values of the attribute dumbbell retention 2 kg - before and after applying the specialized fitness model

Dumbbell retention 2 kg	n	I research		II research		d	d%	Cohen's d	t	□
		$\overline{X_1}$	S₁	$\overline{X_2}$	S₂					
Experimental	36	53,81	17,07	69,06	20,55	15,25	28,34	1,40	8,42	0,000
Control	33	54,03	14,77	54,42	11,73	0,39	0,73	0,05	0,26	0,798
d		-0,22		14,63		14,86				
Cohen's d		-0,014		0,798		1,20				
Eta²		0,007		-0,401		0,60				
t		0,06		3,67		6,22				
α		0,954		0,000		0,000				

The results in the test "dumbbell retention 2 kg" of the two groups in the first study varied between 17 and 90 s, with an average value of EG is 53.81 s, and the CG - slightly higher - 54.03 s. The coefficients of variation for EG are 31.72%, and for CG is 27.33%, which shows a similar level of

variability of the results. In the second study, average values of EG of 69.06 s were observed, as the variation of the values decreased slightly (V = 29.76%). The achievements of the subjects from CG have approximately the same average value - 54.42 s and variability (V = 21.55%),

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 " dumbbell retention 2kg" are presented in **Table 2** and shown in **Figure 2.** EG students showed an average value of 53.81 s in the entrance tests, and an average value of 69.06 s in the outgoing tests. The students from KG showed the following results in the first study - average value 54.03 s, in the second study 54.42 s. The growth of the experimental group was 15.25 s (28.34%). It is

statistically significant (t = 8.42, α = 0.000) and large from a practical point of view (Cohen's d = 1.40). The control group performed little from a practical point of view (d = 0.39 s, Cohen's d = 0.05) and unreliable (t = 0.26, α = 0.80) improvement of the results.

The difference between the increments of the two groups is 14,86 s which shows a large (Cohen's d = 1.20) and statistically significant (t = 6.22, α = 0.00) effect of the conducted fitness model. The Eta2 coefficient shows that 60% of the differences in the growth rates of the strength capabilities of the shoulder muscles in the experimental period are due to the training tools we use. This emphasizes their high efficiency.
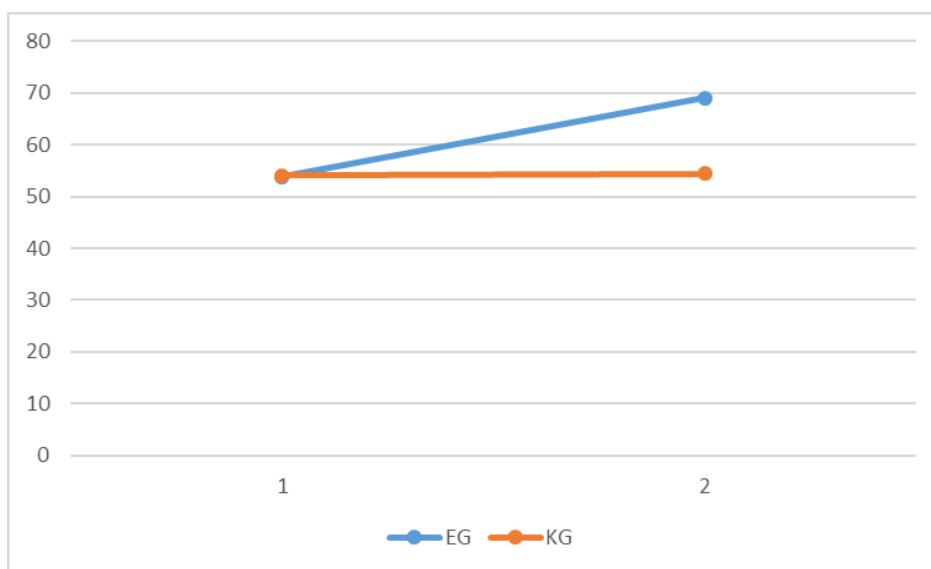

Figure 2. Dumbbell retention 2 kg

Table 3. Comparison of the arithmetic mean values of the attribute plank - before and after applying the specialized fitness model

Plank	n	I research		II research		d	d%	Cohen's d	t	α
		$\overline{X_1}$	S₁	$\overline{X_2}$	S₂					
Experimental	36	81,33	38,06	104,47	50,76	23,14	28,45	0,92	5,53	0,000
Control	33	65,61	20,22	65,00	17,66	-0,61	-0,92	0,08	0,44	0,666
d		15,73		39,47		23,74				
Cohen's d		0,497		0,913		1,07				
Eta²		-0,250		-0,460		0,54				
t		2,17		4,39		5,39				
α		0,034		0,000		0,000				

The results in the "plank" test of the two groups in the first study varied between 25 and 190 s,

with an average EG value of 81.33 s and a lower CG value of 65.61 s. The coefficients of variation

for EG are 46.79%, and for CG is 30.82%, which shows a high level of variability of the results. In the second study, average EG values were observed to be 104.47 s, with the variation of the values increasing slightly (V = 48.58%). The achievements of the subjects from CG have approximately the same average value - 65 s and variability (V = 17.16%), 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. An exception is made by the values of EG in the first study, where they show an asymmetry of 1.27.

The results of the experiment in the "plank" test are presented in **Table 3** and illustrated in **Figure 3**. EG students showed an average value of 81.33 s in the entrance tests, and in the outgoing tests - an average value of 104.47 s. The students from

KG showed the following results in the first study - average value 65.61 s, in the second study 65 s. The growth of the experimental group was 23.14 s (28.45%). It is statistically significant (t = 5.53, α = 0.000) and large from a practical point of view (Cohen's d = 0.92). The control group realized a negative increase (d = -0.61 s) and a little from a practical point of view (Cohen's d = 0.08) and unreliable (t = 0.44, α = 0.67) improvements.

The difference between the increments of the two groups is 23.74 s, which shows a large (Cohen's d = 1.07) and statistically significant (t = 5.39, α = 0.00) effect of the conducted fitness model. The Eta2 coefficient shows that 54% of the differences in the growth rates of the strength capabilities of the abdominal muscles in the experimental period are due to the training tools we use. This emphasizes their effectiveness.
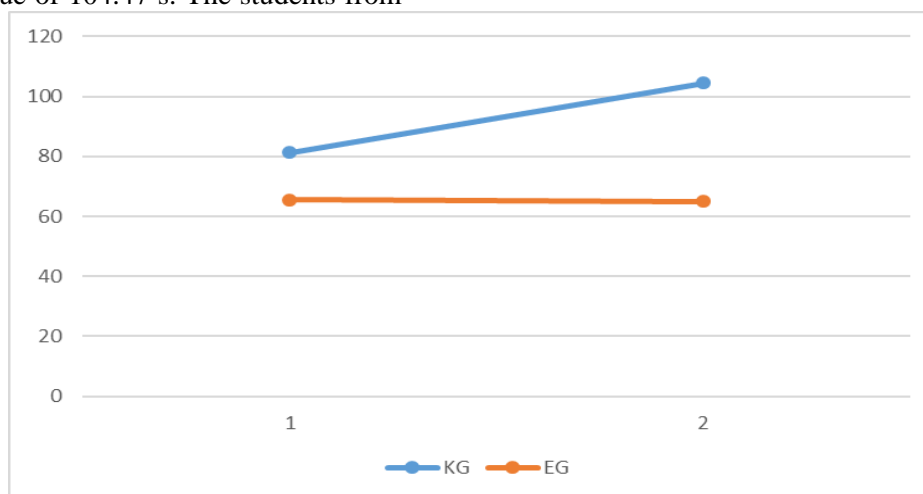

Figure 3. Plank

Table 4. *Comparison of the arithmetic mean values of the knee push ups until failure - before and after applying the specialized fitness model.*

Knee push ups until failure	n	I research		II research		d	d%	Cohen's d	t	α
		$\overline{X_1}$	S₁	$\overline{X_2}$	S₂					
Experimental	36	18,61	8,82	26,67	9,99	8,06	43,28	1,60	9,61	0,000
Control	33	18,06	7,28	18,45	5,69	0,39	2,18	0,15	0,86	0,399
d		0,55		8,21		7,66				
Cohen's d		0,068		0,898		1,37				
Eta²		-0,034		-0,452		0,69				
t		0,28		4,24		8,01				
α		0,779		0,000		0,000				

The results in the test " Knee push ups until failure" of the two groups in the first study varied

between 5 and 40 pcs, with an average value of EG is 18.61 pcs, and the CG - slightly lower than

6 - 18. The coefficients of variation for EG are 47.41%, and for CG is 40.28%, which shows a high level of variability of the results. In the second study, average values of EG were observed - 26.67 pcs, as the variation of the values decreased (V = 37.46%). The achievements of the subjects from the CG have approximately the same average value - 18.45 and variability (V = 30.83%), 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 " Knee push ups until failure" are presented in **Table 4** and illustrated in **Figure 4.** The students from EG showed an average value of 18.61 pcs in the entrance tests, and in the outgoing ones - an average value of 26.67 pcs. The students from

KG showed the following results in the first study - an average value of 18.06 pcs, in the second study 18.45 pcs. The growth of the experimental group was 8.06 (43.28%). It is statistically significant (t = 9.61, α = 0.000) and large from a practical point of view (Cohen's d = 1.60). The control group realized little from a practical point of view (d = 0.39 pcs, Cohen's d = 0.15) and unreliable (t = 0.86, α = 0.40) improvement of the results.

The difference between the increments of the two groups is 7.66 pcs, which shows a large (Cohen's d = 1.37) and statistically significant (t = 8.01α = 0.00) effect of the conducted fitness model. The coefficient Eta2 shows that 69% of the differences in the rates of increase of the strength endurance of the muscles of the upper experimental period are due to the applied means. This emphasizes their high efficiency.
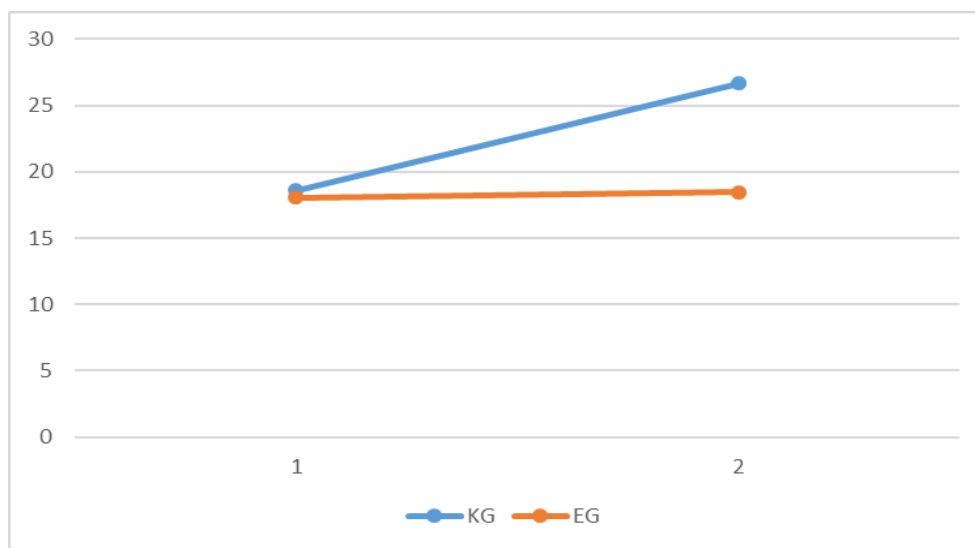

Figure 4. Knee push ups until failure

The results in the test "Sit ups to failure" of the two groups in the first study vary between 17 and 71 pcs, with an average value of EG is 42.19 pcs, and the lower KG - 33.30 pcs. The coefficients of variation for EG are 33.93%, and for CG is 24.12%, which shows a high level of EG variability and a similar level of variability of the CG results. In the second study there was an increase in the average values of EG - 51 pcs, as the variation of the values slightly increased (V =

34.72%). The achievements of the subjects from the CG have an increase in the average value - 34.82 units and variability (V = 20.70%), 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.

Table 5. Comparison of arithmetic mean values of the attribute Sit ups to failure - before and after applying a specialized fitness model

Sit ups to failure	n	I research		II research		d	d%	Cohen's d	t	α
		$\overline{X_1}$	S₁	$\overline{X_2}$	S₂					
Experimental	36	42,19	14,31	51,00	17,71	8,81	20,87	0,82	4,91	0,000
Control	33	33,30	8,03	34,82	7,21	1,52	4,55	0,46	2,65	0,012
d		8,89		16,18		7,29				
Cohen's d		0,712		1,019		0,83				
Eta²		-0,358		-0,513		0,42				
t		3,22		5,05		3,88				
α		0,002		0,000		0,000				

The results of the experiment in the test "Sit ups to failure" are presented in **Table 5** and illustrated in **Figure 5.** The students from EG showed an average value of 42.19 pcs in the entrance tests, and in the outgoing ones - an average value of 51 pcs. The students from KG showed the following results in the first study - average value 33.30 pcs, in the second study 34.82 pcs. The growth of the experimental group was 8.81 (20.87%). It is statistically significant (t = 4.91, α = 0.000) and large from a practical point of view (Cohen's d = 0.82). The control group performed moderate from a practical point of view (d = 1.52 pcs,

Cohen's d = 0.46) and reliable (t = 2.65, α = 0.01) improvement of the results.

The difference between the increments of the two groups is 7.29 pcs, which shows a large (Cohen's d = 0.83) and statistically significant (t = 3.88, α = 0.00) effect of the conducted fitness model. The Eta2 coefficient shows that 42% of the differences in the rates of increase of the strength endurance of the abdominal muscles in the experimental period are due to the training means applied by us. This emphasizes their high efficiency.
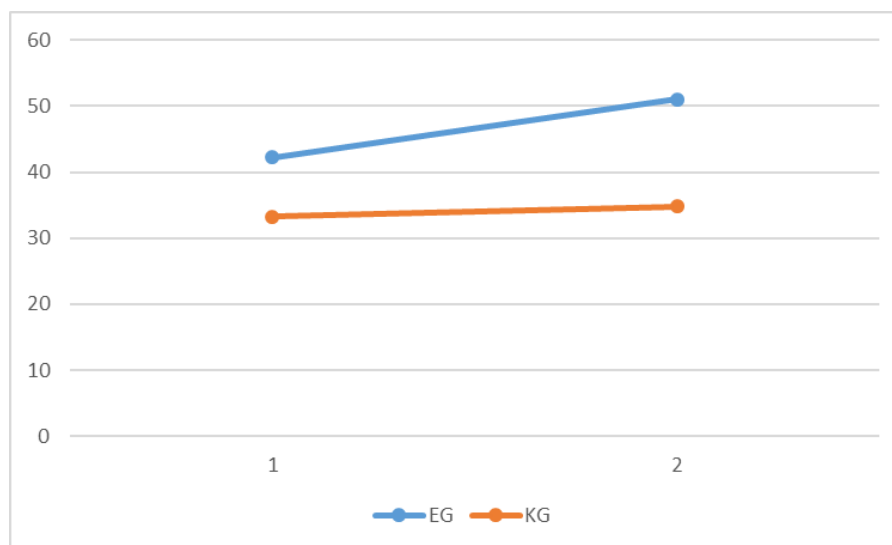

Figure 5. Sit ups to failure

The following conclusion can be drawn from the conducted **research:**
Circuit training improves students' strength support.

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