



INFLUENCE OF CIRCULAR EXERCISES ON THE CARDIOVASCULAR AND RESPIRATORY SYSTEM OF FEMALE STUDENTS

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ABSTRACT

The purpose of the present study is to determine the influence of circular exercises on the cardiovascular and respiratory systems of Trakia's University female students. To achieve this goal the following methods are used: testing, pedagogical experiment, variation analysis, comparative analysis, graphic analysis. 69 female students are the contingent of the study with an average age of 20.04 years old from the first and second school year, studying in three different faculties of the Trakia University - Faculty of Economics, Faculty of Agriculture and Faculty of Veterinary Medicine. They were divided into two groups. The experimental group of 36 female students - with this group was hold circuit trainings twice a week in the duration of 30 weeks. On the basis of the conducted research, in order to increase the efficiency of the fitness training by applying a specialized training fitness model intended for the students, and the analyzes made it can be concluded: The effectiveness of the author's fitness model, based on circular training, as part of the overall fitness training of the students for strengthening the cardiovascular and the respiratory systems of the students, are experimentally substantiated.

Key words: circular training, students, university

INTRODUCTION

Big part of the young generation is leading unhelathy lifestyle. The youngsters are demonstrating numerous unhealthy habits. The consumption of alcohol, unregular sleep, reduced physical activity, unrational eating and smoking are amongst the most common dangerous factors leading to adverse social and health consequences (1). At the present stage in the development of research on physical capacity and related health status, there are relatively few developments dedicated to assessing the health of students using simple methods without complex test batteries or lengthy tests (2).

The majority of students have health knowledge that is not converted into beliefs, and those who have stable beliefs do not have health attitudes, habits, motivation and behavior. We distinguish two ways of behavior: "positive" - includes balanced diet

and physical activity to boost the health; "negative" - is expressed in overweight, stress, smoking, alcohol and other health risk factors (3).

The strength as a basic physical quality is determined by the fact that it characterizes the health of the younger generation. Many specialists give a special place to the general strength in the practice of physical education in the groups of all ages (4, 5). This is due to the fact that the general strength determines the effective work of vital systems in the human body: cardiovascular, respiratory, circulatory system and the musculoskeletal system (6, 7.) The purpose of the present research is to determine the influence of circular exercises on the cardiovascular and respiratory systems of female students from the Trakia University.

METHODS

To achieve this goal the following tasks are set:

- To make a book study of the problem.
- To develop and test a specialized fitness model.
- Develop a test battery.

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- To conduct a scientific experiment.
- To process and analyze the data from the conducted testing.

Research methods:

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

69 female students are the contingent of the study with average age of 20.04 years old from the first and second school year, studying in 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 female students - with this group were hold circuit trainings twice a week in the duration of 30 weeks. And a control group of 33 female students who were trained 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 1 - FVC (Forced Vital Capacity)

It is measured with the help of a Contec SP-10 spirometer with specialized PC software. Forced vital capacity is the total volume of air that can be exhaled during forced exhalation after maximum deep inhalation.

Test 2 - Forced expiratory volume for 1 second

$$N = \frac{t \times 100}{(P1+P2+P3) \times 2} \quad N = \frac{t \times 100}{P1 \times 5,5}$$

where "t" is the time of increasing and decreasing in seconds, and P1, P2 and P3 are the heart rate values measured during the first, second and third minutes of recovery. The obtained value is compared:

- Excellent > 96,
- Good 83 - 96,
- Average 68 - 82,
- Below average 54 - 67,
- Unsatisfactory < 54.

During a Harvard tap test, measurements of an average and maximum heart rate were performed with Sigma Sport PC 15.11 heart

It is measured with the help of a Contec SP-10 spirometer with specialized PC software. Forced expiratory volume per 1 second is the exhaled air volume from the beginning of the forced exhalation for the first one second. Practically this represents the average rate of exhalation during the first second of forced expiration.

Test 3 - Blood pressure

The measurement was performed with a blood pressure monitor "SENDO" in compliance with the rules.

Test 4 - Chest circuit

When measuring, the muscles do not have to be tense. It is necessary to make sure that during the maximum inhalation the examined person does not raise his shoulders, and during the maximum exhalation he or she does not lower them and leans forward. The difference in the circuit of the chest during inhalation and exhalation characterizes the movement of the chest.

Test 5 - Harvard step test and heart rate monitor

Immediately after stopping the test (due to time lapse), the subject of the experiment sits down and takes three 30-second heart rate measurements at timed intervals. These intervals are between the end of the test and 30 seconds, between 1 minute and 1 minute and 30 seconds and between 3 minutes and 3 minutes and 30 seconds from the recovery period. An index is calculated according to which the functional state of the cardiovascular system is judged. The index can be calculated according to the full or the shortened formula:

rate monitors. The heart rate monitors were placed at the beginning of the test. The final data was downloaded with software.

RESULTS

The results of the experiment in the "FVC" test are presented in **Table 1** and illustrated in **Figure 1**. The students from the experimental group showed an average value of 3.39 l in the entrance tests, and an average value of 3.94 l in the outgoing tests. The students from the control group showed the following results in the first study - average value 3.41 l, in the second study - 3.51 l. The growth of the

experimental group was 0.55 l (16.06%). This result is statistically significant ($t = 5.59$, $\alpha = 0.000$) and is large from a practical point of view (Cohen's $d = 0.93$). The control group had a moderate performance from a practical point of view ($d = 0.10$ l, Cohen's $d = 0.36$) and reliable improvement of the results ($t = 2.07$, $\alpha = 0.05$). The difference between the increments of the two groups is 0.45 l, which

shows a large (Cohen's $d = 0.88$) and statistically significant ($t = 4.16$, $\alpha = 0.000$) effect of the conducted fitness model. The Eta² coefficient shows that 44% of the differences in the rates of growth of the vital capacity in the experimental period are due to the applied training methods. This emphasizes their effectiveness.

Table 1. Comparison of the average arithmetic values of the attribute fvc - before and after applying the specialized fitness model

FVC	n	I research		II research		d	d%	Cohen's d	t	α
		S ₁	S ₂	S ₁	S ₂					
Experimental	36	3,39	0,55	3,94	0,84	0,55	16,06	0,93	5,59	0,000
Control	33	3,41	0,44	3,51	0,43	0,10	2,81	0,36	2,07	0,047
d		-0,02		0,43		0,45				
Cohen's d		-0,040		0,608		0,88				
Eta ²		0,020		-0,306		0,44				
t		0,16		2,70		4,16				
α		0,870		0,009		0,000				

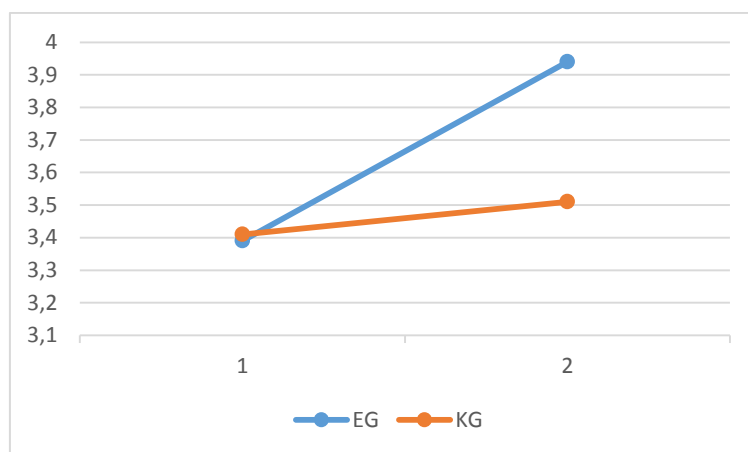


Figure 1. FVC

Table 2. Comparison of the average arithmetic values of the attribute fev1 - before and after applying the specialized fitness model

FEV1	n	I research		II research		d	d%	Cohen's d	t	α
		S ₁	S ₂	S ₁	S ₂					
Experimental	36	3,05	0,64	3,12	0,68	0,07	2,24	0,10	0,60	0,553
Control	33	3,22	0,51	3,16	0,52	-0,06	1,99	0,17	0,97	0,338
d		-0,17		-0,04		0,13				
Cohen's d		-0,292		-0,061		0,24				
Eta ²		0,147		0,031		0,12				
t		1,21		0,26		1,01				
α		0,229		0,799		0,318				

The results of the experiment in the "FEV1" test are presented in **Table 2** and illustrated in **Figure 2**. The students from the experimental group showed an average value of 3.05 l in the

entrance tests, and an average value of 3.12 l in the outgoing ones. The students from the control group showed the following results in the first study - average value 3.22 l, in the

second study - 3.16 l. The growth of the experimental group was 0.07 l (2.24%). It is statistically insignificant ($t = 0.60$, $\alpha = 0.55$) and small from a practical point of view (Cohen's $d = 0.10$). The control group realized a negative growth and a little from a practical point of view ($d = -0.06$ l, Cohen's $d = 0.17$) and unreliable ($t = 0.97$, $\alpha = 0.34$) improvements.

The difference between the increase of the two groups is 0.13 l, which shows a moderate (Cohen's $d = 0.24$) and statistically insignificant ($t = 1.01$, $\alpha = 0.32$) effect of the conducted fitness model. The coefficient Eta^2 shows that 12% of the differences in the rates of the increase of exhaled air for one second in the experimental period are due to the training tools and used methods. This underscores their inefficiency.

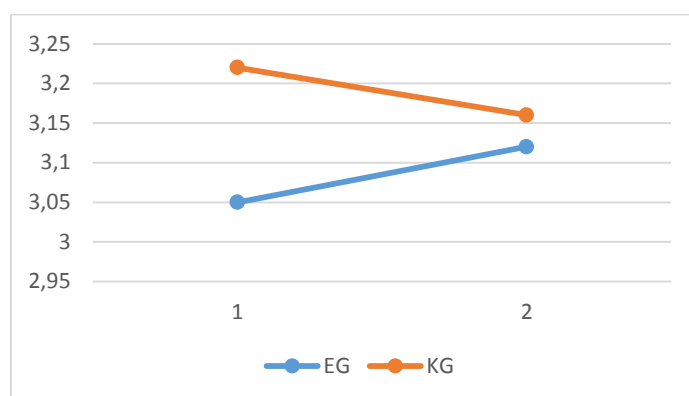


Figure 2. FEV1

In order for the blood to reach the smallest blood vessels in the body and then return to the heart, a certain pressure is needed: that's the arterial pressure. The higher figure corresponds to the systolic pressure. This is the force with which the oxygen-charged blood is sent to the body, when the heart contracts, to expel the blood. The lower value is that of the diastolic pressure: this is the force with which the used blood returns to the heart when it is preparing to be refilled. When measuring, the pressure that the blood exerts on the veins and arteries is checked. On average, these values are

between 60 and 90 mmHg for diastole and between 100 and 140 mmHg for systole.

The blood pressure is a factor without which the functioning of the body is not possible. A mean arterial pressure of 60mmHg is usually required for the functioning of the kidney and the brain. Blood pressure varies a lot throughout the day. It depends on the work that is done, on the posture of the body, on the stress levels and many others and the heart has to adapt to the specific situation.

Table 3. Comparison of the average arithmetic values of the attribute blood pressure top number - before and after applying the specialized fitness model

Blood pressure top number	n	I research		II research		d	d%	Cohen's d	t	α
		S ₁	S ₂	S ₁	S ₂					
Experimental	36	114,42	12,13	117,44	9,85	3,03	2,65	0,43	2,56	0,015
Control	33	116,45	11,04	119,09	9,47	2,64	2,26	0,30	1,70	0,098
d		-2,04		-1,65		0,39				
Cohen's d		-0,176		-0,171		0,05				
Eta ²		0,089		0,086		0,02				
t		0,73		0,71		0,20				
α		0,469		0,483		0,840				

The results of the experiment in the "blood pressure top number" are presented in Table 3 and illustrated in Figure 3. The students from

the experimental group showed an average value of 114.42 mmHg in the entrance tests, and in the outgoing tests - an average value of

117.44 mmHg. The students from the control group showed the following results in the first test - an average value of 116.45 mmHg, in the second test 119.09 mmHg. The growth of the experimental group was 3.03 mmHg (2.65%). This is statistically significant ($t = 2.56$, $\alpha = 0.02$) and moderate from a practical point of view (Cohen's $d = 0.43$). The control group performed moderate from a practical point of view ($d = 2.64$ mmHg, Cohen's $d = 0.30$) and has an unreliable ($t = 1.70$, $\alpha = 0.10$) improvement of the results.

The difference between the increments of the two groups is 0.39 mmHg, which shows a small (Cohen's $d = 0.05$) and statistically insignificant ($t = 0.20$, $\alpha = 0.84$) effect of the conducted fitness model. The Eta2 coefficient shows that 2% of the differences in the rates of change of the upper limit of the blood pressure in the experimental period are due to the methods applied by the trainer. This emphasizes their effectiveness.

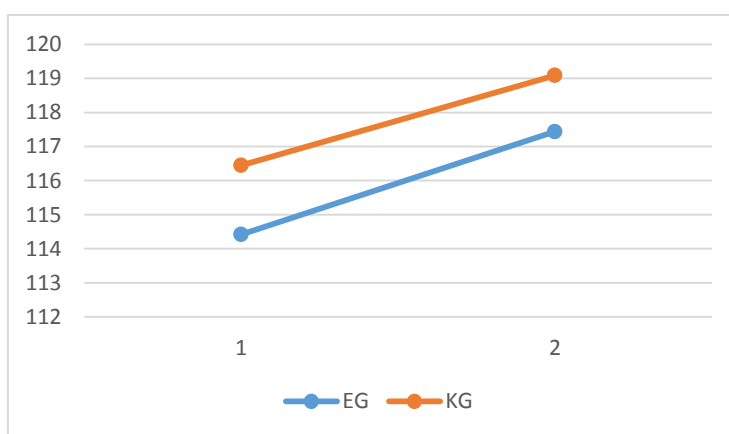


Figure 3. Blood pressure top number

Table 4. Comparison of the average arithmetic values of the attribute pressure lower number - before and after applying the specialized fitness model

Blood pressure lower number	n	I research		II research		d	d%	Cohen's d	t	α
		S ₁	S ₂	S ₁	S ₂					
Experimental	36	80,03	12,10	80,06	11,29	0,03	0,03	0,00	0,02	0,984
Control	33	83,18	10,53	83,03	10,75	-0,15	0,18	0,01	0,08	0,938
d		-3,15		-2,97		0,18				
Cohen's d		-0,277		-0,269		0,02				
Eta ²		0,139		0,135		0,01				
t		1,15		1,12		0,08				
α		0,254		0,267		0,939				

The results of the experiment in the "blood pressure lower number" are presented in Table 4 and illustrated in Figure 4. The students from the experimental group showed an average value of 80.03 mmHg in the entrance tests, and in the outgoing ones - an average value of 80.06 mmHg. The students from the control group showed the following results in the first testing - average value 83.18 mmHg, in the second testing 83.03 mmHg. The growth of the experimental group was 0.03 mmHg (0.03%). This is statistically insignificant ($t = 0.02$, $\alpha = 0.98$) and small from a practical point of view (Cohen's $d = 0.00$). The control group performed little from a practical point of view

($d = -0.15$ mmHg, Cohen's $d = 0.01$) and unreliable ($t = 0.08$, $\alpha = 0.94$) improvement of the results.

The difference between the gains of the two groups was 0.18 mmHg, which shows a small (Cohen's $d = 0.02$) and statistically insignificant ($t = 0.08$, $\alpha = 0.94$) effect of the conducted fitness model. The coefficient Eta2 shows that 1% of the differences in the rates of change of the lower limit of blood pressure in the experimental period are due to the methods applied by the trainer. This underscores their inefficiency.

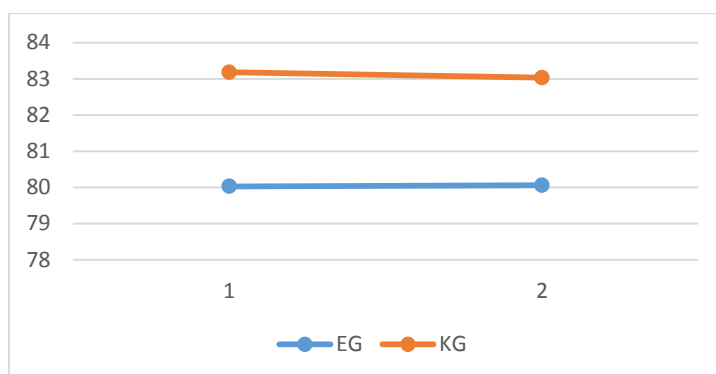


Figure 4. Blood pressure lower number

Table 5. Comparison of the average arithmetic values of the chest circuit - difference - before and after applying the specialized fitness model

Chest circuit - difference	n	I research		II research		d	d%	Cohen's d	t	α
		S ₁	S ₂	S ₁	S ₂					
Experimental	36	4,92	1,32	6,47	1,61	1,56	31,64	0,78	4,65	0,000
Control	33	5,06	1,48	5,33	1,31	0,27	5,39	0,16	0,94	0,353
d		-0,14		1,14		1,28				
Cohen's d		-0,104		0,723		0,66				
Eta²		0,052		-0,364		0,33				
t		0,43		3,20		2,88				
α		0,670		0,002		0,005				

The results of the experiment "chest circuit - difference" are presented in Table 5 and illustrated in Figure 5. The students from the experimental group showed an average value of 4.92 cm in the entrance tests and an average value of 6.47 cm in the outgoing tests. The students from the control group showed the following results in the first study - average value 5.06 cm, in the second study - 5.33 cm. The growth of the experimental group was 1.56 cm (31.64%). This is statistically significant (t = 4.65, α = 0.000) and significant from a practical point of view (Cohen's d = 0.78). The control group performed little from

a practical point of view (d = 0.27 cm, Cohen's d = 0.16) and unreliable (t = 0.94, α = 0.35) improvement of the results.

The difference between the increments of the two groups is 1.28 cm, which shows a significant (Cohen's d = 0.92) and statistically significant (t = 2.88, α = 0.005) effect of the conducted fitness model. The Eta2 coefficient shows that 33% of the differences in the growth rates of the difference in the chest circumference in the experimental period are due to the applied methods by the trainer. This emphasizes their high efficiency.

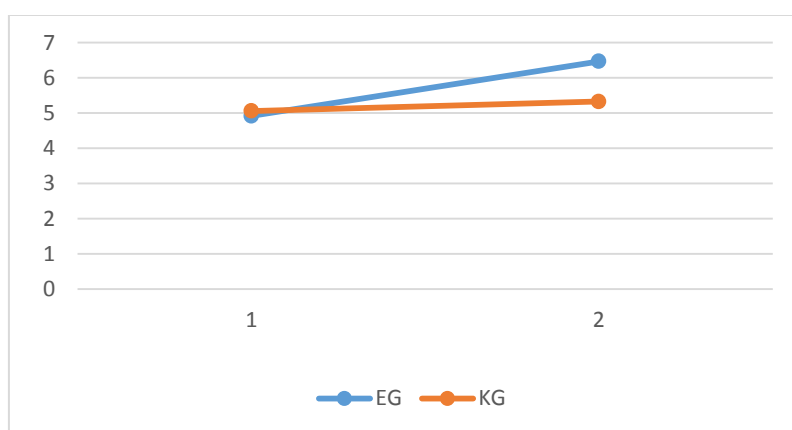


Figure 5. Chest circuit – difference

Table 6. Comparison of the average arithmetic values of the recovery factor on the pulse for up to 3 minutes - before and after applying the specialized fitness model

Recovery of the pulse for up to 3 minutes	n	I research		II research		d	d%	Cohen's d	t	α
		S ₁	S ₂	S ₁	S ₂					
Experimental	36	-44,56	16,89	-63,89	19,02	-19,33	43,39	0,80	4,79	0,000
Control	33	-49,39	14,78	-47,58	12,00	1,82	-3,68	0,10	0,59	0,557
d		4,84		-16,31		-21,15				
Cohen's d		0,303		-0,910		-0,89				
Eta²		-0,152		0,458		0,45				
t		1,26		4,22		4,12				
α		0,212		0,000		0,000				

The results of the test "recovery of the pulse for up to 3 minutes" are presented in **Table 6** and illustrated in **Figure 6**. The students from the experimental group showed an average value of heart rate recovery in the 3rd minute of -44.56 beats / min in the incoming tests, and in the outgoing ones - an average value of -63.89 beats / min. The students from the control group showed the following results in the first research - average value -49.39 beats / min, in the second study -47.58 beats / min. The growth of the experimental group was -19.33 beats / min (43.39%). It is statistically significant (t = 4.79, α = 0.00) and high from a practical point of view (Cohen's d = 0.80). The

control group performed little from a practical point of view (d = 1.82 beats / min, Cohen's d = 0.10) and unreliable (t = 0.59, α = 0.56) improvement of the results.

The difference between the increments of the two groups is -21.15 beats / min, which shows a large (Cohen's d = 0.89) and statistically significant (t = 4.12, α = 0.00) effect of the conducted fitness model. The Eta2 coefficient shows that 45% of the differences in the rate of recovery of the pulse in 3 minutes in the experimental period are due to the training tools and the used methods. This emphasizes their high efficiency.

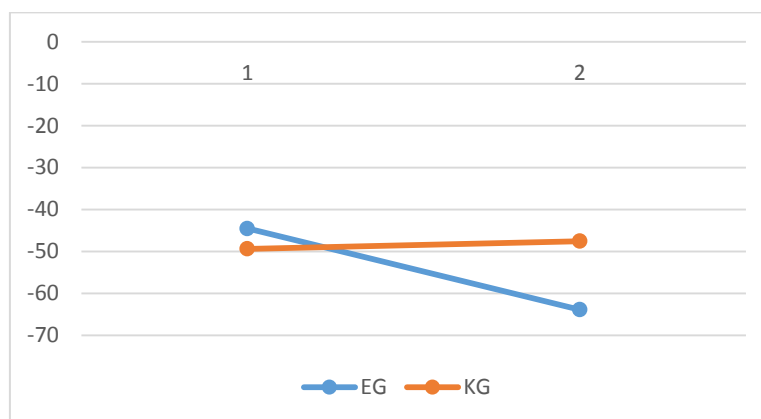


Figure 6. Recovery of the pulse for up to 3 minutes

The results of the test "initial pulse - 3rd minute of the recovery" are presented in **Table 7** and illustrated in **Figure 7**. The students from the experimental group showed an average value of recovery of heart rate from the beginning of the test and the 3rd minute after the end of the test difference of 27.94 beats / min in the incoming average of the test. . The students from the control group showed the following results in the first study - average value 27.58 beats / min, in

the second study 36.06 beats / min. The growth of the experimental group was -12.11 beats / min (43.34%). It is statistically significant (t = 3.06, α = 0.00) and significant from a practical point of view (Cohen's d = 0.51). The control group performed a moderate from a practical point of view (d = 8.48 beats / min, Cohen's d = 0.46) and reliable (t = 2.63, α = 0.01) improvement of the results.

Table 7. Comparison of the average arithmetic values of the pulse sign at the beginning - the 3rd minute of recovery - before and after the application of the specialized fitness model

Initial pulse – 3 rd minute of the recovery ВЪЗСТАНОВЯВАНЕТО	n	First		Second		d	d%	Cohen's d	t	Sig
			S ₁		S ₂					
Experimental	36	27,94	16,46	15,83	14,22	-12,11	-43,34	0,51	3,06	0,004
Control	33	27,58	14,58	36,06	12,23	8,48	30,77	0,46	2,63	0,013
d		0,37		-20,23		-20,60				
Cohen's d		0,024		-1,213		-0,87				
Eta2		-0,012		0,610		0,44				
t		0,10		6,31		3,99				
Sig		0,922		0,000		0,000				

The difference between the increments of the two groups is -20.16 beats / min, which shows a large (Cohen's d = 0.87) and statistically significant (t = 3.99, α = 0.00) effect of the conducted fitness model. The Eta2 coefficient

shows that 44% of the differences in the rate of recovery of the pulse in the 3rd minute after the end of the test and comparison with the pulse before the start of the test. This emphasizes their high efficiency.

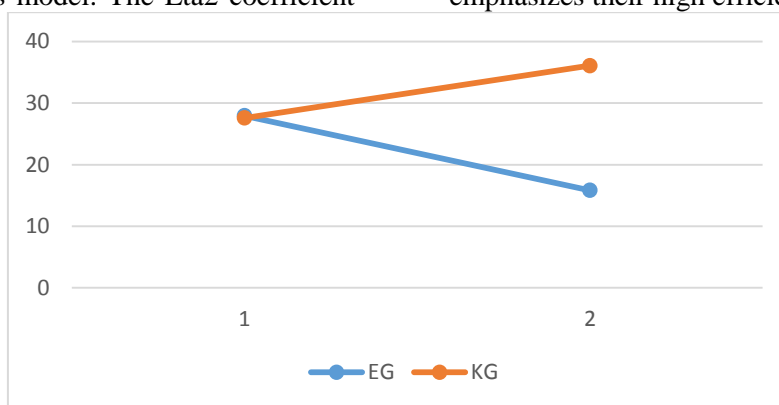


Figure 7. Initial pulse - 3rd minute of the recovery

We use the following formula for determining the index for the functional state of the cardiovascular system:

$$N = \frac{t \times 100}{(P1+P2+P3) \times 2} \quad N = \frac{t \times 100}{P1 \times 5,5}$$

t - duration of the test in seconds
P1 - pulse rate in the first minute of recovery

In the input test, the average values of the pulse of the EG were 150.28 beats / min, and of the CG was 149.39 beats / min. The duration of the test is 180 seconds. The following results were obtained when calculating the index for the functional state of the cardiovascular system - for the experimental group the index is 21.78, and for the control group is 21.88. On the initial test the average values of the pulse of the

experimental group are 144.68 beats / min, and of KG is 151.13 beats / min. The values of the index in the outgoing test for the experimental group is 22.62, and for the control group is 21.65. It is noticed that before the experiment the control group has a higher index. After the application of the developed fitness model, the experimental group has increased its index and after the end of the experiment it has higher values than the control group, which has slightly decreased the values of the other. The fitness model used by us strengthens the cardiovascular system and improves its

functional condition. It is concerning that both groups in the first and second tests show values of the index for the functional state of the cardiovascular system as unsatisfactory.

Based on the research in order to increase the effectiveness of the fitness training by applying a specialized fitness model, designed for students and the analysis made, it can be concluded:

- The effectiveness of the developed author's fitness model, based on circular training, as part of the overall fitness preparation of the students, for strengthening the training of the cardiovascular and respiratory systems of the students are experimentally substantiated.
- During the applied fitness model the full working capacity of the respiratory and circulatory system is used, the heart rhythm is in the anaerobic zone, which leads to the strengthening of the heart.

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