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Evaluation of functional parameters dynamics during physical education and sport training

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ABSTRACT

The progress of sport performances is possible because of the adaptive reactions of the human body to different requests, which rise in intensity and volume at the physical education lessons. In order to show how the organism is adapting to a certain physical effort, we have tested the functional capacity based on the following paramters: respiratory frequency, pulse, arterial tension, spirometry, Sargent test, Harward and Ruffier test. The experimental group was evaluated at the start of the experiment with a medium physical condition (65-79), and at the final test there was registered a statistically significant improvement, resulting in a good physical condition (80-99). The progress of the control group still preserved the medium physical condition (65-79). The Ruffier test results demonstrated that the organism is adapting to the physical effort and is suffering modifications during trainings, partly du to the improvement of the maximum anaerobe power, as demonstrating by the Sargent test. All the functional indicators were positively influenced by the training program, with a significant increase for the experimental group, demonstrating their utility in monitoring the evolution and optimising de effort capacity of the female students during the physical education training classes.

Keywords: *respiratory frequency, heart frequency, arterial blood pressure, spirometry, Sargent test, Harward test, Ruffier test, physical effort*

1. INTRODUCTION

The metabolical muscular systems which are activated during physical activity are represented by: A. Phosphates system; B. Lactic acid glycogen system and C. Aerobe system. Phosphocreatine and ATP form the phosphates energetic system that can produce a maximum of muscular power for 8 to 10 seconds, almost sufficient for 100 m running. In this way, the energy from the phosphates system is used for for short maximal running muscular power. The glycogen from the muscle can be turned into glucose and then used for the energy, in 2 phases: glycolysis, who doesn't need oxygen and therefore is called anaerobe metabolism. When the glycolysis starts, every molecule is shared in 2 molecules of piruvic acid, and the realeased energy is used to form some ATP molecules. The piruvic acid penetrates the muscular cells mitochondria and reacts with the oxygen to form even more ATP molecules [1-6]. Still, when insufficient oxygen exists for this second phase (oxidation phase), the most part of the piruvic acid is transformed in lactic acid, which is diffused outside the muscular cell in the interstitial fluid and then in the blood. In optimal conditions, the lactid acid-glycogen system is capable to insure 1,3 to 1,6 minutes of maximal muscular activity besides the 8-10 seconds insured by the phosphates system. The aerobe system represents the oxidation of the main nutritrients (glucose, fatty acids and the amino acids from food) in the

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mitochondria for the energy supply, used for the converting of AMP and ADP in ATP [1-6]. Comparing this aerobe mechanism of energy supply with the lactic acid-glycogen and the phosphate system, the phosphate system is the one used by the muscle for the maximum power which is lasting few seconds, and the aerobe system is necessary for the prolonged sport activity. The lactid acid-glycogen is intermediary, and is important for offering extra energy in 200-800 metres races. Considering the intensity of a certain duration and sport activity, it can be estimated well enough which energetic system is used for every type of activity. The sport activities imply motrical activity such muscular contractions, needing energy. The energetic substrate used immediately is a phosphatemacroergic bond from the adezinotriphosphoric acid (ATP) whose resynthesis is realised with big and very short efforts because of the phosphocreatine (CP). Both substances with macroergic phosphorus, and with the help of glycogen system and the aerobe system insures the necessary energy for the muscular contractions. Depending on the degraded energetic substrate, the modality of developing these intracitoplasmatic biochemical reactions (anaerobe) and intramitochondrial (aerobe), the main subject is represented by the aerobe and anaerobe efforts [1-6]. The anaerobe capacity is called also the anaerobe power and is defined as a maximum ability to produce energy, respectively, a maximum energetic intensity in the 2 aerobe energetical systems, like phosphogens systems (ATP and CP) and glycolysis. The aerobe capacity is also called the maximum aerobe power (PMA), i.e. the maximal amount of the available energy for the aerobe efforts or the mechanical work quantity that can be executed with the help of energogenic reactions [1-6]. The insurance of a high effort capacity depends of some dimensional factors and some certain functional capacities of the respiratory tract, out of which the most important are the ventilation capacity and the diffusion capacity of the lungs [7-11]. The harmony between the morphological and functional indexes, like the ratio between functional indexes, represents main objective of physycal education. The progress of sport performances came possible because of adaptive reactions of the human body to different requests which rise in intensity and volume at the physical education lessons [12-15].

2. EXPERIMENTAL SECTION

In order to show how the organism is adapting to a certain physical effort, we have tested the functional capacity based on the following paramters: respiratory and heart frequency, arterial blood pressure, spirometry, Sargent test, Harward and Ruffier test on 50 femele studentd. The results were analyzed by using the statistical analysis (p and t student test).

3. RESULTS SECTION

The results of the tested functional indicators are presented in the table 1.

Table 1: Dinamics of the tested functional indices (n=50)

Control sample		Subject groups	Initial testing	Final testing	t	P
			$\bar{X} \pm m$	$\bar{X} \pm m$		
Repsiratory frequency resp/min		E	18.8±0.49	17.72±0.24	1.10	>0.05
		M	18.76±0.53	18.72±0.41	0.25	>0.05
t, P			0.93>0.05	2.05<0.05		
Heart beats/min.		E	73.96±0.93	69.92±0.34	4.95	<0.001
		M	73.28±1.04	72.84±0.96	3.38	<0.05
t, P			0.48>0.05	2.85<0.01		Aas
Arterial blood pressure	Maximum, mm col HG	E	120.36±1.48	118.56±1.18	4.28	<0,001
		M	124.04±1.22	123.52±1.01	1.95	>0,05

	t, P		1.90>0.05	3.18<0.01		
	Minimum, mm col HG	E	73.2±0.8	70.68±0.84	7.06	<0,001
		M	73.8±0.99	73.44±0.95	2.22	<0.05
	t, P		0.47>0.5	2.16<0.05		
SPIROMETRY cm^3		E	3516±76.95	3984±73.63	8.75	<0.001
		M	3584±108.11	3672±96.52	3.46	<0.01
t, P			0.51>0.05	2.56<0.05		
RUFFIER- IR Sample		E	11.62±0.25	9.82±0.13	9.50	<0.001
		M	11.4±0.19	10.95±0.14	6.49	<0.001
t, P		E-M	0.70>0.05	5.67<0.001		
SARGENT- P TEST		E	103.39±4.31	140.78±3.14	8.94	<0.001
		M	109.31±4.48	110.85±4.17	1.45	>0.05
t, P		E-M	0.95>0.05	5.72<0.001		
HARWARD – IH Sample		E	64.43±1.87	81.03±1.09	9.6	<0.001
		M	66.1±2.12	67±1.89	1.81	>0.05
t, P		E-M	0.58>0.05	6.40<0.001		

Notes: E- experimental; M- model;

P		0.05	0.01	0.001
	n=24	2.064	2.797	3.745
t	n=50	2.009	2.678	3.496

Respiratory frequency (resp/min). At the inital testing was observed that the arithmetical median values of the experimental group are 18.8, with an error of 0.49, while those of the control sample are 18.76 with an error of 0.53. At the final testing, the value of arithmetical median of the experimental group reached 18.72 with an error of 0.41 (Fig 1). In can be observed that the experimental group is much closer to the control values reported in the specialty literature (17.45 resp/min).

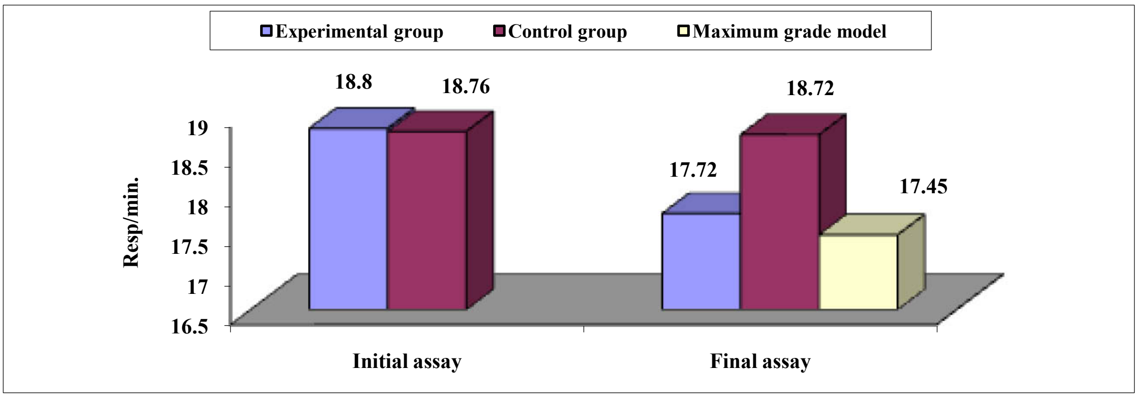

Figure 1: Respiratory frequency of the experimental groups versus model

The differences between the initial and final testings of the experimental groups shows that "t" is calculated with a value of 1.10 is smaller then tabular "t" (Fischer) at 0.05 value, demonstrating a insignificant difference between testings. In the case of sample group, the value of "t" is 0.25 smaller then statistical "t", resulting insignificant differences between tests with a P value >0.05. Observing median differences between experimental group and the sample one at the initial tests, the calculated "t" has a value of 0.93, which is smaller than the statistical "t" at P>0.05, the result being insignificant and at the final test calculated "t" with a value of 2.05 is higher than the statistical "t" (P<0.05).

Heart frequency (beats/minute). The values of the arithmetical median value of the experimental group has an error of 0.93, and for the control sample is 73.28 with an error of 1.04. At the final tests, the arithmetical median values of the experimental group is about 69.92 with an error of 0.34, meanwhile the values for the control sample is 72.84 with an error of 0.96 (Fig 2). In our study, the experimental group is above the values reported in the speciality literature (70,35 beats/minute).

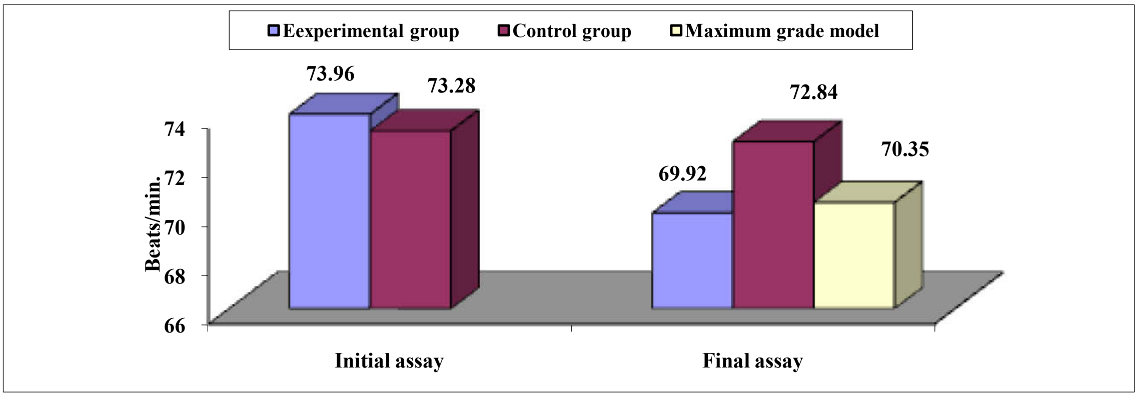

Figure 2: Heart frequency of the experimental groups versus model

The differences between the inital and final tests of the experimental groups showed that "t" has a value of 4,95 higher then tabular "t" (Fisher) ($P<0,001$), demonstrating significant differences between tests. For the control group, the calculated value of "t" is 3.38 higher than the statistical "t", resulting significantly differences between testings ($P<0.05$). Observing the median differences between the experimental group and the control one at the initial test, it can be seen that calculated "t" value of 0.48 is smaller then the statistical "t" at $p>0.05$, the result being insignificant, and at the final test "t" value of 2.85 is higher than the statistical "t", the result being significant at $P<0.01$. The final obtained results are due to the systematic effort to which the two types of subjects have been submitted. Doesn't matter what means were used (physical, tactical or tehnical), the total volume of effort, which was applied to both types of groups, led to the adaptation of the cardio-vascular machine for the respective physical education activity.

Arterial blood pressure (mmHg). For the initial tests, the sistolic arterial pressure arithmetical median value in the experimental group was 120.36 with an error of 1.48. while in the control group

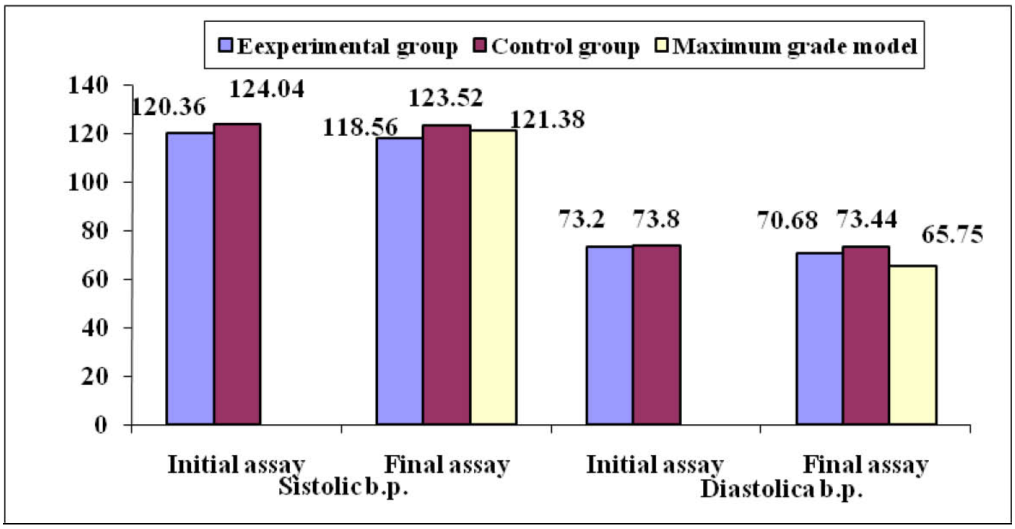

Figure 3: Arterial tension results of the experimental groups versus model

124.04, with an error of 1,22 and the diastolic arterial pressure arithmetical median value in the experimental group was 73.2 with an error of 0.8 and in the control group 73.8. with an error of 0.99.

At the final test, the sistolic arterial pressure arithmetical median value in the experimental group was 118.56 with an error of 1.18. and in the control group is 123.52 with an error of 1.01 and the diastolic arterial pressure arithmetical median value in the experimental group was 70.68 with an error of 0.84 and at the control group is 73.44 with an error of 0.95 (Fig. 3).

Concerning the sistolic pressure differences between the inital and final tests of the experimental groups, “t” has a value of 4.28 higher then tabular “t” (Fisher) ($p<0.001$), demonstrating statstically significant differences between tests. For the control group, the calculated value of “t” is 1.95 smaller than the statistical “t”, resulting insignificant differences between testings ($P>0.05$). Observing the median differences between the experimental and control group at the initial test, it can be seen that “t” calculated at the value of 1.90 is smaller then statistical “t” at $p>0.05$, the result being insignificant, while at the final test “t” calculated value of 3.18 is higher than the statistical “t”, the result being significant ($P<0.01$). For the diastolic tension differences in initial and final tests of the experimental groups, the “t” has a value of 7.06 higher then tabular “t” (Fisher) ($P< 0.001$), demonstrating important differences between tests. For the control group, the calculated value of “t” is 2.22 higher than statistical “t”, resulting insignificant differences between testings ($P<0.05$). Observing the median differences between the experimental and control group at the initial test, it can be seen that “t” calculated value of 0.47 is smaller then the statistical “t” at $P>0.05$, the result being insignificant, and at the final test “t” calculated value of 2.16 is higher than statistical “t”at $P<0.05$, the result being significant.

Spirometry (cm^3). For the initial tests, the value of arithmetical median of the experimental group is 3516 with an error of 76,95, and the control group is 3584 with an error of 108.11. At the final tests, the value of arithmetical median is 3984 with an error de 73.63, the control groups have a value of 3672 with an error of 96.52.

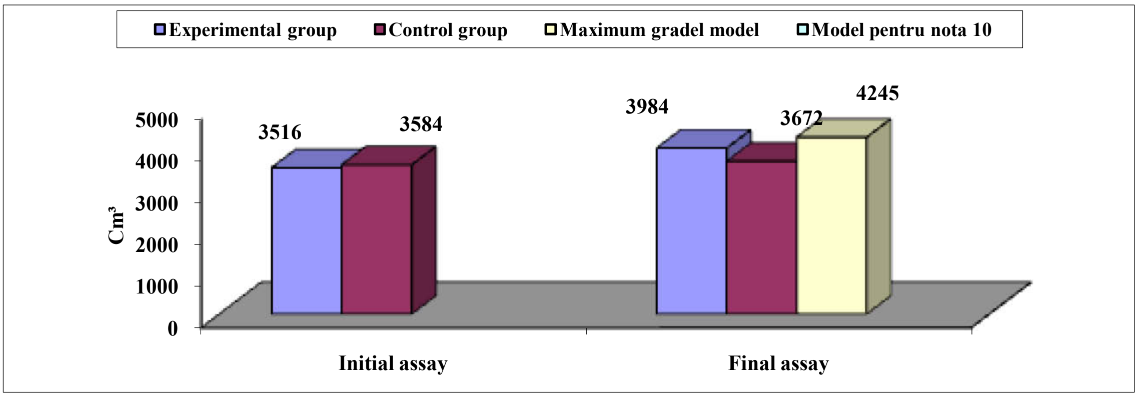

Figure 4: Spirometry results of the experimental groups versus model

The experimental group is even closer to the value reported in the specialty literature ($4245cm^3$) (Fig. 4). The differences from inital and final tests of the experimental groups it's showed that “t” has a value of 8,75 higher then tabular “t” (Fisher) with a importance of 0.001, demonstrating important differences between tests. For the control group, the calculated value of “t” is 3.46 higher than statistical “t”, resulting significantly differences between testings at $P<0.01$. Observing the median differences between experimental group and control one at the initial test, it can be seen that “t” calculated at the value of 0.51 is smaller then statistical “t” at $P>0.05$, the result being insignificant, and at the final test “t” calculated at a value of 2.56 higher than statistical “t”at $P<0.05$, the result being significantly.

Ruffier test. For the initial tests, the value of arithmetical median of the experimental group is 11.62 with an error of 0.25, and the control group is 1.,4 with an error of 0.19. At the final tests, the value of arithmetical median is 9.82 with an error of 0.13, while the control groups have a value of 10.95 with an error of 0.14 (Fig. 5). The results obtained for the experimental group are very close to the value reported in the specialty literature (7.13).

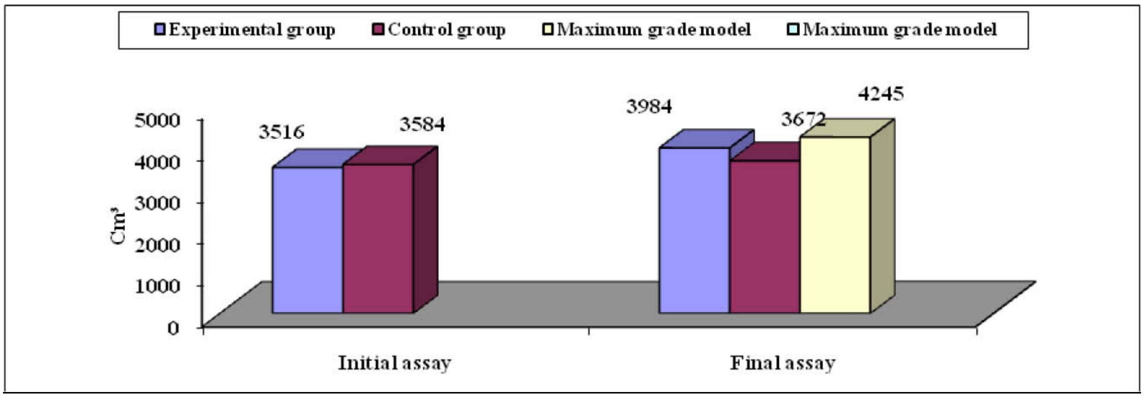

Figure 5: The results of Ruffier test for the experimental groups versus model

The differences between the inital and final tests of the experimental groups showed that "t" value of 9,50 is higher then tabular "t" (Fisher) (P<0.001), demonstrating important differences between tests. For the control group, the calculated value of "t" is 6.49 higher than statistical "t", resulting significantly differences between testings at P<0.001 (Fig. 6). Observing the median differences between the experimental and control group at the initial test, it can be seen that "t" calculated at the value of 0.70 is smaller then statistical "t" at P>0.05, the result being insignificant, and at the final test "t" calculated at a value of 5.67 higher than statistical "t"at P<0.001, the result being significant. The Ruffier test results demonstrated that the organism is adapting to the physical effort and is suffering modifications during trainings.

Sargent test. For the initial tests, the value of arithmetical median of the experimental group is 103.39 with an error of 4.31. and the control group is 109.31 with an error of 4.48. At the final tests. the value of arithmetical median is 140.78 with an error of 3.14, the control groups have a value of 110.85 with an error of 4.17. The final results in the experimental group are much closer to the values from the specialty literature (127.34). The differences from inital and final tests of the experimental groups it's showed that "t" has a value of 8.94 higher then tabular "t" (Fisher) with a importance of 0.001, demonstrating important differences between tests. For the control group, the calculated value of "t" is 1.45 smaller than statistical "t", resulting insignificantly differences between testings at P>0.05.

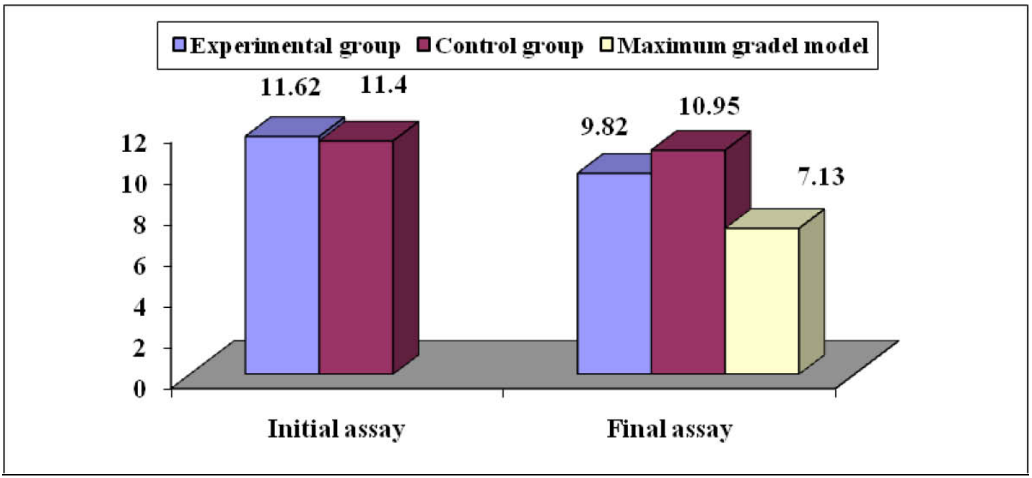

Figure 6: Sargent test for the experimental groups versus model

Observing the median differences between experimental group and control one at the initial test, it can be seen that "t" calculated at the value of 0.95 is smaller then statistical "t" at P>0.05, the result being insignificant, and at the final test "t" calculated at a value of 5.72 higher than statistical "t"at P<0.001, the result being significant. The Sargent test evaluating the maximum anaerobe power of the subjects is offering a qualitative appreciation of the students training state. In our case the experimental group has obtained at the final tests results exceeding the values reported in the specialty literature for the maximum grade model and framing them in a "medium" rank for the maximum anaerobe power, while the control group has been framed in the "satisfactory" rank.

Harward test. For the initial tests, the value of arithmetical median of the experimental group is 64.43 with an error of 1.87 and the control group is 66.1 with an error of 2.12. At the final tests, the value of arithmetical median is 81,03 with an error of 1,09 , the control groups have a value of 67 with an error of 1.89 (fig. 7). The experimental group is even closer of the values from the specialty literature (85.46).

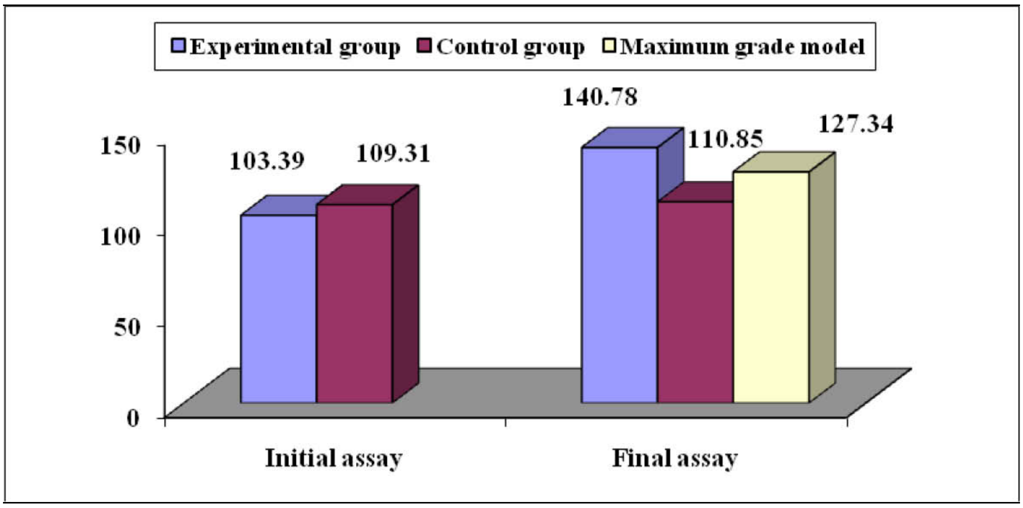

Figure 7: Harward test results for the experimental groups versus model

The differences between inital and final tests of the experimental groups showed that "t" has a value of 9.6 higher then tabular "t" (Fisher) (P<0.001), demonstrating important differences between tests. For the control group, the calculated value of "t" is 1,81 smaller than statistical "t", resulting insignificant differences between testings (P>0.05). Observing the median differences between experimental group and control one at the initial test, it can be seen that "t" calculated at the value of 0.58 is smaller then statistical "t" at p>0.05, the result being insignificant, and at the final test "t" calculated at a value of 6.40 higher than statistical "t"at P<0.001, the result being significant. The coming back of the cardiac frequency during the submaximal effort represents an indicator for the evaluation of the physical condition of the students included in this experiment. The experimental group was evaluated at the start of the experiment with an medium physical condition (65-79), and at the final test there was registered a statistically significant improvement, resulting in a good physical condition (80-99). The progress of the control group still preserved the medium physical condition (65-79).

4. CONCLUSIONS

The experimental group was evaluated at the start of the experiment with an medium physical condition (65-79), and at the final test there was registered a statistically significant improvement, resulting in a good physical condition (80-99). The progress of the control group still preserved the medium physical condition (65-79). The Ruffier test results demonstrated that the organism is adapting to the physical effort and is suffering modifications during trainings, partly du to the improvement of the maximum anaerobe power, as demonstrating by the Sargent test. All the functional indicators were positively influenced by the training program, with a significant increase for the experimental group, demonstrating their utility in monitoring the evolution and optimising de effort capacity of the female students during the physical education training classes.

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