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ANALYSING THE EFFECTS OF A PERSONALISED PROGRAM OF PSYCHO-MOTOR EDUCATION ON SOMATIC AND MORPHO-FUCTIONAL CHARACTERISTICS OF FEMALE STUDENTS

DUMITRESCU REMUS[1]

Abstract

This study evaluates the effectiveness of a personalised program of educational psycho-motor skills through an analysis of basic somatic and morpho-functional characteristics of female students and its comparison with the results obtained for a control group that followed a non-personalized software.

First, a graphical data analysis was performed, as well as data validation and Kolmogolov-Smirnof, Cramer-von Mises and Anderson-Darling normality tests. For statistical analysis the T test was used for paired samples, the Wilcoxon test, the F test and linear regression. Also, the jackknife technique was used for data replication and results validation.

Keywords*:* personalised training programs for psycho-motor skills, fitness.

Introduction

In individual development, the importance of relationship-exercise nutrition is an essential factor in maintaining an optimal health status, and / or improving health and physical and psychological comfort.

Westcott, W., quoted by Quinn, E. (1994), shows that women who are physically active and retain their muscle tones, have a balanced metabolism and good control of body weight compared with sedentary women.

Experimental studies made by Willmore, H., & Costill, D. (1998), in animals and humans have shown that subjects undergoing food deprivation can lose up to 25% of body weight, a loss that is recovered quickly after the return to a normal diet. A hipercaloric diet leads to an increase of 15% - 20% in weight, which regress with the cessation of the diet.

Scope. The analysis of the effects of fitness in the physical education lessons, undertaken by female students in the University of Bucharest in order to obtain a positive effect in terms of somatic and morpho-functional parameters.

Hypothesis 1 - Making an individualized program of physical training improves physiological and morphological parameters of female students, with positive consequences for their health and physical welfare.

Hypothesis 2 – By applying an individualized, well established, fitness program, through the sizing of the load evolution, depending on characteristics and the progress obtained, it is possible to obtain a significant improvement in quality and effectiveness of lessons.

Methods and research techniques.

- Direct observation;
- Indirect observation.

The Sidentrop, D. & Tannehill, D. system (2000), *Developing teaching skills in Physical Education* was used for data registry. The system involves taking a period of time, in which the subjects are observed and their activities are classified.

The experiment was conducted on a sample of 20 subjects - 20 subjects **experimental group** - **control group**. At the start of the experiment, students were in their first year of college, all opting for fitness as a means of achieving their physical education course.

The subjects are female students in 16 faculties of the University of Bucharest aged between 18 and 22 years, registered in the medical department on the state of health.

Venue of the experiment. The experiment was conducted during two academic years 2009-2010 and 2010-2011, in room no. 1 inside the Faculty of Law, 36-46 Kogalniceanu Blvd. This room is specially equipped for physical education courses with topics on fitness and it is where preparations, measurements and initial and final testing was carried out.

Duration and stages. The annual training plan of the university was respected with on physical education lesson per week, including holidays and exam periods.

According to our research objectives there were several types of measurements carried out: ***somatic*** and ***general motric***

Data processing methods for small size samples

For this study the jackknife re-sampling method was used, consisting of recalculating basic statistics (mean and dispersion) of the sample data obtained by omitting successively an observation of the sample basis. In the present case the new samples were obtained through 12 draws for every 11 observations by successive omission of one of the observations (the first observation in the first extraction, the second in the second extraction, etc..), resulting in a total of 121 observations for each cell analysis: the experimental group, the initial test (IT) and final test (FT), and control group, initial testing (IT) and the final test (FT).

The re-sampling and calculation of basic

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statistical parameters was performed using an SAS macro program and the statistical assumptions calculation was performed by direct application of statistical formulas using Excel.

From the data measurements on the study participants the following variables were selected for analysis:

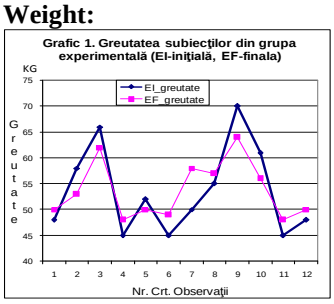
- Weight:
- The perimeter of the chest at inspiration (PTORINS):
- The Perimeter of the thighs at rest (PCOASR):
- Horizontal Rowing (RowingORIZ):
- Squats with bar on shoulders (GenoBara):
- Dynamometers left (DianmoS):
- The Cooper test (TCooper):

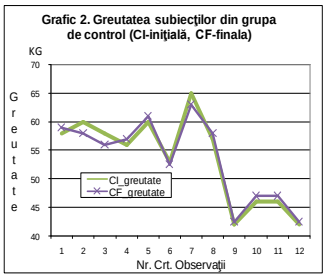
The duplicate data was eliminated, thus reducing the total samples to 12 subjects with single observations, both for the experimental group and for the control group.

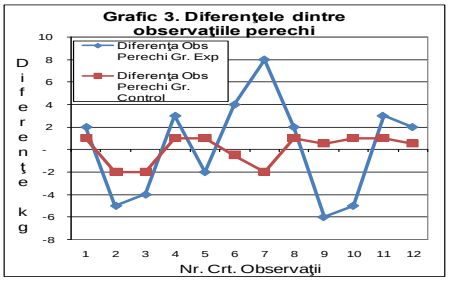
- For the experimental group: 1,2,3,4,5,6,7,8,9,10,17,20
- For the control group: 1,2,3,4,5,6,7,8,9,10,19,20

The corresponding null hypothesis of the normality tests is that the data has a normal distribution. Thus, P values higher than the 5% limit indicate a normal distribution, while lower values lead to rejection. The cases where the normality hypothesis was rejected are those for which at least two tests had P values below 0.05.

Weight:







The analysis of the results obtained by applying the T test to the experimental group and the Wilcoxon test to the control group confirms the H0.1 hypothesis. Thus, the differences between the averages are not significant; the P values are well above the accepted threshold of significance of 0.05.

Table 1: Results for the significance of the average body weight

t-Test: Paired Two Sample for Means

	EI_greutate	*EF_greutate*
Mean	53.583	53.75
Variance	72.629	30.75
Observations	12.000	12
Pearson Correlation	0.886	
Hypothesized Mean Difference		0
df	11.000	
t Stat	-0.130	
P(T<=t) one-tail	0.449	
t Critical one-tail	1.796	
P(T<=t) two-tail	0.899	
t Critical two-tail	2.201	

Wilcoxon Two-Sample Test	
Statistic	151.5
Normal Approximation	
Z	0.0583
One-Sided Pr > Z	0.4768
Two-Sided Pr > |Z|	0.9535
t Approximation	
One-Sided Pr > Z	0.477
Two-Sided Pr > |Z|	0.954
Z includes a continuity correction of 0.5.	

The increased variability of the weight values of the experimental group compared to the control group is confirmed by the F test. The P value of 0.00016 for the significance test leads to the rejection of H0.2 and confirms the alternative hypothesis.

F-Test Two-Sample for Variances

	Diferenta Observatii Perechi E	*Diferenta Observatii Perechi C*
Mean	0.1666667	0.04166667
Variance	19.606061	1.70265152
Observations	12	12
df	11	11
F	11.515017	
P(F<=f) one-tail	0.000162	
F Critical one-tail	2.8179305	

Table 2: The F test results for differences in body weight dispersion

The regression analysis performed for the control group confirms H0.3 hypothesis, but does not confirm it for the experimental

the group.

The negative slope of the regression line -0.44, with P value of 0.005 and R2 coefficient of 0.647 leads to accepting the alternative hypothesis for the experimental group, namely that for a higher initial weight, the weight loss is more rapid and greater increase in weight corresponds to a lower initial weight.

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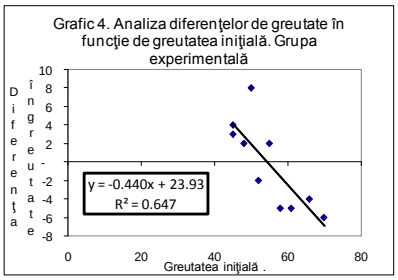
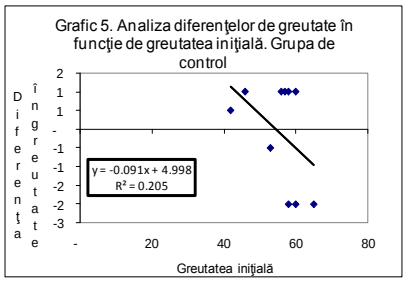
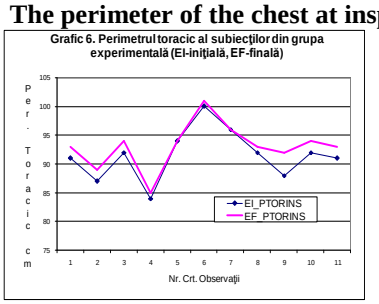


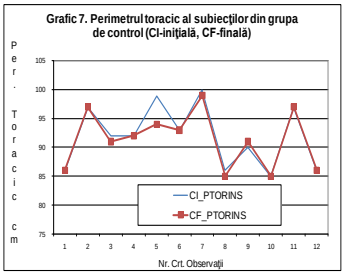


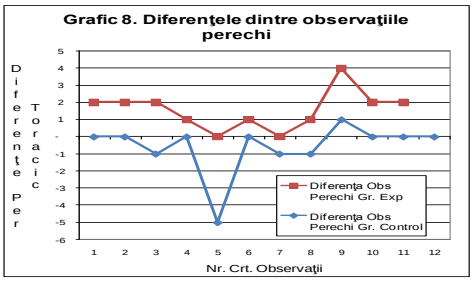
The T test statistics calculated for each sample separately gave a value of 0.1422 for the experimental group and a value of 0.1631 for the control group.

For the F test the value obtained was 3.11, which is higher than the critical F value of 2.82 at a significance level of 5%. This leads to the rejection of hypothesis H0.2. and the conclusion that the differences in weight between the two groups involved in psycho-motor training programs are significant.

The perimeter of the chest at inspiration (PTORINS):







The analysis of the results obtained by applying the Wilcoxon test for the experimental group and the T test to the control group confirms the H0.1. hypothesis for the data that includes the aberrant observation.

t-Test: Paired Two Sample for Means
Fără outlier

	CI_PTORINS	*CF_PTORINS*
Mean	91.2727	91.0909
Variance	27.0182	26.2909
Observations	11	11
Pearson Correlation	0.9933	
Hypothesized Mean Difference		0
df	10	
t Stat	1	
P(T<=t) one-tail	0.1704	
t Critical one-tail	1.8125	
P(T<=t) two-tail	0.3409	
t Critical two-tail	2.2281	

Hypothesis H0.2 is rejected based on the P value of 0.034 and it can be concluded that the effects of personalized methods of psycho-motor training on developing the chest area are superior to traditional methods.

Table 3: Results of the significance tests for the average chest perimeter at inspiration.

t-Test: Paired Two Sample for Means

	CI_PTORINS	*CF_PTORINS*
Mean	91.9167	91.3333
Variance	29.5379	24.6061
Observations	12	12
Pearson Correlation	0.962164	
Hypothesized Mean D	0	
df	11	
t Stat	1.342638	
P(T<=t) one-tail	0.103220	
t Critical one-tail	1.795885	
P(T<=t) two-tail	0.206440	
t Critical two-tail	2.200985	

Table 4: Results of the F test for the dispersion of the chest perimeter differences

F-Test Two-Sample for Variances

	Diferenta Observatii Perechi E	*Diferenta Observatii Perechi C*
Mean	1.545454545	-0.583333
Variance	1.272727273	2.2651515
Observations	11	12
df	10	11
F	0.56187291	
P(F<=f) one-tail	0.186450991	
F Critical one-tail	0.339794264	

F-Test Two-Sample for Variances
Fără outlier

	Diferenţa Obs Perechi Gr. Exp	*Diferenţa Obs Perechi Gr. Control*
Mean	1.5455	-0.1818
Variance	1.2727	0.3636
Observations	11	11
df	10	10
F	3.5	
P(F<=f) one-tail	0.0304	
F Critical one-tail	2.9782	

The small negative slope of the regression lines and coefficients R^2 of less than 25% lead to the acceptance that the development of the chest area of the participants in the psycho-motor training program is not influenced by their initial values. It is to be mentioned here that omitting outlier reduced the absolute slope of the regression coefficient and R^2 which becomes completely insignificant.

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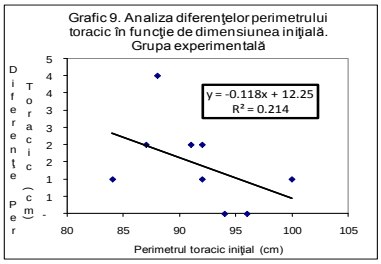
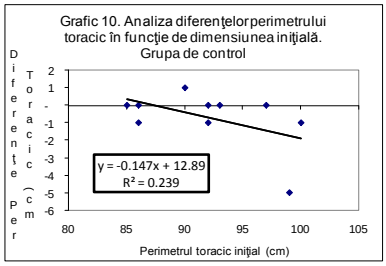
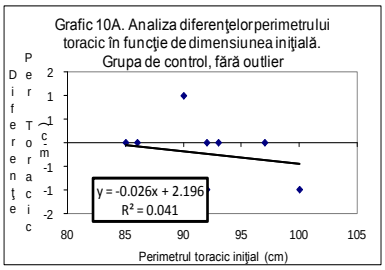
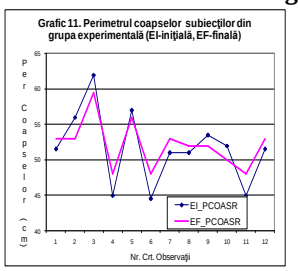


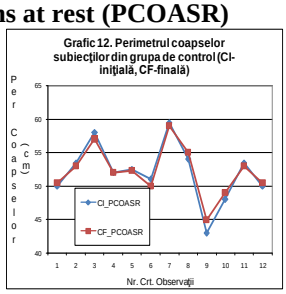




The T test statistics calculated for each sample separately gave values of 2.76 for the experimental group and 0.67 for the control group. For the F test, a value of 1.277 was obtained, which is lower than the F critical value of 2.82 at a significance level of 5%. This leads to acceptance of the hypothesis H0.2.

The Perimeter of the thighs at rest (PCOASR)





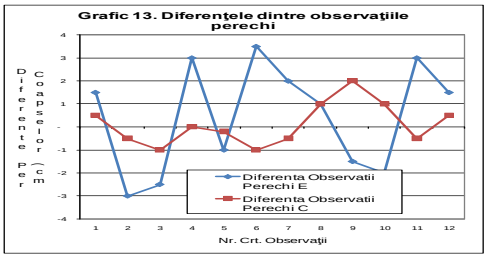


Table 5: Results of the significance tests for the average of the perimeter of the thighs at rest

The differences between the means are not significant; the P values are well above the accepted threshold of significance of 0.05. In conclusion it can be said that participation in psycho-motor training programs does not affect the average perimeter of the participants' thighs.

t-Test: Paired Two Sample for Means

	CI_PCOASR	*CF_PCOASR*
Mean	52.0833	52.1917
Variance	18.8106	13.7408
Observations	12	12
Pearson Correlation	0.9865	
Hypothesized Mean Difference	0.0000	
df	11.0000	
t Stat	-0.4115	
P(T<=t) one-tail	0.3443	
t Critical one-tail	1.7959	
P(T<=t) two-tail	0.6886	
t Critical two-tail	2.2010	

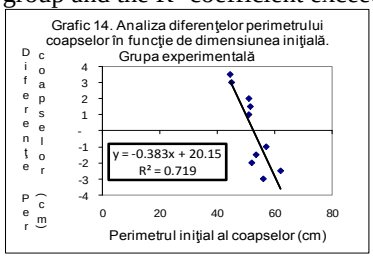
Table 6: Results of the F test for the dispersion of the differences in perimeter of the thighs

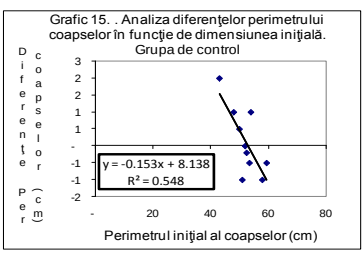
F-Test Two-Sample for Variances

	Diferenta Observatii Perechi E	*Diferenta Observatii Perechi C*
Mean	0.4583	0.1083
Variance	5.4299	0.8317
Observations	12.0000	12.0000
df	11.0000	11.0000
F	6.5284	
P(F<=f) one-tail	0.0021	
F Critical one-tail	2.8179	

The P value of 0.021 obtained for the F test leads to the rejection of hypothesis H0.2, concluding that the effect of personalized method of psycho-motor training on musculoskeletal development differs significantly from that of the traditional method.

It also shows that the impact is much greater for the experimental group; the regression slope is more than double that for control group and the R^2 coefficient exceeds 70%.





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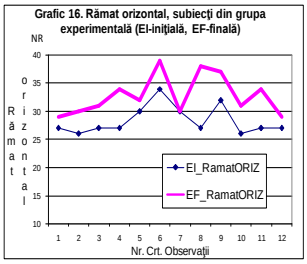
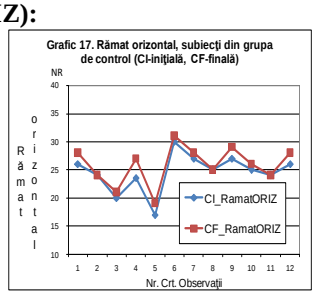
The T test statistics calculated for each sample separately gave values of 0.162 for the experimental group and values of 0.638 for the control group. Being well below the critical t value of 1.8, the results confirm the hypothesis H0.1

For the F test the value obtained is 2.57, which is lower than the critical F of 2.82 at a level significance of 5%. This leads to the acceptance of hypothesis H0.2.

Horizontal Rowing (RowingORIZ):





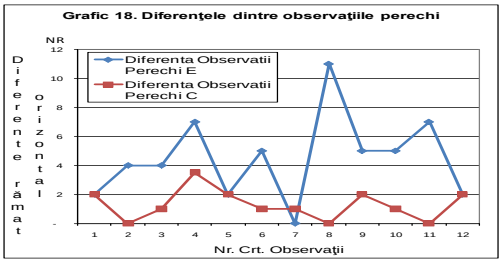


Table 7: Results of the significance tests for the average of the number of horizontal rowings

Wilcoxon Two-Sample Test	
Statistic	98.5
Normal Approximation	
Z	-2.979
One-Sided Pr < Z	0.0014
Two-Sided Pr > |Z|	0.0029
t Approximation	
One-Sided Pr < Z	0.0034
Two-Sided Pr > |Z|	0.0067
Z includes a continuity correction of 0.5.	

t-Test: Paired Two Sample for Means

	CI_RamatORIZ	*CF_RamatORIZ*
Mean	24.5417	25.8333
Variance	11.4299	11.7879
Observations	12	12
Pearson Correlation	0.9522	
Hypothesized Mean Difference	0	
df	11	
t Stat	-4.24364	
P(T<=t) one-tail	0.00069	
t Critical one-tail	1.79588	
P(T<=t) two-tail	0.00138	
t Critical two-tail	2.20099	

The analysis of the results obtained by applying the Wilcoxon test for the experimental group and the T test for the control group disproves the H0.1. hypothesis.

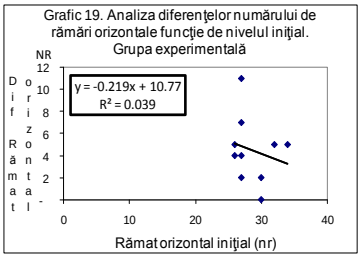
The differences between the means are significant; the P values are far below the accepted significance of 0.05. In conclusion it can be said that participation in psycho-motor training programs positively affects the development of the back muscles and the bodies of the participants.

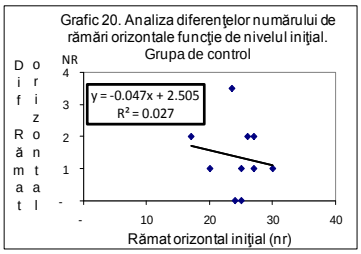
Table 8: Results of the F test for the dispersion of the differences of the number of horizontal rowings

The P value obtained for the F test leads to the rejection of hypothesis H0.2, thus concluding that the effect of personalised psycho-motor training method on the back and trunk muscle development differs significantly from that of the traditional method. This conclusion was verified by using the F test through re-sampled data. The F statistics of 4.24, far better than the 2.81 critical level of 0.05, confirms the correctness of the decision to reject the hypothesis H0.2.

F-Test Two-Sample for Variances

	Diferenta Observatii Perechi E	*Diferenta Observatii Perechi C*
Mean	4.5	1.29166667
Variance	8.636364	1.11174242
Observations	12	12
df	11	11
F	7.768313	
P(F<=f) one-tail	0.000996	
F Critical one-tail	2.81793	





Squats with bar on shoulders (GenoBara)

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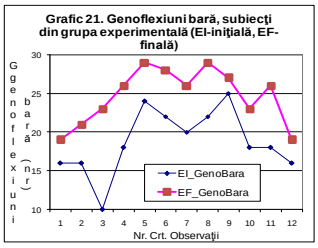
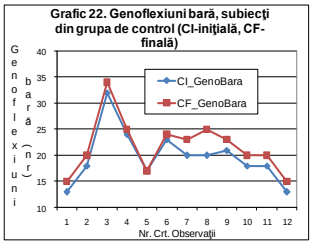




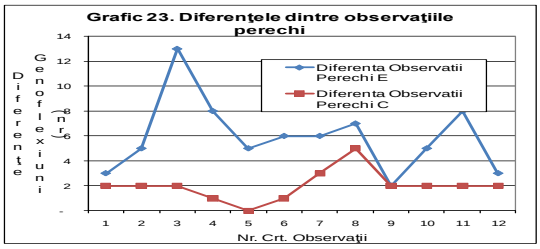


Table 9: Results of the significance tests for the average number of squats with a bar of 10 kg on shoulders

t-Test: Paired Two Sample for Means

	CI_GenoBara	*CF_GenoBara*
Mean	19.7500	21.7500
Variance	26.2045	27.4773
Observations	12	12
Pearson Correlation	0.9732	
Hypothesized Mean Difference		0
df	11	
t Stat	-5.7446	
P(T<=t) one-tail	0.0001	
t Critical one-tail	1.7959	
P(T<=t) two-tail	0.0001	
t Critical two-tail	2.2010	

t-Test: Paired Two Sample for Means

	EI_GenoBara	*EF_GenoBara*
Mean	18.7500	24.6667
Variance	17.2955	12.9697
Observations	12	12
Pearson Correlation	0.7223	
Hypothesized Mean Difference		0
df	11	
t Stat	-6.9774	
P(T<=t) one-tail	0.0000	
t Critical one-tail	1.7959	
P(T<=t) two-tail	0.0000	
t Critical two-tail	2.2010	

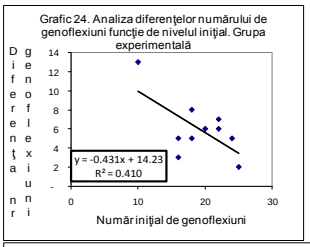
The analysis of the test results obtained by applying the T test to both groups denies hypothesis H0.1.

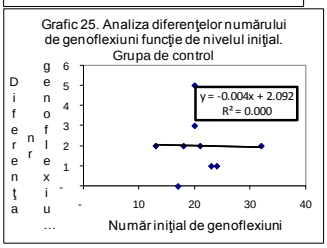
The differences between the averages are significant; the P values are far below the accepted significance of 0.05. It can be said that participation in training psycho-motor programs positively affects leg muscles development.

F-Test Two-Sample for Variances

	Diferenta Observatii Perechi E	*Diferenta Observatii Perechi C*
Mean	5.917	2.000
Variance	8.629	1.455
Observations	12	12
df	11	11
F	5.9323	
P(F<=f) one-tail	0.0032	
F Critical one-tail	2.8179	

Table 10: Results of the F test for the dispersion of the differences for the number of squats with bar on shoulders

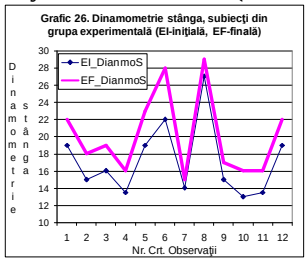


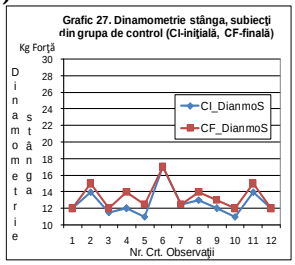


The significant coefficient R^2 and slope of the regression of -0.431 with a P value of 0.046, leads to the conclusion that leg muscles development for the participants in a personalised psycho-motor training program is influenced by its initial values.

The F test statistics obtained for the data sample is 2.83, confirming that the limit of personalised psycho-motor training program has higher effects than the traditional program.

Dynamometers left (DianmoS)





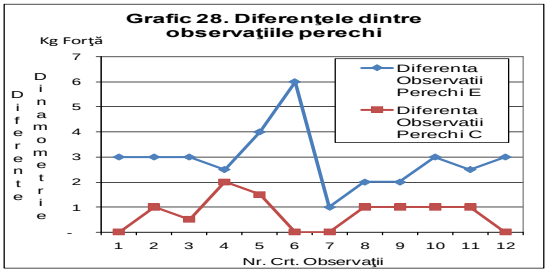


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Table 11: Results of the significance tests for the average number of dynamometers left

t-Test: Paired Two Sample for Means

	EI_DianmoS	*EF_DianmoS*
Mean	17.1667	20.0833
Variance	17.7424	22.6288
Observations	12	12
Pearson Correlation	0.9702	
Hypothesized Mean Difference		0
df	11	
t Stat	-8.2705	
P(T<=t) one-tail	0.0000	
t Critical one-tail	1.7959	
P(T<=t) two-tail	0.0000	
t Critical two-tail	2.2010	

Wilcoxon Two-Sample Test	
Statistic	125
Normal Approximation	
Z	-1.447
One-Sided Pr < Z	0.074
Two-Sided Pr > |Z|	0.1479
t Approximation	
One-Sided Pr < Z	0.0807
Two-Sided Pr > |Z|	0.1614
Z includes a continuity correction of 0.5.	

The analysis of the results obtained by applying the Wilcoxon test for the control group disproves hypothesis H0.1, by comparison, the T test for the experimental group disproves hypothesis H0.1, the very low P value showing that the muscle force of the arms increases significantly for the experimental group.

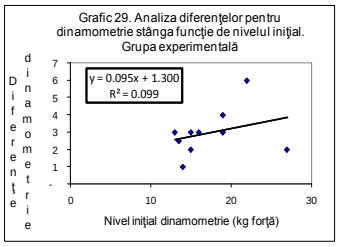
F-Test Two-Sample for Variances

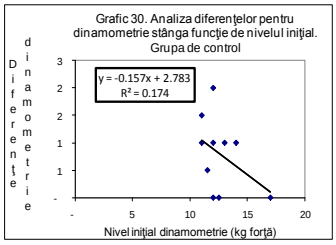
	Diferenta Observatii Perechi E	*Diferenta Observatii Perechi C*
Mean	2.9166667	0.75
Variance	1.4924242	0.43181818
Observations	12	12
df	11	11
F	3.4561404	
P(F<=f) one-tail	0.0254438	
F Critical one-tail	2.8179305	

Table 12: Results of the F test for the dispersion of the differences for dynamometers left

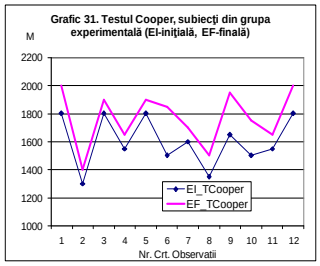
The P values obtained for the F test statistic leads to the rejection of hypothesis H0.2

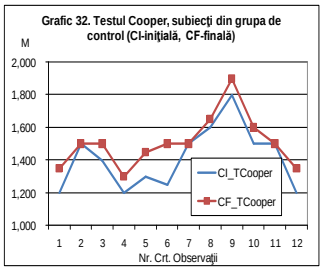
T test statistics calculated for each sample separately gave values of 3.9 to for the experimental group and 2.73 for the control group. Being well above the critical t value of 1.8, the results refute hypothesis H0.1. The F test statistics obtained for the data sample is 3.21, confirming that the personalised psycho-motor training program has significantly superior effects compared to the traditional program.





The Cooper Test (TCooper):





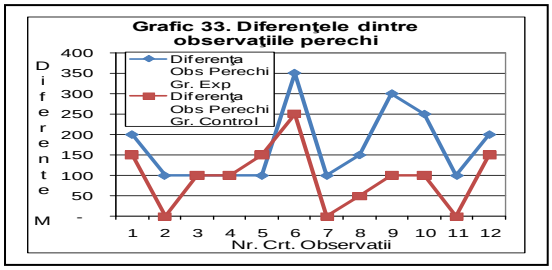


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Table 13: Results of the significance tests for the Cooper test

t-Test: Paired Two Sample for Means

	EI_TCooper	*EF_TCooper*
Mean	1600.0	1770.8
Variance	30909.1	38390.2
Observations	12	12
Pearson Correlation	0.8907	
Hypothesized Mean Difference		0
df	11	
t Stat	-6.6431	
P(T<=t) one-tail	0.0000	
t Critical one-tail	1.7959	
P(T<=t) two-tail	0.0000	
t Critical two-tail	2.2010	

t-Test: Paired Two Sample for Means

	CI_TCooper	*CF_TCooper*
Mean	1412.5	1508.3
Variance	35511.4	25378.8
Observations	12	12
Pearson Correlation	0.9198	
Hypothesized Mean Difference		0
df	11	
t Stat	-4.4115	
P(T<=t) one-tail	0.0005	
t Critical one-tail	1.7959	
P(T<=t) two-tail	0.0010	
t Critical two-tail	2.2010	

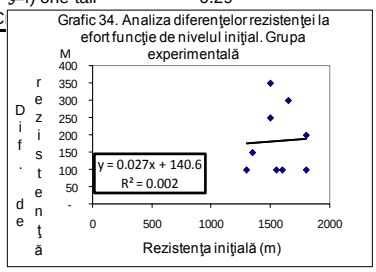
The results of both tests refute hypothesis H0.1 with high significance for both P values. It can be concluded that both psycho-motor training methods have a beneficial effect on enhancing resilience to exercise of the participants.

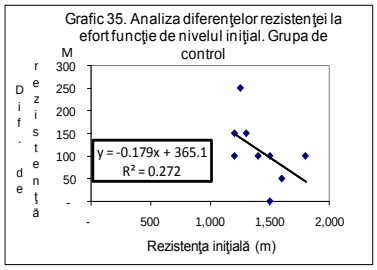
Table 14: Results of the F test for the dispersion of the differences of the results of the Cooper test

F-Test Two-Sample for Variances

	Diferenta Observatii Perechi E	*Diferenta Observatii Perechi C*
Mean	170.83	95.83
Variance	7935.61	5662.88
Observations	12	12
df	11	11
F	1.40	
P(F<=f) one-tail	0.29	
F C		

The P value obtained for F test statistic leads to confirm hypothesis H0.2. Thus it can be concluded that the effect of the personalized psycho-motor training method on the body's ability to withstand prolonged effort is superior to that achieved by the traditional method.





The small negative slope of the regression lines and the R^2 coefficients of less than 30% lead to accepting that the development of the chest area in the participants to the psycho-motor training programs is not influenced by its initial values.

The F test statistic of 1.59, lower than the critical F value of 2.82 at a significance level of 5%, confirms the previous result and thereby validates the hypothesis H0.2.

Conclusions and recommendations

The overall evaluation of somatic effects leads to the conclusion that both psycho-motor training programs have differentiated effects on participants. A simple statistical analysis on the differences between initial and final values of somatic characteristics would lead to the false conclusion that these programs do not have a significant influence on them. That is wrong if we consider that these programs are aimed at harmoniously developing the bodies of the participants, a development that to some extent takes the initial coordinates of the participants for personalized training, and not an absolute improvement of somatic parameters, namely body weight.

Regression analysis results, coupled with that of the T test, the Wilcoxon test and F test confirms that participants have made progress in harmoniously developing their bodies, the somatic parameters evolving to standard values, appropriate for their age and their generally good health status. The effect is apparent in the weight and perimeter of the thighs, the exercises having a significant regulatory effect on them. The advantage of practicing personalized methods is obvious when we consider that the phenomenon of regression to the mean is more pronounced for participants in this program.

Morph-functional parameters results reflected the efficiency of different methods of training the participants, with visible effects for the experimental group for the horizontal rowing parameters (the measure for the development of the trunk and back muscles), squats with the bar on shoulders (the measure for locomotor development) and dynamometers left (the measure of arm muscle development). For the Cooper test (the measure of resistance to prolonged effort), however, the results obtained by participating in two psycho-motor education programs show similar performance statistically.

Based on the results, it can be concluded that the effects of personalised psycho-motor training program are higher for most parameters analyzed, although prospects vary according to their nature.

In the case of somatic parameters, regression to the mean is noticeably stronger for the experimental group for body weight and the perimeter of the tights.

For the chest perimeter, the results are comparable between the two groups; there was no clear indication of the superiority of a method over the other.

In the case of morpho-functional parameters, the personalised training method gave superior results for three parameters, horizontal rowing, squats with the bar on shoulders and dynamometers left. For the other parameters, no significant differences between the two programs other than the average regression of the squats with bar, but at the same time it cannot be concluded from the results obtained that the method is inferior to traditional methods.

The results indicate also provide the best method of planning and analysing of the effects of psycho-motor training programs. Thus, their primary objective, the harmonious physical development of the participants, should be evaluated primarily based on the baseline characteristics of the participants and from knowledge of specific somatic parameters such as age, gender and size.

The Jackknife re-sampling technique was a key tool in improving the analysis and validation the results.

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