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ORIGINAL ARTICLE**

EFFECTS ON BODY COMPOSITION THROUGH 2 TYPES OF MUSCLE TRAINING

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Abstract

The purpose of this study is that of comparing the effects of aquatic training to the effects of land training, in order to improve body composition by decreasing the fat tissue. 24 male students from the UPIT Physical Education and Sport Departament, aged in between 18 and 20 years have been voluntarily selected and divided into two experimental groups (aquatic n=12 experimental group and land n=12 control group). The subjects do not practice any performance sport except the loisir sport or the sport exercises from during the faculty hours. The same trainings and testing facilities and methods have been used for each evaluation and each lesson. Each lesson of muscular training lasted for 65-70 minutes, 3 days per week. In order to establish body composition, we have appealed to a Bosch PPW2200 scale, determining the fat tissue in accordance with the BIA (bioelectrical impedance analysis) principle. A significant difference of 2.72 has been registered (pre=18.2 and post=15.47) between the two groups with regards to the fat tissue established after the water training programs had ended. The muscular training in water is an efficient means of improving body composition, by a decrease of the fat tissue.

Keywords: workout, fat tissue, loose weight.

Introduction

Water and movement: these are two of the fundamental existential components. The body requires movement in order to maintain its good health condition and state of well being; one second sine qua non element is water, necessary for the body to exert its essential functions.

Aquatic is a term used for various disciplines taking place in water, their popularity having increased during the last decade.

This present presentation announces a new point of view, that of approaching force by means of combining the contraction regimes, the efficiency of the stretching exercises, as well as by using water as support.

The popularity of aquatic exercises is still increasing due to the following factors: **water buoyancy**- bodies "loose" weight when in water, have this apparent weight that can be continuously modified up until the floating state(the condition of non-gravity is created); **water resistance**-12 times greater than that of air, makes aquatic exercises involve more muscles and are at the same time more difficult to perform due to the instable environment they are performed into; the **water pressure** acts as a muscular massage, being a stimulant of the process of elimination of the lactic acid at muscle level. Water is also a cooling system in itself, which can decrease heart rhythm with up to 10-20 bpm in comparison to the land performed exercises.**Viscosity -** water creates a non-impact environment that solicits the muscles, bones and conjunctive tissue to a lesser extent than land based activities.

„Principalul avantaj al activităţilor acvatice este efectul flotabilităţii şi rezistenţei apei asupra organismului, întrucât dispune de o solicitare minimă asupra articulaţiilor şi musculaturii." (Beasley, B.L., 1988, pag. 3)

Deoarece apa este mai densă decât aerul, muşchii lucrează mai din greu în apă decât în aer sau pe sol. Apa este, ca efect, o maşină de antrenament cu greutăţi naturală, care poate fi instantaneu ajustată: cu cât se împinge, trage şi loveşte mai tare în apă cu atât se întâmpină mai multă rezistenţă din partea ei.

Water offers support to a sportsman body while moving downwards and also offers resistance when the sportsman lifts (concentric) or jumps (plyometrics). It also adds resistance to lateral moves, thus increasing intensity, with a potential advantage of raising the force level.

The importance of this research

This paper researches the effects of the "new" muscular training (in an aquatic environment) by combining contraction regimes that may lead to physical adjustments such as reducing the fat tissue.

The importance of determining body composition

Determining body composition is a fundamental measurement of the health state, as of the effort capacity, to be applied both to sportsmen and to population in general. The fat tissue percentage varies in function of age, sex and physical training.

A certain percentage of fat tissue is absolutely necessary for maintaining the health state. The essential lipids are indispensable for the well being of our organisms.

The optimal fat tissue level for non-sportive male adults is of 10-20%.

The body composition is one of the factors leading to sport performance, its measurement being an

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important part of the process of monitoring the dynamics of muscular training.

Monitoring the weight and body composition in dynamics offers useful information for guiding the muscular training process that needs to be performed.

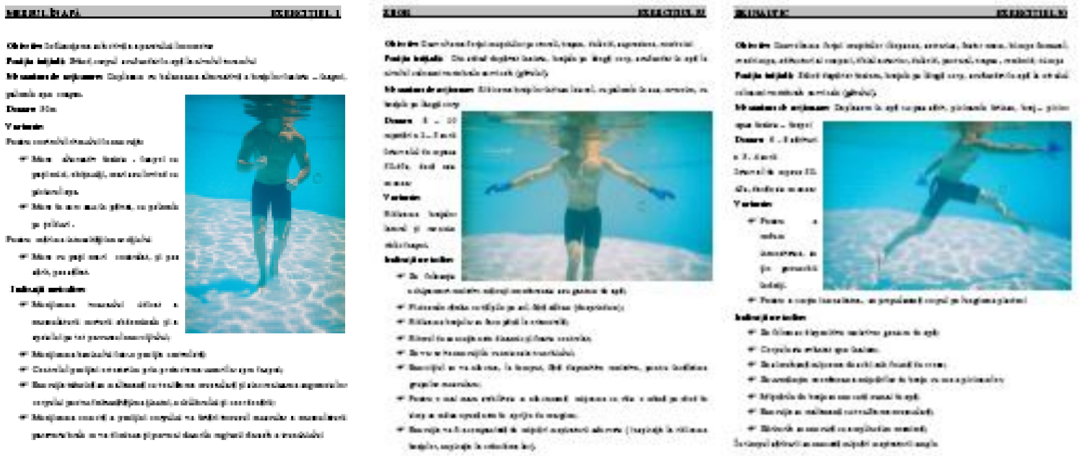
Organizing and unfolding the research

The experiment also took place in the Pitesti Olympic Pool, the sample group being composed of 12 students (18-20years) from the Physical Education and Sport Department. The control group was composed of 12 students from the same university, unfolding their activity inside the Faculty fitness area.

The pedagogical experiment consisted in the application of some muscular training programs, by use of combined aquatic contractions regimes, the subjects being an experimental group (students SEFI, Pitesti), whose results were compared to those of a witness group that unfolded its activity on land, following the very same adapted programs.

The most important aspect of muscular training was represented by the exercise choice, as by the elaboration of the training programs.

Example of aquatic exercises



The progression of the training volume was accomplished through the following: increase of the muscular training sessions, of the number of repetitions, exercises, as well as through the increase of the distance or length/ repetition or exercise. In order to reach systematic progress of the training program, three aquatic muscular preparation sessions were held each week.

The aquatic muscular training per session varied in between 45- and 70 minutes, function of the preparation period. The aquatic muscular training began with a 10-15 minutes warm-up, increasing intensity. Then followed the force development exercises for 40-45 minutes in order to increase intensity and the ending was represented by a 10 minutes stretching exercise stage. The in between series pause was of 30-45 seconds, respectively of 1-2 days if reference is made to the aquatic muscular trainings.

The training intensity increased by the use of resisting apparatus specific to the aquatic environment (water weights, membrane gloves), by increasing speed, execution rhythm, by increasing the number of repetitions performed at the same intensity, as well as by reducing the repose interval in between repetitions or exercises.

The heart rhythm is the main means of measuring aquatic training intensity.

The research hypothesis

Determining the body composition is of essential importance in estimating the health condition as well as effort capacity both in the case of the trained people, as in the case of the untrained ones. Likewise, the body composition is an element contributing to the sportive performance. This is the very thing compelling us to presuppose that **the exercise of combining muscular contraction regimes in an aquatic environment leads to a decrease of the fat tissue.**

The purpose of the present study

This research aims isto compare the effects determinating in fat tissue of aquatic training with land training using the combined contraction regimes for the Physical Education and Sport students (18-20 years)

Materials and methods

In order to put into practice this experiment, the following research methods were used: the pedagogical observation method, the measurements and test method; the pedagogical experiment; the statistical-mathematical data processing; the comparative analysis; the graphical method.

Determining the fat tissue

Determining the fat tissue is important for monitoring the effects of physical exercises over the active mass and over the fat tissue.

The body composition can be evaluated throughout several methods. For our research purposes, we have chosen to use a Bosch PPW2200 scale measuring the fat tissue in accordance with the BIA (bioelectrical impedance analysis) principle. The apparatus transmits a weak, non-dangerous electric signal through the body.

The impedance is thus measured, representing the body opposition to the signal transmission. The resistance is influenced by the structure of the human body. The muscles and organs contain water, and as a

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consequence, they are good conductors, while the fat tissue opposes resistance to the signal transmission, this being the reason why it is a poor conductor.

The fat tissue is calculated by starting from the measured impedance and also taking into consideration the data introduced into the scale's memory: height, age and sex.

The data was analyzed with the help of the **Microsoft Excel, 2003.**

In order to **test the hypothesis** of the present study, the dependent variables were compared by first using the t dependent test for each of the two groups- the experimental and the control one (**paired t test**), with the purpose of determining if there are any differences in between T.I and T.F in what the aquatic muscular training and land force training are concerned.

The **unpaired t** test was independently used in order to analyze the comparative evolutions of the experimental and control groups with a direct view to the somatic, functional and motric indicators, considered both during the initial as in the final tests.

The t (Student test) was used in our research in order to determine the significance of the averages; the test was compared with the t value from Ficher's table at the 0.05 level of significance, as well as to that of 0,01 and 0,001 , with the freedom degrees equal to n.

Results

Table 1.1.physical characteristics, recorded by an initial and a final test to students (experimental group and control group) involved in our experiment.

The data presented in this table, you can see anthropometrics measured parameters are height, length of legs, weight and fat.

Table no. 1.1. Dynamic evolution of indicators of somatic growth in initial – final experimental group

Nr.	SUBJECT	Waist (cm)		Length of legs (cm)		Weight (Kg)		Adipose tissue	
		TI	TF	TI	TF	TI	TF	TI	TF
1.	Q	186	186	97	97	65.81	66.98	12.9	11.0
2.	B	172	172	87	87	62.84	64.03	15.9	14.0
3.	C	178	178	93	93	59.63	60.98	11.8	10.3
4.	D	176	176	86	86	68.39	70.50	17.9	14.2
5.	E	181	181	93	93	80.02	76.20	24.3	20.6
6.	F	176	176	93	93	85.46	83.00	26.9	22.5
7.	G	178	178	88	88	75.84	75.50	17.9	15.8
8.	H	176	176	88	88	88.22	83.50	26.7	21.1
9.	I	182	182	100	100	77.37	75.45	18.3	16.2
10.	J	173	173	89	89	70.30	69.20	13.6	12.5
11.	K	184	184	96	96	86.70	84.00	19.4	16.2
12.	L	180	180	90	90	67.36	69.50	12.8	11.3
	x	178,5	178,5	91,6	91,6	73.99	73.23	18.2	15.475
	S	4,25	4,25	4,39	4,39	9.69	7.67	5.32	4.10
	Cv	2,38	2,38	4,79	4,79	13.09	10.47	29.23	26.52
	t calculated		-		-		1,106		6.834
			-		**-**		**> 0.05**		**< 0.001**

Evolution of somatic factor experimental group **(Table no. 1.1.)**

The fat tissue –Indicator presents a decrease of the averages from 18.2 in the initial testing to 15.47 to the final testing, the significant difference being of 2,72, **critical t** = 2,11 < **calculat**ed t = 11,06, **p < 0,001**. The null hypothesis is rejected. The homogeneity of results is maintained to an exaggerated value Cv = 26,52 %.

H_0 Ipoteză nulă	H_1 Ipoteză alternativă	α	df	t calculated	t critical
$m_1 = m_2$	m_1 # m_2	0.001	2,72	**6,834**	**2,179**

t critical <t calculated. Statistically, the results of two tests differ significantly.
The null hypothesis is thus rejected and *the alternative one is accepted*

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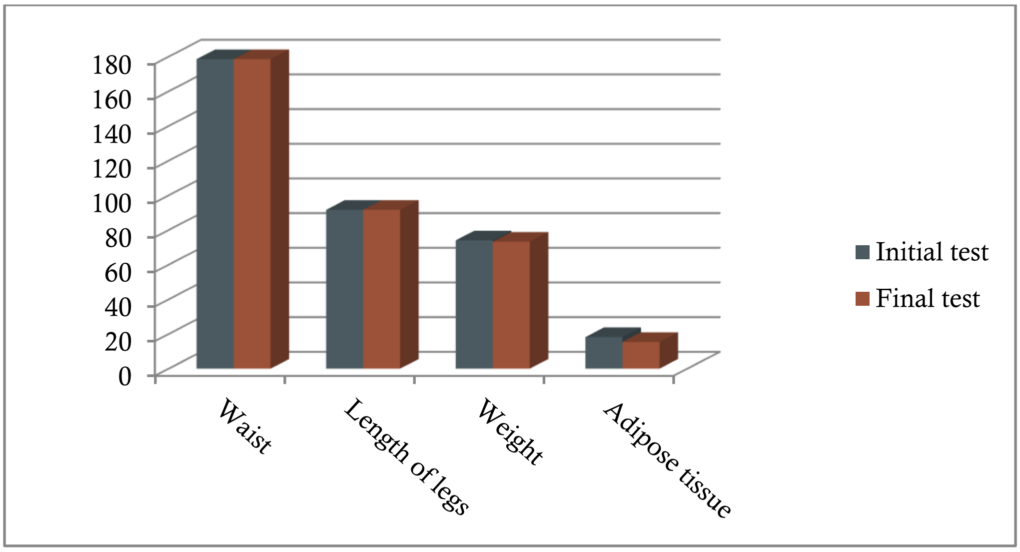

Figure no.1.1. Dynamic evolution of indicators of somatic growth in initial – final experimental group

Table no. 1.2. Dynamic evolution of indicators of somatic growth in initial – final control group

Nr.	Subjects	Waist (cm)		Length of legs(cm)		Weight (Kg)		Adipose tissue	
		TI	TF	TI	TF	TI	TF	TI	TF
1.	B.A.	180	180	92	92	70.55	69.84	15.9	15.0
2.	N.E.	174	174	89	89	72.40	74.30	14.5	14.3
3.	R.D.	183	183	95	95	88.70	89.00	24.1	23.6
4.	B.I.	173	173	89	89	63.27	62.88	17.8	15.3
5.	U.A	172	172	84	84	60.58	59.48	12.2	12.0
6.	P.C.	177	177	95	95	67.40	69.80	11.7	11.5
7.	A.I.	175	175	91	91	76.32	77.40	22.0	23.5
8.	S.R.	178	178	94	94	89.40	89.90	25.6	24.1
9.	L.A.	184	184	94	94	87.22	89.40	19.8	19.6
10.	G.V.	176	176	93	93	73.00	73.20	18.3	18.0
11.	C.I.	172	172	86	86	63.10	64.3	17.1	16.8
12.	D.R.	181	181	93	93	79.00	79.3	25.3	24.3
	x	177.08	177.08	91.25	91.25	74.24	74.9	18.69	18.16
	S	4.16	4.16	3.57	3.57	10.13	10.48	4.79	4.77
	Cv	2.35	2.35	3.91	3.91	13.65	13.99	25.64	26.26
	t calculated		-		-		**2.017**		**1.922**
			-		-		**> 0.05**		**> 0.05**

The fat tissue –Indicator presents a decrease of the averages from 18,69 in the initial testing to 18,66 to the final testing, the **non-significant** difference being of 0,53, **critical t** = 2,179< **calculated** t = 1,922, **p < 0,05**.

The null hypothesis is accepted. The homogeneity of results is maintained to an exaggerated value Cv = 26, 26 %.

H_0 Ipoteză nulă	H_1 Ipoteză alternativă	α	df	t calculated	t critical
$m_1 = m_2$	$m_1 \# m_2$	0.05	0,53	**1,922**	**2,179**

t critical <t calculated. Statistically, the results of two tests differ insignificant.

The null hypothesis is accepted.

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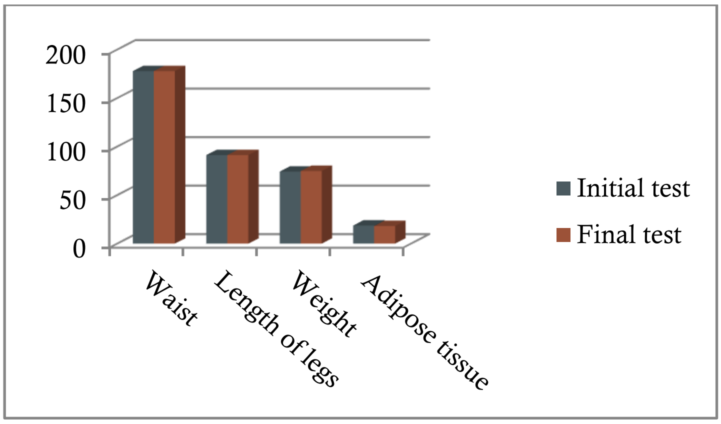


Figure no.1.2. Dynamic evolution of indicators of somatic growth in initial – final control group

Comparative analysis of somatic evolution indicators in the experimental group and control
Initial testing

Table no. 1.3.

	Control group	Experimental group	Difference	t - calculated	p - semnification
Waist	177.08	178.5	1,41	0.824	p > 0,05
Length of legs (cm)	91,25	91,66	0,41	0.254	p > 0,05
Weight (Kg)	74,.245	73.995	0,25	0.061	p > 0,05
Adipose tissue (%)	**18, 691**	**18, 2**	**0,49**	**0.237**	p > 0,05

It is to be noticed that the experimental and control group showed non-significant differences in all 3 indicators, the p significance level being of p < 0,05 in the beginning of the experiment, which demonstrates the initial homogeneity of the 2 sample groups.

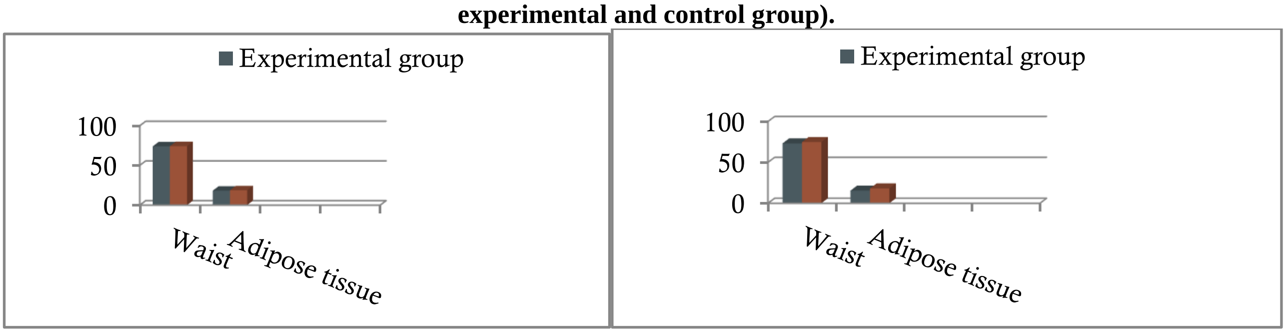
Comparative evolution of the experimental and control groups in the final testing

Table no. 1.4.

	Control group	Experimental group	Difference	t - calculated	p - semnificaţtion
Waist	178.5	177.083	1,41	0.824	p > 0,05
Length of legs (cm)	91,25	91,66	0,41	0.254	p > 0,05
Weight (Kg)	74,.9	73.236	1,67	0.443	p > 0,05
Adipose tissuee(%)	**18.166**	**15.475**	**2,69**	**1.481**	p > 0,05

The experimental group had non-significant increases in all three indices, for thep < 0,05level of significance if compared to the control group, which proves that the biological, somatic factor did not have any effects on the length of the experiment.

Figures 1.3 and 1.4 graphically represent the date obtained by the two groups under study (the experimental and control group).



Figures no 1.3 and 1.4 The dynamics of the comparative evolution of the somatic indices in the initial and final testing.

Conclusion

1. A series of decreases of the fat tissue percentage has been noticed following the aquatic training programs; a significant change is triggered: 2, 72 (pre = 18,2, post = 15,47). The null hypothesis is rejected and the alternative one is taken into consideration. (Table 1.1)

2. With direct regards to the comparative evolution of the experimental and control groups in the initial testing, one can remark that the fat tissue indicator registers non-significant differences for the p < 0,05 level of significance, which demonstrated the initial homogeneity of the two sample groups.

3. By using the apparent resistance for measuring the percentage of fat body tissue a significant reduction of 2.72% was registered after a period of 33 weeks of aquatic exercise performed by the experimental group, while the o.53% decrease in the case of the control group is not significant enough.
4. The aquatic muscular training is an efficient means of improving body composition, by reducing the fat tissue.
5.The effects of the regular aquatic versus land training requite different with regards to the organism changes, no modifications being registered for the control group.
6. We appreciate that there is a connection in between the use of water muscular training programs and the decrease in fat tissue.
7. Experiments without nutrition control require for a longer muscular training before reaching the noticeable body composition changes.

References

Albright A.L., Stern, J.S., 1998, *Adipose tissue*, Encyclopedia of Sports Medicine and Science.

Beasley B.L., 1988, *Aquatic exercise*, Sports Medicine

Brodie D. A., 1988, *Techniques of measurement of body composition* Part II. Sports Medicine, 5, 74-98.

Case L., 1997, *Fitness Aquatics*. Champaign, IL: Human Kinetics

Dyon N, Gaden Y., 2005, .*Musculation et renforcement musculaire du sportif,* Ed. @mphora Sport, Paris,.20

Flec, S.J., and Kraemer, W.J., 1987, *Designing resistance training programs,* Humans Kinetics Books, Champain, Illinois

Hered S. L., Darby, L. A., &Yaekle, G. C. 1997, *Comparison of physiological responses to comparable land and water exercises*, Medicine and Science in Exercise and Sport (Abstract).

Lohman T.G., et al., 2000, *Assessing body composition and changes in body composition. Another look at dual-energy X-ray absorptiometry,* Ann NY AcadSci

Mateescu A., 2009, Contribuţii privind dezvoltarea forţei prin antrenamentul acvatic utilizând combinări ale regimurilor de contracţii la vârsta de 18 – 20 ani, teză de doctorat

Niculescu M., Iorga, I.,S., Mateescu, A., 2008, *Pregătirea musculară în condiţii speciale*, Editura Universitaria Craiova.

McArdle W. D., Katch, F. I. & Katch, V. I. 2001, *Body composition assessment. Exercise physiology*: Energy, nutrition and human performance (5 rded).