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THE INFLUENCE OF SWIMMING ON THE SOMATIC-FUNCTIONAL PARAMETERS OF PREPUBESCENT CHILDREN

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Abstract. *This article presents some general aspects regarding the influence of swimming on the growth and development processes of prepubescent children (ages 11-13), especially the adaptation of somatic-functional parameters as stabiliser factors of evolution, body posture attitude at this age. Development and implementation of a program specific to swimming' means, adapted towards the development of somatic-functional potential of pre pubertal children represent the main objective for optimising the growth process of children at this age.*

Keywords: *swimming, somatic-functional, growth and development, pre puberty.*

The actuality of the subject: Adolescence is one of the most important periods in a person's life. At this stage of growth and development the most important somatic, functional and psychological changes are manifested in the structure of the future adult. According to some authors (Littre, Gilbert, Hutniel, Lesne, cited by A. Ionescu 1962), puberty and adolescence are equivalent, and last from the first signs of puberty until their individual somatic, organic and psychological traits are established. Ionescu A.N. (1994) believed that adolescence is a stage of life, and puberty is a complex of biological phenomena, by which the body transforms to a higher state, the adult [4].

The skeletal system is still in development, bones are long and thin, muscles are insufficient, joints have an acute ligamentous laxity. They all favour a lack of stability and functional physical deficiencies, bad posture, which once installed continue to develop and are hard to stabilise and correct. In addition to such deficiencies in structural and functional relationships, imbalances between segments or organs can be observed: long, thin arms, chest bulging or flat. They are sometimes accompanied by functional or mental disorders. [1,2]

The prepubescent period is marked by accelerated growth in height and weight, with higher intensity in girls than boys. For height, accelerated growth begins at 11 years old and takes up to approximately 13 years; for weight it starts at the same age (11) and ends at about 14 [3,5]. Before and after puberty, when bone growth processes are faster, bone length increases faster than thickness, therefore height stands out first. The supporting musculature is poor, favouring misalignments in the emerging musculoskeletal structures.

The purpose of the paper: improving the implementation of specific swimming means to develop somatic-functional indicators, with the aim of preventing physical and functional deficiencies in prepubescent children.

Objectives: developing and implementing a methodology for therapeutic swimming, to prevent the installation of physical and functional spine deficiencies in children aged 11-13 years.

Material and method: Homogeneous control and experiment groups, allowing the tests and programs without execution difficulties, were selected. Both the control and experiment group consisted of 30 students aged 11 to 13 (4th through 7th grade in the Romanian education system), with 15 girls and 15 boys.

Table 1. Results of somatic indices of the subjects included in the educational experiment; initial-final testing (n = 30)

Crt. nr.	Testing	Groups of subjects	Initial testing boys			final testing boys			t	P	Initial testing girls			final testing girls			t	P
			X±m	S	Cv	X±m	S	Cv			X±m	S	Cv	X±m	S	Cv		
1	Height (Cm)	E	153,00 ±5,87	7,93	0,05	154 ±6,28	8,23	0,05	0,66	>0,05	152,6 ±5,17	6,43	0,04	154,07 ±5,40	6,62	0,04	0,19	>0,05
		M	153,73 ±4,55	5,46	0,04	154,60 ±4,43	5,34	0,03	0,41	>0,05	153,33 ±4,80	5,64	0,04	153,27 ±4,61	5,55	0,04	0,00	>0,05
		t; P	E-M	0,23/>0,05	–	0,61/>0,05	–	–	–	–	0,50/>0,05	–	0,15/>0,05	–	–	–		
2	weight (Kg)	E	46,00 ±6,40	8,60	0,19	48,33 ±4,80	6,78	0,14	0,66	>0,05	43,40 ±6,45	8,02	0,18	47.07 ±4,06	4,98	0,11	1,03	>0,05
		M	46,87 ±4,01	4,67	0,10	47,67 ±4,36	5,33	0,11	0,34	>0,05	43,13 ±4,56	6,19	0,14	44,73 3,56	5,27	0,12	0,22	>0,05
		t; P	E-M	0,40/>0,05	–	0,27/>0,05	–	–	–	–	0,05/>0,05	–	1,17/>0,05	–	–	–		
3	Body mass index (uc.)	E	19,55 ±2,02	2,58	0,13	20,12 ±1,13	1,54	0,08	0,24	>0,05	18,55 ±2,08	2,72	0,15	19,79 ±1,01	1,15	0,06	1,03	>0,05
		M	19,79 ±0,66	0,96	0,05	19,92 ±1,03	1,53	0,08	0,39	>0,05	18,52 ±1,49	1,89	0,10	19,07 ±1,94	2,41	0,13	0,62	>0,05
		t; P	E-M	0,32/>0,05	–	0,43/>0,05	–	–	–	–	0,09/>0,05	–	1,19/>0,05	–	–	–		
4	Anvergura (cm)	E	153,07 ±6,48	8,61	0,06	154,40 ±6,56	8,93	0,06	0,31	>0,05	153,13 ±6,26	7,45	0,05	154,33 ±6,18	7,34	0,05	0,34	>0,05
		M	153,47 ±4,77	5,99	0,04	154,60 ±4,83	5,78	0,04	0,33	>0,05	153,20 ±4,69	5,61	0,04	153,80 ±4,64	5,65	0,04	0,17	>0,05
		t; P	E-M	0,37/>0,05	–	0,31/>0,05	–	–	–	–	0,17/>0,05	–	0,05/>0,05	–	–	–		
5	Upper limb length (cm)	E	64,07 ±2,62	3,79	0,06	66,20 ±3,07	4,31	0,07	0,05	>0,05	64,93 ±3,40	4,20	0,06	66,27 ±3,48	4,15	0,06	0,81	>0,05
		M	63,47 ±4,84	5,25	0,08	64,00 ±4,93	5,35	8,08	0,40	>0,05	65,87 ±3,06	3,56	0,05	66,20 ±2,88	3,49	0,05	0,52	>0,05
		t; P	E-M	0,21/>0,05	–	0,04/>0,05	–	–	–	–	0,79/>0,05	–	0,10/>0,05	–	–	–		
6	Leg length (cm)	E	86,80 ±4,05	5,05	0,06	90,53 ±4,64	5,45	0,06	0,02	>0,05	84,40 ±4,08	5,07	0,06	89,67 ±3,38	4,20	0,05	2,34	<0,05
		M	86,40 ±4,03	4,60	0,05	89,80 ±3,65	4,07	0,05	0,02	>0,05	83,93 ±3,79	4,61	0,05	86,73 ±3,72	4,74	0,05	1,15	>0,05
		t; P	E-M	0,26/>0,05	–	0,19/>0,05	–	–	–	–	1,15/>0,05	–	1,56/>0,05	–	–	–		
7	Length finger-ground (cm)	E	56,40 ±2,61	3,31	0,06	58,13 ±2,69	3,27	0,06	0,08	>0,05	58,40 ±3,81	4,63	0,08	59,93 ±4,33	5,12	0,09	0,30	>0,05
		M	56,60 ±3,04	4,75	0,08	57,27 ±2,79	4,53	0,08	0,35	>0,05	57,60 ±1,92	2,29	0,04	58,73 ±2,12	2,63	0,04	0,31	>0,05
		t; P	E-M	0,39/>0,05	–	0,31/>0,05	–	–	–	–	0,66/>0,05	–	0,78/>0,05	–	–	–		
8	Acromion ground length (cm)	E	121,33 ±5,29	6,67	0,05	123,80 ±5,12	6,36	0,05	0,14	>0,05	123,47 ±3,77	4,70	0,04	126,00 ±3,47	4,36	0,03	0,89	>0,05
		M	122,60 ±3,17	3,68	0,03	123,93 ±3,27	3,86	0,03	0,17	>0,05	124,47 ±3,90	4,93	0,04	125,80 ±3,81	5,06	0,04	0,24	>0,05
		t; P	E-M	0,45/>0,05	–	0,32/>0,05	–	–	–	–	0,.75/>0,05	–	0,12/>0,05	–	–	–		
9	SIAS ground length (cm)	E	92,33 ±4,22	5,42	0,06	94,47 ±3,83	4,97	0,05	0,13	>0,05	89,73 ±4,48	5,13	0,06	93,93 ±3,67	4,42	0,05	1,66	>0,05
		M	92,73 ±4,89	5,90	0,06	94,80 ±3,31	3,93	0,04	0,15	>0,05	89,80 ±3,36	4,21	0,05	92,67 ±3,82	4,45	0,05	1,26	>0,05
		t; P	E-M	0,44/>0, 05	–	0,39/>0,05	–	–	–	–	0,08/>0, 05	–	0,04/>0,05	–	–	–		

Notă: E- experimental group ; n-15, f-14: P – 0,05; 0,01; 0,001. n-15, f-28: P – 0,05; 0,01; 0,001.

M- control. group t – 2,145 2,977 4,140 t – 2,048 2,763 3,674

At the beginning of the experiment both groups were subjected to somatic-functional testing: *9 somatic indicators*: height, weight, body mass index, upper limb length, lower limb length, fingers-to-ground distance, acromion-to-ground distance, anterior-superior-iliac-spine-to-ground distance; 5 *functional indicators*: resting heart rate, exercise heart rate, maximum allowed heart rate, resting respiratory rate, exercise respiratory rate. After testing both groups, the control group will continue the exercise program in school physical education classes. The experiment group will be placed in a specific swimming class for a period of 6 months, with 3 hours of practice per week. The swimming program has four stages: the first 18 hours are dedicated to developing swimming technique and means; the other 3 stages are allocated to both swimming technique (technical elements), to the development of motor skills and awareness, and to correcting the body's static and dynamic posture. Tables 1 and 2 show the results of somatic and functional testing respectively.

The research results: Due to the short length

of the experiment (6 months), differences between initial and final assessment are not very significant. Analysis of the assessed somatic indices shows a slight increase, higher for the experimental group achieved due to the swimming program followed.

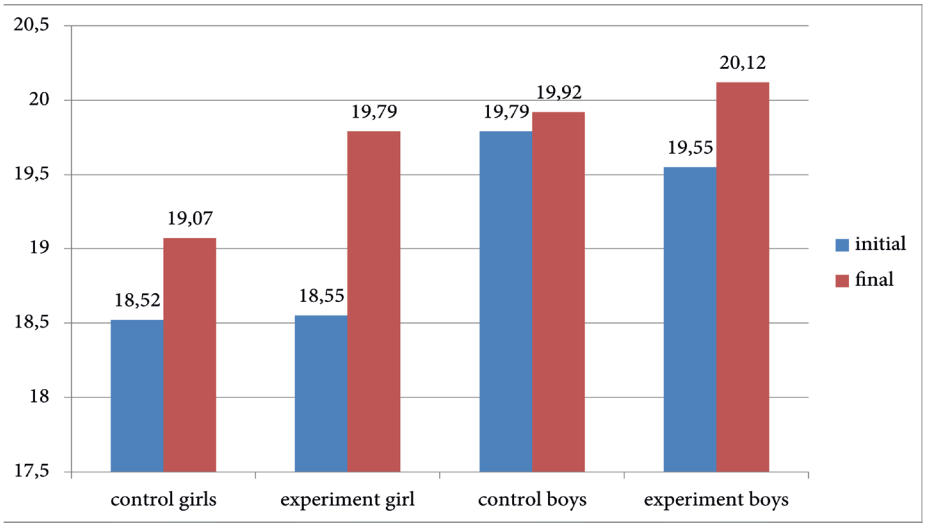

Fig. 1. BMI (body mass index) evolution during the experiment.

Boys' height increased for both the control (153.73 ± 4.55 cm to 154.60 ± 4.43 cm) and experiment groups (153.00 ± 5.87 cm to 154.00 ± 6.28 cm). In girls, the experiment group achieved a score higher than the control group, the difference being approximately 2 cm, but without statistically significant differences (P > 0.05). Weight and body mass index also increased slightly in the experiment group, girls having higher increases than boys. The Body Mass Index (BMI) of the control group increased from 19.79 ± 0.66 to 19.92 ± 1.03 for boys, and from 18.52 ± 1.49 to 19.07 ± 1.94 for girls Both are at the lower end of normal scores (BMI between 18,5 and 24,9). In the experiment group, boys' BMI increased from 19.55 ± 2.02 to 20.12 ± 1.13, and the girls' BMI increased from 18.55 ± 2.08 to 19.79 ± 1.01. The differences are not statistically significant (P > 0.05).

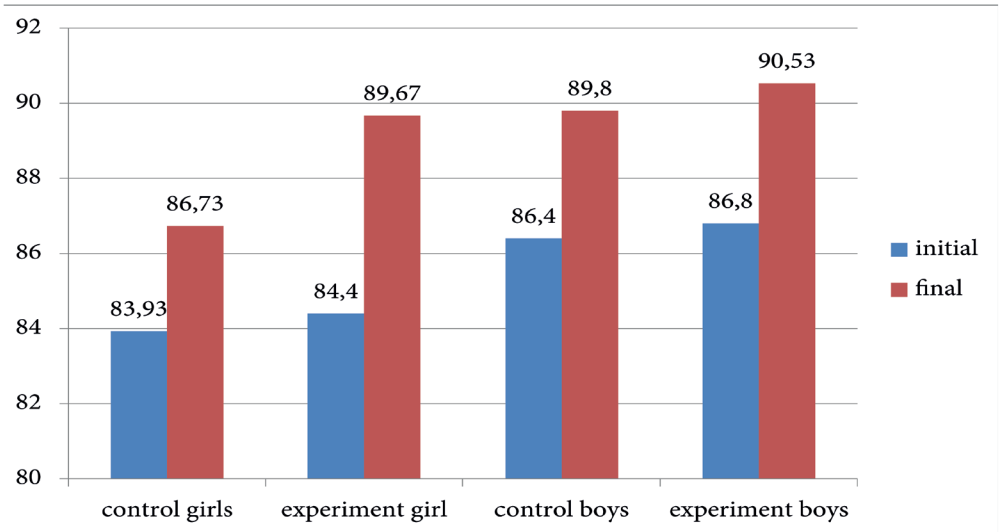

Fig. 2. Evolution of lower limb length

From Table 1, it can be seen that there are no significant differences in the somatic indicators examined, apart from lower limb length, which has an accelerated growth at this age. Figure 2

shows the values obtained.

Table 2. Results of functional indices of the subjects included in the educational experiment; initial-final testing (n = 30)

Crt. nr.	Testing	Groups of subjects	Initial testing boys			final testing boys			t	P	Initial testing girls			final testing girls			t	P
			X±m	S	Cv	X±m	S	Cv			X±m	S	Cv	X±m	S	Cv		
1	rest cardiac frequency (b / min)	E	67,53 ±4,50	5,77	0,09	66,27 ±2,72	3,15	0,05	0,75	>0,05	66,73 ±4,82	5,89	0,09	66,13 ±3,49	4,16	0,06	0,25	>0,05
		M	65,67 ±5,11	6,03	0,09	66,40 ±5,01	5,87	0,09	0,21	>0,05	65,67 ±5,11	6,03	0,09	67,53 ±3,17	3,91	0,06	0,89	>0,05
	t; P	E-M	0,72/>0,05		–	0,17/>0,05		–	–	–	0,28/>0,05		–	1,01/>0,05		–	–	–
2	effort cardiac frequency (b / min)	E	132,80 ±6,75	8,40	0,06	128,13 ±4,77	6,22	0,05	1,79	>0,05	131,60 ±8,64	10,46	0,08	127,93 ±4,20	5,20	0,04	1,01	>0,05
		M	131,07 ±7,55	9,69	0,07	132,07 ±7,94	10,66	0,08	0,09	>0,05	131,87 ±6,91	9,09	0,07	132,13 ±6,37	7,82	0,06	0,21	>0,05
	t; P	E-M	0,02/>0,05		–	1,49/>0,05		–	–	–	0,26/>0,05		–	1,95/>0,05		–	–	–
3	maximum cardiac frequency (b / min)	E	176,66 ±0,51	0,64	0,00	176,66 ±0,51	0,64	0,00	0,00	>0,05	>0, 05	0,74	0,00	176,59 ±0,65	0,74	0,00	0,00	>0,05
		M	176,61 ±0,47	0,58	0,00	176,61 ±0,47	0,58	0,00	0,00	>0,05	176,71 ±0,54	0,68	0,00	176,71 ±0,54	0,68	0,00	0,00	>0,05
	t; P	E-M	0,28/>0,05		–	0,28/>0,05		–	–	–	0,96/>0,05		–	0,96/>0,05		–	–	–
4	respiratory rate at rest (resp / min)	E	20,87 ±1,63	2,00	0,10	19,73 ±0,85	1,03	0,05	1,83	>0,05	20,67 ±1,47	1,80	0,09	20,27 ±1,18	1,44	0,07	0,67	>0,05
		M	20,53 ±2,04	2,42	0,12	20,00 ±1,47	1,81	0,09	0,54	>0,05	20,53 ±2,04	2,42	0,12	19,93 ±1,67	2,15	0,11	0,69	>0,05
	t; P	E-M	0,69/>0,05		–	0,25/>0,05		–	–	–	0,45/>0,05		–	0,23/>0,05		–	–	–
5	frequency of respiratory effort (resp / min)	E	34,73 ±4,25	4,88	0,14	29,20 ±2,21	2,68	0,09	3,64	<0,01	33,53 ±4,23	4,76	0,14	30,00 ±1,60	2,04	0,07	2,21	<0,05
		M	33,47 ±4,36	5,08	0,15	32,20 ±4,48	5,09	0,16	0,67	>0,05	33,47 ±4,36	5,08	0,15	31,40 ±4,91	5,34	0,17	1,03	>0,05
	t; P	E-M	0,90/>0,05		–	1,80/>0,05		–	–	–	0,20/>0,05		–	0,52/>0,05		–	–	–

Notă: E- experimental group n-15, f-14: P – 0,05; 0,01; 0,001. n-15, f-28: P – 0,05; 0,01; 0,001.
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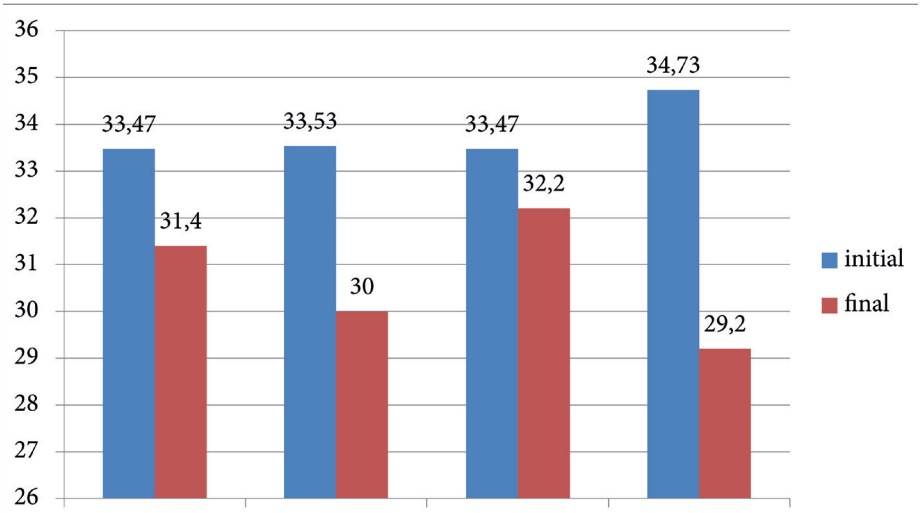

Fig. 3. Exercise respiratory rate change during the experiment

The exercise heart rate shows positive changes in both control and experiment groups: boys experiment group has a decrease from 132.80 ± 6.75 to 128.13 ± 13; girls experiment group has a decrease from131.60 ± 8.64 to 127.93 ± 4.20. They compare positively to the control group, where the boys had an increase from 131.07 ± 7.55 to 132.07 ± 7.94, while the girls had an increase from 131.87 ± 6.91 to 132,13 ± 6,37. The differences are not statistically significant (P > 0.05).

Changes due to swimming are most evident in the exercise respiratory rate results: in the exper-

iment group boys showed a decrease from 34.73 ± 4.25 to 29.20 ± 2.11, with t=3.64 ($P < 0.01$), while the girls showed a decrease from 33.53 ± 4.23 to 30.00 ± 1.60, with t=2.21 ($P < 0.05$). Both results are statistically significant. A graphical representation can be seen in Figure 3.

Conclusions:

- Analysis of the assessed somatic indices shows a slight increase of the experiment group's values due to the swimming program compared to the control group. Weight and body mass index also had a slightly higher increase in the experiment group, with girls showing greater differences to the control group than boys.
- The relationship of proportionality between segments and somatic-postural state are within the physiological limits. Both overall body mass index and segment lengths relative to each other and to the ground result in a positive development;
- BMI was selected as a benchmark for the overall development of the subjects tested in the experiment. The results of the experiment groups are superior and closer to normal BMI values. (18.5 – 24.9);
- Regarding functional status, at this age due to the fragility and physiological changes, normal at this stage of child development, major long-term performance changes cannot be achieved. However, respiratory capacity is greatly enhanced.

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