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Analysis of the scoliosis onset mechanisms for children and optimal rehabilitation interventions through aquatic activities

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Abstract

It is known, certainly, that it is much easier to form a correct attitude than to correct the vicious one, a reason that must determine the approach of prophylactic means of physical therapy and therapeutic swimming. The identification, at an early stage, of the etiological factors responsible for the installation of postural deficiencies, is a determining factor in the management of programs for their maintenance or recovery in children of prepubertal age. The study took place at the Constantinescu Mihai Physiotherapy Office of Suceava and at the Cornișa Botoșani Swimming Complex. It is known that the correct position is formed from childhood, and movement and exercise are the main factors of its construction. In this sense, the paper proposes kinetic recovery and therapeutic swimming programs in order to strengthen the postural status in children during growth and development. In this regard, we have set the following objectives: identification of children with vicious postural attitudes because of the overloads in the prepubertal period and analysis of the scoliosis mechanisms in children of prepubertal age on a vulnerable somato-functional status.

Keywords: *therapeutic swimming, evaluation, scoliosis, children, analysis,*

1. INTRODUCTION

One of the problems that modern child face more and more often is the postural deficiency, given that walking and vertical bipedal posture is replaced in daily life by the use of means of transport, sitting position, backpack use, lack of physical activities, inadequate nutrition, incorrect allocation of sleep periods, sedentary lifestyle, etc.

Scoliosis, like other physical deficiencies, must be the concern of recovery specialists, because these cases have grown (1,2,3,4,5,6).

Magnesium is an essential nutrient for living organisms and an enzymatic cofactor for more than 300 reactions (7). In order to maintain a correct posture, support from the skeleton is needed. It contains about 99% of the total calcium in the body, the rest being distributed in plasma and extracellular fluid. Reducing the amount of calcium (inadequate dietary intake, increased metabolic intake) and magnesium can influence muscle contraction, enzymatic processes and excitability of the heart (8).

Regarding the recovery of the scoliotic attitude, we must take into account the degree of installed angulation and the way of developing a specific kinetic program in order to obtain favorable results for children.

The literature shows that most specialists in the field recommend for an angulation of 0-30 degrees the use of medical gymnastics, for 30-50 degrees gymnastics plus corset and over 50 degrees surgery followed by recovery program in stages.

The author Jianu M. (9) quotes in ”Pediatric Scoliosis” in 2010 the orthopedic surgeons from France Carlios and Syringe, stating that ”there is no kinetotherapeutic treatment of evolutionary scoliosis”. In this sense, we aimed to analyze the mechanisms of scoliosis in children of prepubertal age, to detect the installation of scoliosis and to develop specific recovery programs in a timely manner.

The most worrying thing is that more and more children develop this deficiency in the spine, with a prognosis not very favorable even for those who play a sport, and, most of the time, the therapeutic behavior is not appropriate or personalized.

The correct position is formed from childhood, and movement and exercise are the main factors of its construction. Water is a suitable environment to facilitate movement and provides extremely effective conditions for obtaining optimal health during growth and development (10,11,12,13).

In this sense, we propose kinetic recovery programs through postural reeducation and therapeutic swimming.
Therapeutic swimming includes a complex of exercises with different techniques, and its great advantage is that it is practiced in the water.
At the same time, the influence of water on the body's attitude is determined by practicing the swimming technique regularly, through the loading made on the musculoskeletal system, especially on the musculo-osteo-articular system, in water the joints being released by the body weight loading. Inthis case, the muscle effort can be reduced or increased depending on the means approached in the workouts schedule, according to the proposed objectives (14,15,16).
The work hypothesis: We started from the premise that, by applying some means of therapeutic swimming in recovering the posture deficiencies of prepubertal children, it will be possible to improve the postural status.
The purpose of the paper is a detailed analysis of the pathophysiology of physical deficiency of thoraco-lumbar scoliosis (TGS) in children of prepubertal age and the identification of the means of optimal recovery through aquatic activities.
Objectives of the paper:
1. Identifying children with vicious postural attitudes due to overloads in the prepubertal period;
2. Analysis of the mechanisms of installation of scoliosis in children of prepubertal age on a vulnerable somato-functional status.

Material and method
The experiment took place at the Constantinescu Mihai Physical Therapy Office of Suceava as well as at the Cornișa Swimming Complex, Botoșani. The children subjected to the experiment, girls and boys, were aged between 11-13 years.
The children were controled and diagnosed by a pediatric orthopedic specialist and referred to us for recovery. The recovery program lasted 6 months (September 2020 – February 2021), including a physiotherapy program of 2 sessions/week and a therapeutic swimming program of 2 sessions/week.

- *Kinetic recovery program (examples of exercises)*

Postural recovery exercises for left thoraco-lumbar scoliosis (model)
Objectives:
- increasing the mobility of the spine, of the scapulo-humeral belt and pelvic belt;
- decreasing the degree of angulation through corrective positions;
- increasing the tone of the muscle groups related to the spine.

Content:
1. Static exercises: asymmetrical positions of sitting, on the knees, in ventral and dorsal decubitus:
- from standing with legs apart with left hand on hip, bringing the bent knee to the chest simultaneously with stretching and bending the right arm, up or side (2x);
- with the left knee resting on a support above the level of the pelvis, the right leg back, with a cane placed diagonally at the back, grabbed from above with the right hand and with the left from lower, wide extension of the torso simultaneously with its twist to the right, with arching (2x);
- from supine position, with legs apart, left hand next to the body and right hand upwards, then the same exercise in ventral supine position (3x3-5 min maintaining).

2. Dynamic exercises: analytical movements of the limbs and torso:
- walking on peaks with small steps, with the right arm stretched up and the left arm down, arching in the rhythm of the steps (3x);
- walking with the left foot sideways, right arm up, left hand on the hip (2x);
- walking with medicine ball on the head supported from the side with the right hand (2x).

3. Breathing exercises: contributes to maintaining respiratory capacity and chest compliance:
- from orthostatism, movements of the arms in extension, inspiration then, on expiration, the arms are brought in flexion (2x);
- raising the arms up, above the head, with inspiration, then lower the arms down, next to the body, with expiration (2x) (17,18).

- *Therapeutic swimming recovery program (examples of exercises)*

Objectives:
- learning the technical elements of swimming;
- toning in conditions of shortening the muscular groups of the back in the convexity part and of elongation in the concavity part;
- chest development.

Content:
1. Initiation exercises in swimming:
- diving exercises (3x);
- jumping in the water (2x);
- floating on the belly, on the back and vertically (3x).

2. moving exercises in water:
- walking back and forth through the water with the help of arms (2x7m);
- learning the legs movement: crawl on the wall (3x) and with the float (4x), back and bras (4x);
- learning the arms movement: crawl, back, arm (4x)

3. Learning to breathe:
- bubbling at the water level (2x);
- inspiration and exhalation underwater (2x);
- opening the eyes underwater (3x).

4. Low water recovery exercises
- standing, with the right hand on the head and the left on the hip, raising the left knee and extending the torso and head;

- from walking with the left foot on the tip, with the right hand at the nape of the neck and the left arm next to the body, extensions and arches of the torso are made on each step;
- the same exercise, but walking slumped on his left leg.

5. Recovery exercises in deep water:
- sliding in the back procedure (2x12.5m);
- sliding in the crawl procedure with the right arm up and the left arm stretched next to the body (2x7m);
- various exercises with pushing from the wall, with the float and with the teacher help (15,16,19).

Results. In order to analyze the data obtained on the study, the following statistical processing methods were used: arithmetic mean, standard deviation, mean error; coefficient of variability, comparison criterion "t" by Student, coefficient of correlation (20,21).

Conclusions

1. In order to carry out the research program, which was based on a considerable volume of information extracted from the literature, an attempt was made to develop the anthropometric evaluation method that has the role of finding the tendency to install vicious postures in prepubertal children coming in addition to evaluating RGF imaging (22,23,24).
2. In the process of conducting the study, the influence of specific kinetic and therapeutic swimming means on somato-functional, motor and psycho-motor parameters was established, the statistical results demonstrating a statistically significant evolution.
3. Somatoscopic and somatometric evaluation, accompanied by the tests used in the experiment performed, cannot replace an imaging evaluation.
4. The imbalances found in the results obtained from the evaluations performed in the experiment, can create a clinical picture that allows to predict the future evolution of the postural status.

Author contributions.

All the authors had the same contribution

Accordance to ethics standards

The study complies with the rules of ethics and deontology according to the legislation in force.

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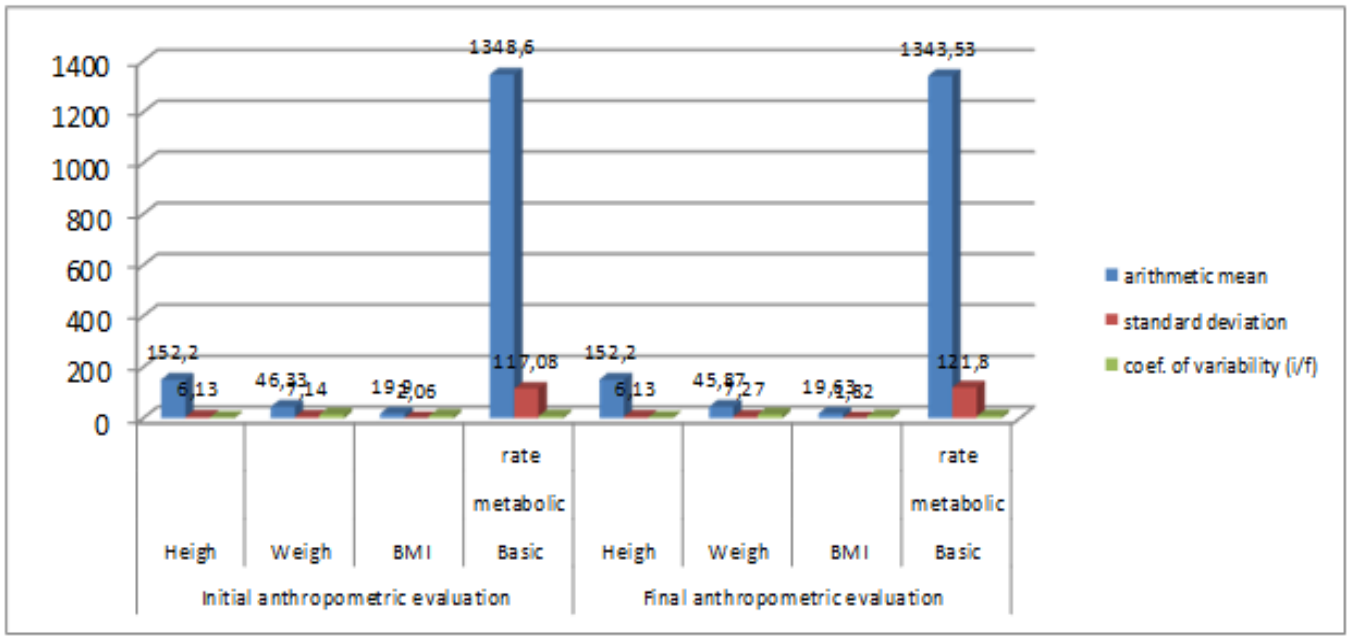
Table 1. Anthropometric evaluation

	nitial anthropometric evaluation				Final anthropometric evaluation			
	Heigh (cm)	Weigh (kg)	BMI (uc)	Basic metabolic rate kcal/day	Heigh (cm)	Weigh (kg)	BMI (uc)	Basic metabolic rate kcal/day
arithmetic mean	152,20	46,33	19,90	1348,60	152,20	45,87	19,63	1343,53
standard deviation	6,13	7,14	2,06	117,08	6,13	7,27	1,82	121,80
coef. of variability	4,03	15,42	10,33	8,68	4,03	15,86	9,27	9,07

It can be seen from the data in table number 3 that the waist did not change during our research, in the weight test we can see an average difference of 0.46, in the body mass index test we can see an average difference of 0, 27. This means continuing the research for a longer period of time.



	Initial assessment of spine joint balance					Final assessment of spine joint balance				
	Distance floor-fingers in flexion	Distance floor-acromion (cm)	Distanc e. floor-sias (cm)	Lateral tilt left (floor-fingers)	Lateral tilt right (floor-fingers)	Distance floor-fingers in flexion	Distance floor-acromion (cm)	Distance floor-sias (cm)	Lateral tilt left (floor-fingers)	Lateral tilt right (floor-fingers)
Arithmetic mean	5,20	123,60	88,80	38,07	35,13	2,27	123,60	88,80	36,20	34,67
Standard deviation	4,96	4,73	4,61	6,10	3,88	3,04	4,73	4,61	4,76	4,44
Coef. of variability	95,30	3,83	5,19	16,04	11,04	134,27	3,83	5,19	13,16	12,80

An average difference of 2.93 can be observed in the distance floor-fingers in flexion test, in the Lateral tilt left floor-fingers test an average of 1.87 can be observed, and in the Lateral tilt right floor-fingers test the average difference is of 0.46. There is no difference in the Distance floor acromion and Distance floor- sias tests, as there were no waist changes.

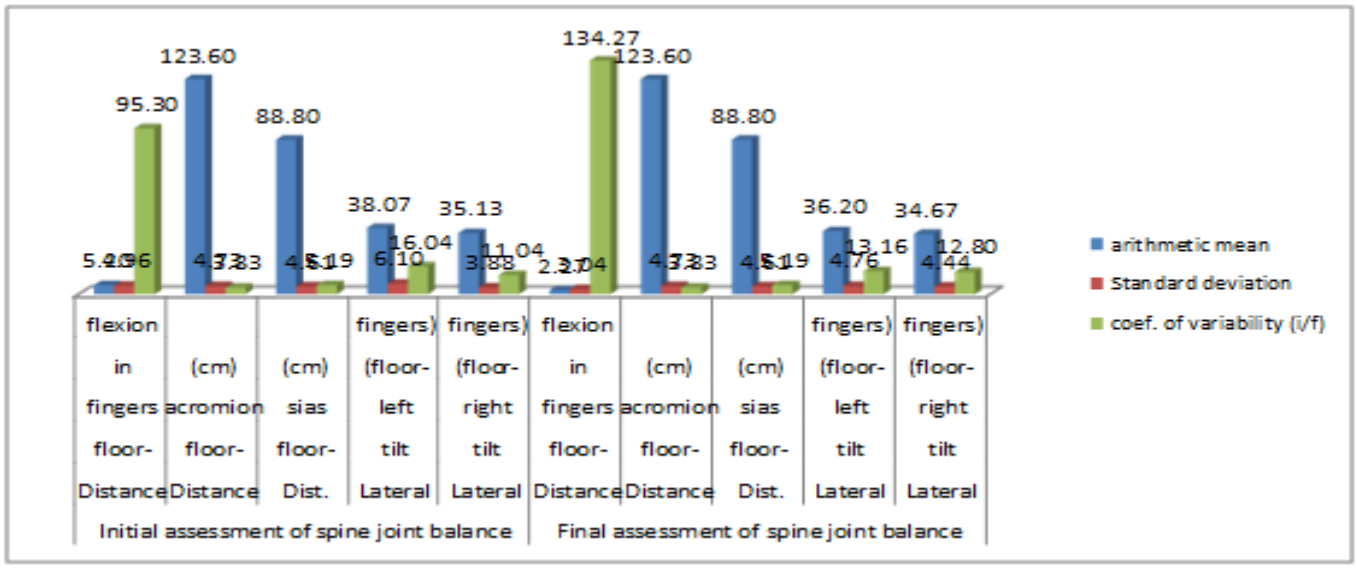


Fig. no.2

TABLE 3. EFFORT EVALUATION TEST

	Initial effort evaluation test					Final effort evaluation test				
	Cobb method values calculated on rgf (G)	Torso lifts from supine position Paravertebral (repetitions/ 20sec)	Torso lifts from supine position Abdominal (repetitions/ 20sec)	Para-vertebral muscle testing (F1-F5)	Abdominal muscle testing (F1-F5)	Cobb method values calculated on rgf (G)	Torso lifts from supine position Paravertebral (repetitions / 20sec)	Torso lifts from supine position Abdominal (repetitions/ 20sec)	Para-vertebral muscle testing (F1-F5)	Abdominal muscle testing (F1-F5)
arithmetic mean	16,67	11,33	11,73	4,27	4,33	15,53	15,27	16,93	4,93	5,00
Standard deviation	7,13	2,18	1,88	0,57	0,47	6,47	1,65	1,34	0,25	0,00
coef. of variability	42,80	19,24	16,01	13,44	10,88	41,65	10,82	7,91	5,06	0,00

From table number 2 you can see an average difference of 1.14 G, in the Cobb method values calculated on rgf, in the Torso lifts from supine position Paravertebral there is an average difference of 3.94, in the Torso lifts test from supine position abdominal a difference of 5.2, in the paravertebral muscle testing test (F1-F5) an average difference of 0.66 can be observed, and in the abdominal muscle testing test (F1-F5) there is an average difference of 0.67.

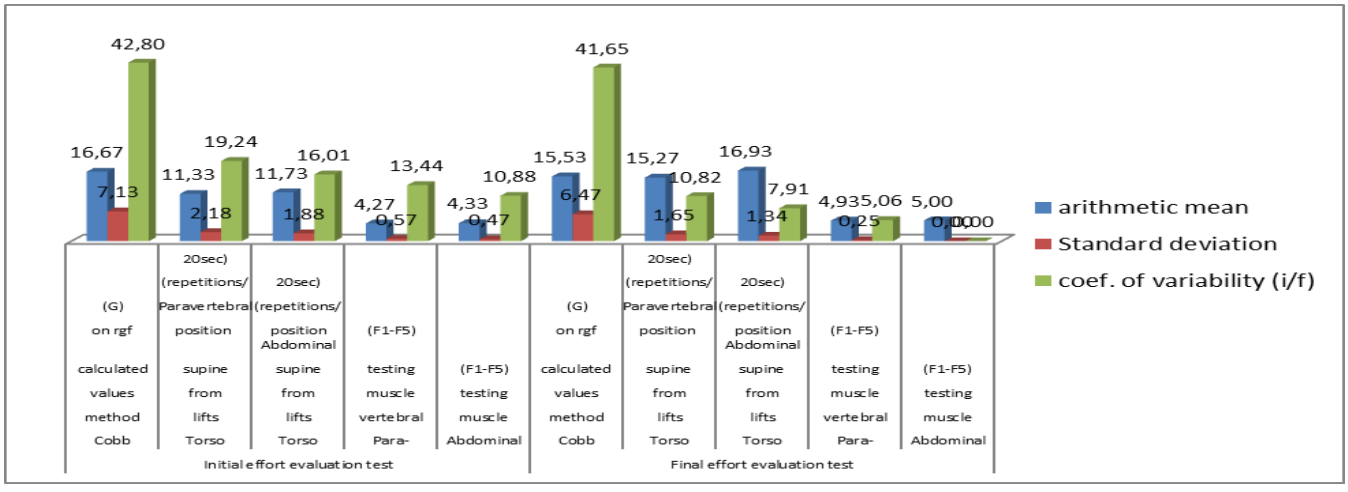


Fig. no 3