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A COMPARATIVE STUDY ON ORGANISM GROWTH AND DEVELOPMENT RATE IN SCHOOLCHILDREN AGED 11 – 14 FROM BRAŞOV MUNICIPALITY GENERAL SCHOOLS

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Abstract: *This research departs from the premise of the level of somatic indicators as important references of the organism growth rate in schoolchildren aged 11 to 14 years. The goal of this research is to verify whether the values of organism growth and development indicators in 2010 are in concordance with the data obtained by the National Sports Research Centre from previous researches. A comparative analysis was achieved regarding the most significant somatic indicators: body height, weight and thoracic perimeter at inspiration/expiration. The obtained data showed that the values of the indicators measured in 2010 are significantly higher when compared to the previous research stages. The significantly higher level of the measured indicators reveals the acceleration phenomenon effect in Braşov's schoolchildren population.*

Key words: *growth rate, organism, acceleration phenomenon, height, weight, thoracic elasticity.*

1. Introduction

The physical growth of human organism represents an increase of height while its development can be described as an increase of the organisms' functionality and capability, both processes being a consequence of genetic, nutrition and environmental factors. The physical growth consists in attaining the optimum height and weight in concordance with age along with dimensional growth of all organs and systems [Beers, M.H., 2009, p. 2248].

The researches in this field showed that the gradual intensification of physical growth and development processes in children were subsequently referred to as acceleration phenomenon [Stoica, T, 1982, p. 33].

The acceleration phenomenon leads to puberty maturation onset at younger age, the age corresponding to attaining the

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definitive height and occurs in countries and social classes enjoying a higher social and economic level of development [7, 9].

Organism maturation is a process that occurs earlier in girls than boys. The growth rate in girls is 12,1±0,9 years whereas in boys the growth rate is 14,1±0,9 years. At the age of 11, girls can exhibit an abrupt height increase of 4 cm which can stop at the age of 13,5. At the age of 18, boys reach 99% of an adult's height [Beers, M.H., 2009, p 2248]. The height increase precedes weight increase by 1,5 years. Girls aged 13 to 14 years exhibit weights in excess of boys' weight of the same age group. Between 14 and 15 years, these differences appear significantly diminished and at the age of 16 years both weight and height in boys will exceed those of girls, with an increased rate during the puberty spurt and the longer adolescent growth period [Beers, M. H. p 2248].

The ponderal and statural growth will also produce a remodeling of body proportions in the process of transition to adult configuration.

2. Material and method

To emphasize the organism's rate of growth and development in secondary school schoolchildren in comparison with the growth rate resulting from previous research periods carried out in 1970, 1981, 1994 by the National Sports Research Centre, between 20th November and 20th December 2010, we conducted a study on the schoolchildren of Braşov municipality general schools 11, 13, 15 and 30.

Measurements were conducted regarding growth indicators like height, weight and thoracic perimeter at inspiration and expiration. The height was measured using centimetre ruler, the height was determined using electronic weighing scales and expressed in kilograms, the thoracic perimeter measured by means of a centimetre tape was expressed in centimetres. All measurements were carried out in sports halls with the support of specialist teachers from each school (Tables 1 and 2).

Somatic indicators in girls aged 11 - 14 measured in 2010 Table 1

Age (years)	Measured Indicator	M_a	C.v. (%)	Extreme values		Frequency (%)	
				L. inf.	L. sup.	Under average	Above average
11	Height (cm)	148.95	5.48	129	170	42.72	57.28
12		156.27	4.52	140	175	41.94	58.06
13		158.49	4.44	141	176	48.94	52.06
14		161.44	3.48	146	173	48.00	52.00
11	Weight (kg)	44.04	27.14	29	87	56.31	43.69
12		51.96	27.94	31	103	49.46	50.54
13		51.07	18.91	32	80	53.19	46.81
14		55.71	16.42	34	78	53.33	46.67
11	Thoracic perimeter inspiration (cm)	80.48	11.14	65	107	55.34	44.66
12		85.41	9.91	68	110	47.31	52.69
13		85.62	7.52	72	104	55.32	44.68
14		89.09	8.17	74	109	50.66	49.34
11	Thoracic perimeter expiration (cm)	73.88	12.13	57	102	57.28	42.72
12		79.40	10.66	63	105	39.78	60.22
13		79.27	7.87	67	98	48.94	51.06
14		82.77	8.29	71	104	49.33	50.67

Somatic indicators in boys aged 11 - 14 measured in 2010 Table 2

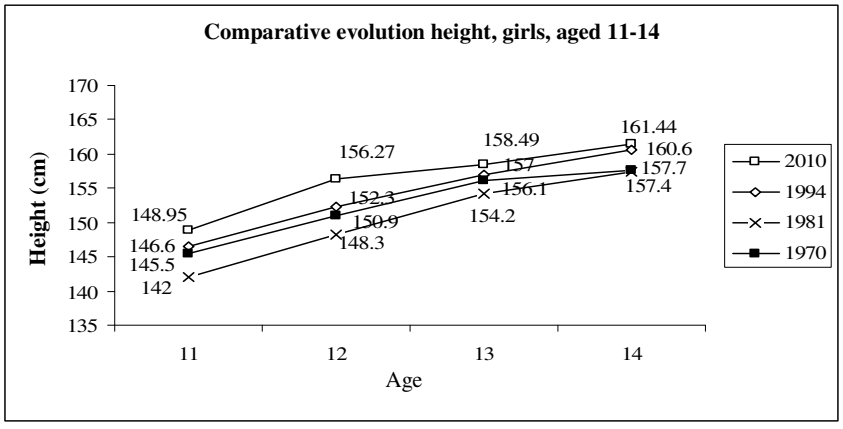
Age (years)	Measured Indicator	M_a	C.v. (%)	Extreme values		Frequency (%)	
				L. inf.	L. sup.	Under average	Above average
11	Height (cm)	147.19	5.27	130	169	45.37	54.63
12		154.55	5.23	139	179	49.45	50.54
13		160.53	4.51	142	178	40.43	59.57
14		167.18	4.9	144	185	42.42	57.58
11	Weight (kg)	42.49	23.91	25	76	56.48	43.52
12		50.11	25.4	31	94	53.85	46.15
13		52.67	22.92	35	95	56.38	43.62
14		60.31	28.46	34	120	51.51	48.49
11	Thoracic perimeter inspiration (cm)	79.57	9.26	66	103	50.00	50.00
12		83.40	10.66	69	113	51.65	48.35
13		85.54	9.17	72	111	52.13	47.87
14		90.61	10.57	75	123	53.53	46.47
11	Thoracic perimeter expiration (cm)	72.57	10.70	60	99	53.70	46.30
12		76.40	11.37	63	106	50.55	49.45
13		78.13	10.82	64	106	55.32	44.68
14		83.15	12.48	68	120	52.52	47.48

3. Data interpretation

Height is the most significant indicator of somatic growth and development and is genetically preconditioned. Table 1 and 2 present the values of this indicator, in girls (Table 1) and in boys (Table 2) for schoolchildren aged 11 – 14 years.

In the case of girls, the height values are the following: 148.95 cm – 11 years, 156.27 cm – 12 years, 158.49 cm – 13 years, 161.44 cm – 14 years (table 1).

The values obtained in 2010 in the case of girls aged 11 (Graph 1) are higher by 2.35 cm compared to the 1994 testing, by 3.45 cm compared to 1970 and by 6.95 cm compared to 1981. For the 12 years age group, the height exceeds by 3.97 cm the 1994 measurements, by 7.97 cm the 1981 values and by 5.37 cm the values obtained in 1970. For the 13 years age group, the height was in excess by 1.49 cm compared to 1994, by 4.29 cm compared to 1981 and by 2.39 cm compared to the 1970 measurements. Finally, for the 14 years age group the growth differences are 0.84 cm compared to 1994, by 4.04 cm compared to 1981 and 3.74 cm compared to the 1970 measurements.



Graph 1

With respect to the frequency of the values above average the measurement results yielded 57.28% for the 11 years group, 58.25% for the 12 years group, 52.06% for the 13 years group and 52% for the 14 years group. Under average results indicate 42.72% for 11 years, 41.94% for 12 years, 48.94% for 13 years and 48.00% for 14 years. The sample homogeneity is high and the coefficient of variation takes values between 3.48 and 5.48% (Table 1).

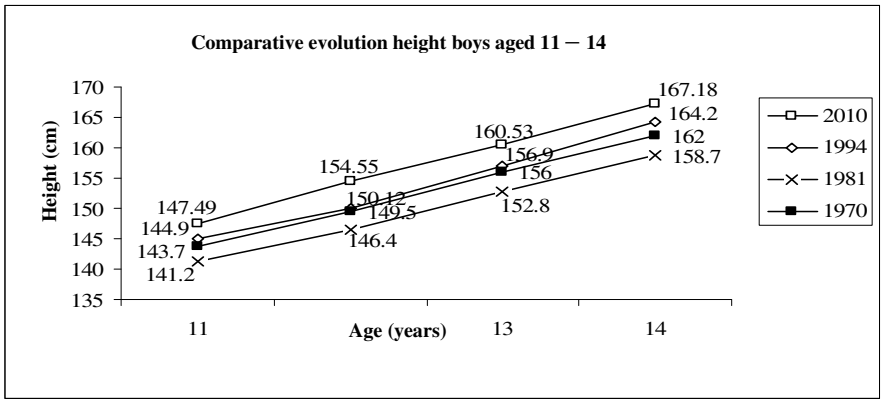
The highest annual growth rate in 2010 was 7.32 cm for the 11 – 12 year group of age, while the values for the previous years are more uniform. (Table 3)

Table 3

Age (years)	Annual rates – height (cm)			
	2010	1994	1981	1970
11 – 12	7.32	5.2	5.2	5.8
12 – 13	2.22	6.8	6.4	6.5
13 – 14	2.95	7.3	5.9	6.0

The measurements conducted on boys yielded the following results for height: 11 years – 147.49 cm , 12 years – 154.55 cm, 13 years – 160.53 cm and 14 years – 167.18 cm (Table 2).

Compared with the previous research, the current values are higher.This situation is shown in Graph 2, with the following differences for boys: 11 years group – 2.59 cm compared to 1994, 6.29 cm compared to 1981 and 3.79cm compared to 1970; 12 years group – 4.43 cm compared to the 1994 values, 8.15 cm compared to 1981 and 5.05 cm compared to 1970; 13 years group – 3.63cm compared to 1994, 7.73 cm compared to 1981 and 4.53 compared to the 1970 values; 14 years group –2.98 cm compared to the 1994 values, 8.48 cm compared to 1981 values and 5.18 cm compared to the 1970 ones (Graph 2).



Graph 2

The percentage of boys with heights above average is 54.63% for the 11 years group, 50.54% the 12 years group, 59.57% the 13 years group and 57.58% the 14 years group. The annual growth rate exhibits its maximum value of 2010, 7,06cm between 11 and 12 years while its minimum of 1.6 cm, was measured in 1970, between 13 and 14 years (Table 4).

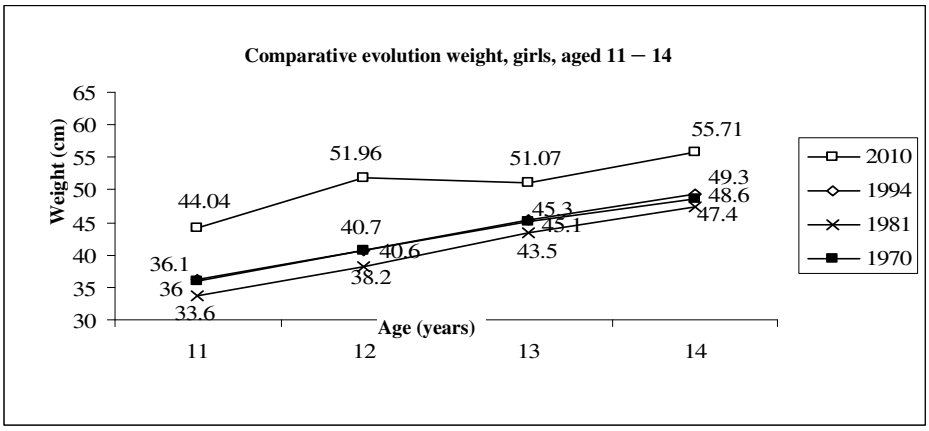
Table 4

Age (years)	Annual rates – height (cm)			
	2010	1994	1981	1970
11 – 12	7.06	5.7	6.3	5.4
12 – 13	5.98	4.3	5.9	5.2
13 – 14	6.65	3.6	3.2	1.6

Weight is a somatic indicator affected by economic, social as well as education factors etc. The values of this indicator are given in Tables 1 and 2, depending on age and gender.

Weight measurements conducted on girls provided the following results: 11 years – 44.04 kg, 12 years – 51.96 kg, 13 years – 51.07 kg and 14 years group – 55.71 kg (Table 1).

Compared with the measurements obtained during the previous study, the currently obtained values are notably higher (Graph 3), with following differences for girls: 11 years group – 8.3 kg compared to 1994, 10.8 kg compared to 1981 and 8.4 kg compared to 1970, 12 years group – 11.26 kg compared to 1994, 13.76 kg compared to 1981 and 11.36 kg compared to 1970, 13 years group – 5.77 kg compared to 1994, 7.57 kg compared to 1981 and 5.97 kg compared to 1970. 6.41 kg compared to 1994, 8.31 kg compared to 1981 and 7.11 kg compared to 1970.



Graph 3

By examining the evolution of the growth rates, we note a slight decrease of weight in the 12 – 13 year groups. This situation occurred since the measured group included, in the 12 year group, 12 overweight girls and 1 obese girl while the 13 year groups included 6 overweight subjects (Table 5).

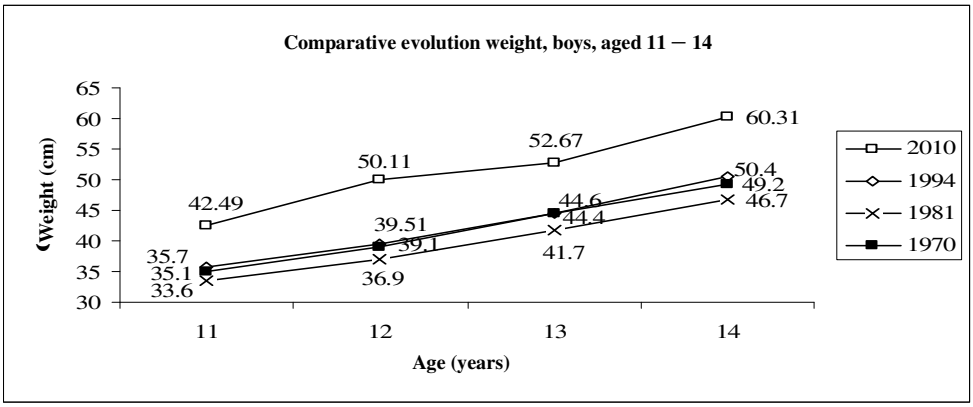
Table 5

Age (year)	Annual rates – weight (kg)			
	2010	1994	1981	1970
11 – 12	7.56	4.6	4.6	4.6
12 – 13	-0.89	4.6	5.3	4.5
13 – 14	4.64	4.0	3.9	3.5

The frequency of under average cases in girls is 56.31% the 11 years group, 49.46% the 12 years group, 53.19% the 13 years group and 53.33% the 14 years group, while the frequency of the over average cases is 43.69% the 11 years group, 50.54% the 12 years group, 46.81% the 13 years group and 46.67% the 14 years group (Table 1). The coefficient of variation indicates medium to low homogeneity compared to the height results, with values between 16.42 and 27.94% depending on the age group (Table 1).

The weight measurements in boys provided following results: 11 years group – 42.49 kg, 12 years group – 50.11 kg, 13 years group – 52.67kg and 14 years group – 60.31 kg (Table 2).

In this case, there are also significant differences (Graph 4): 11 years group – a difference of 6.79 kg compared to 1994, 8.89 kg compared to 1981 and 7.39 kg compared to 1970; 12 years group –10.6 kg compared to 1994; 13.21 kg compared to 1981 and 11.1 kg compared to 1970; the 13 years group – 8.07 kg compared to 1994, 10.67 kg compared to 1981 and 10.97 kg compared to 1970; the 14 years group – 9.91 kg compared to 1994 values, 13.61 kg compared to the 1981 values and 11.11 kg compared to the 1970 measurements.



Graph 4

By examining the evolution of the growth rate a significant increase can be observed, by 7.62 kg between 11 – 12 years, a very small increase between 12 and 13 years, while again, a considerable increase occurs between 13 and 14 years. The measured group included 10 overweight boys, aged 11, 10 overweight and 3 obese boys in the 12 years age group, 7 overweight and 1 obese in the 13 years age group while the 14 years group included 11 overweight and 3 obese boys (Table 6).

Table 6

Age (years)	Annual rates – weight (kg)			
	2010	1994	1981	1970
11 – 12	7.62	3.8	3.3	4.0
12 – 13	2.56	5.1	4.8	5.3
13 – 14	7.64	5.8	5.0	4.8

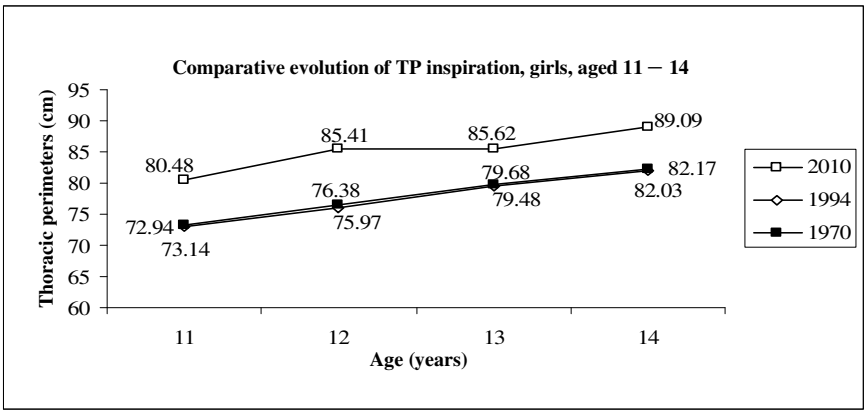
The frequency of over average results in boys, is the following: for the 11 years age group 43.52%, the 12 years age group 46.15%, the 13 years age group 43.62% and 48.49% the 14 years age group. The

frequency of under average results is: 56.48% for the 11 years group, 53.85% the 12 years age group, 56.3% the 13 years age group and 51.51% the 14 years age group (Table 2). Similar to the girls' results, the coefficient of variation indicates an medium to low homogeneity, with values between 22.92% and 28.48% depending on age.

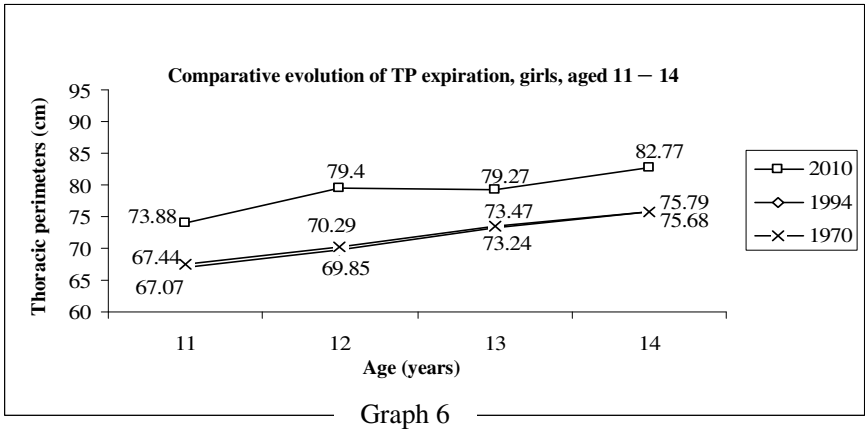
The thoracic perimeter in inspiration and expiration reflects the dimension of the respiratory act. Calculating the difference between the thoracic perimeter in deep inspiration and thoracic perimeter in forced expiration will yield the thoracic elasticity.

In the case of girls, the values of the thoracic perimeter in inspiration are: 11 years –80.48 cm, 12 years – 85.41 cm, 13 years – 85.62 cm, 14 years – 89.09 cm; while the values for expiration are: 11 years – 73.88 cm, 12 years – 79.4 cm, 13 years – 79.27 cm, 14 years – 82.77 cm (Table 1).

The differences with respect to the 2010 research are significant for this indicator, as well: in inspiration (Graph 5), the 11 years group – 7.54 cm compared to 1994 values and 7.34 cm compared to the 1970 situation, the 12 years group – 9.44 cm compared to the 1994 values and 9.03 cm compared to 1970, the 13 years group – 6.14 cm compared to the 1994 results and 5.94 cm compared to 1970, the 14 years group – 7.06 cm compared to 1994 and 6.92 cm compared to 1970. The results for expiration (Graph 6) are: the 11 years group – 6.81 cm compared to 1994 and 6.44 cm compared to 1970, the 12 years group – 9.55 cm compared to 1994 and 9.11 cm compared to 1970, the 13 years group – 6.03 compared to 1994 and 5.80 cm compared to 1970 and the 14 years group – 7.09 cm compared to 1994 and 6.98 cm compared to 1970. We note that the differences are smaller for the case of the 1970 sample compared to the 1994 sample, however in both cases the values are getting closer toward the age of 14.



Graph 5



Graph 6

Thoracic elasticity can be observed in Table 7 and exhibits year after year a slight increase as resulting from previous researches. By analysing the results of the current research, we note that the largest value was measured in the girls of the 11 years age group, followed by a decrease in the 12 years group while the results of the 13 years and 14 years age groups are close but lower in the case of the 14 years group. The values measured in girls aged 12 – 14 did not exceed the values measured in girls aged 11. Comparatively to the previous researches a slight increase can be noticed in the 11 – 13 years group, while for the other values, even if slightly decreasing, the differences were not significant.

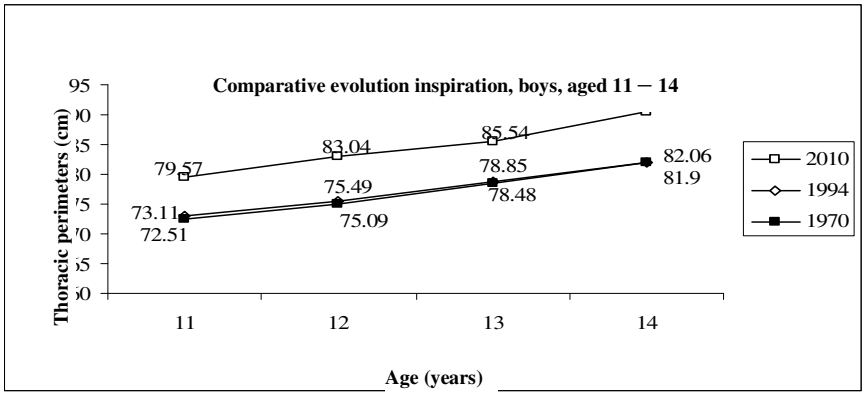
Table 7

Age (years)	Thoracic elasticity (cm)		
	2010	1994	1970
11	6.6	5.87	5.70
12	6.01	6.12	6.09
13	6.35	6.24	6.21
14	6.32	6.35	6.38

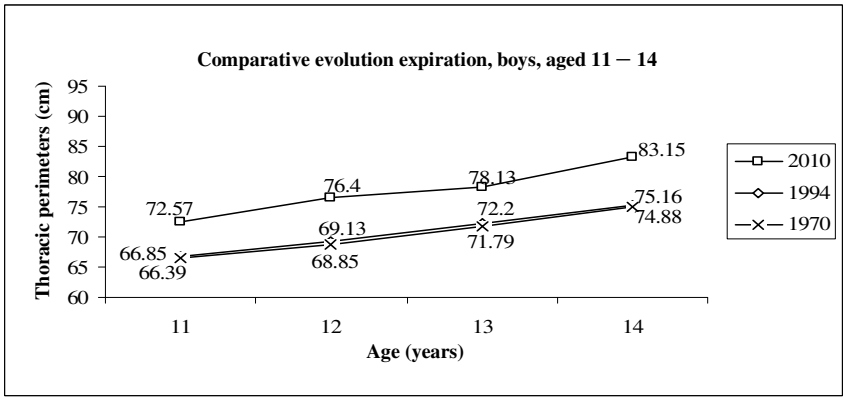
The coefficient of variation indicates a high homogeneity in both inspiration and expiration values (Table 1). The frequency of cases above average is the following: 44.66% – the 11 years group, 52.69% – the 12 years group, 44.68% – the 13 years group and 49.34% – the 14 years group. The frequency of cases under average is: 42.72% – the 11 years group, 60.22% – the 12 years group, 51.06% – the 13 years group and 50.67% – 14 years group for the thoracic perimeter at expiration. In the case of thoracic perimeter in inspiration the calculated frequencies under average are: 55.34% – the 11 years group, 47.31% – the 12 years group, 55.32% – the 13 years group and 50.66% – the 14 years group. For expiration, the frequencies are: 57.27% – the 11 years group, 39.78% – the 12 years group, 48.94% – 13 years group and 49.33% – 14 years group (Table 1).

The measurement results of boys' thoracic perimeter exhibits a gradual increase: at inspiration, 11 years – 79.57cm, 12 years – 83.04 cm, 13 years – 85.54 cm, 14 years – 90.61 cm; at expiration, 11 years – 72.57 cm, 12 years – 76.4 cm, la 13 years – 78.13 cm and 14 years – 83.15 cm (Table 2).

The differences to the previous research results also appear in ascending order. At inspiration (Graph 7), The difference is 6.46 cm compared to the 1994 results and 7.06 cm compared to 1970 – the 11 years group, 7.55 cm compared to 1994 and 7.95 cm compared to 1970 – the 12 years group, 6.69 cm compared to 1994 and 7.06 cm compared 1970 – the 13 years group, 8.55 cm compared to 1994 and 8.71 cm compared to 1970 – the 14 years group. In expiration (Graph 8) the differences are: 5.72 cm compared to 1994 and 6.18 cm compared to 1970 – 11 years group, 7.27 cm compared to 1994 and 7.55 cm compared to 1970 – the 12 years group, 5.93 cm compared to 1994 and 6.34 cm compared to 1970 – the 13 years group, 7.99 cm compared to 1994 and 8.27 cm compared to 1970 – the 14 years group.



Graph 7



Graph 8

The thoracic elasticity is presented in Table 8 and exhibits a slight increase year after year as results from previous researches. Compared with the previous researches, the currently obtained values are larger, although a decrease followed by slight increases in the 11 – 12 years age group can be observed over the years.

Table 8

Age (years)	Thoracic elasticity (cm) B		
	2010	1994	1970
11	7.00	6.26	6.12
12	6.64	6.36	6.54
13	7.41	6.65	6.69
14	7.46	6.90	7.02

Like with girls, the coefficient of variation indicates a high homogeneity of the measured group of boys, taking values between 9.17 and 10.66% in inspiration and 10.70 – 12.48% in expiration (Table 8).

4. Conclusions

The researches conducted in 2010 on a representative sample of schoolchildren indicate a significant increase of the somatic indicators compared with the measurements carried out in 1970, 1981 and 1994.

The significant increase of somatic indicators levels measured in 2010 compared with the values obtained previously, in 1970, 1981 and 1994 constitute a decisive argument regarding the effects of the acceleration phenomenon produced on schoolchildren of the Braşov municipality general schools.

The number of overweight and obese as well as underweight schoolchildren has affected the value levels of the average annual growth rates of the samples studied in 2010, in girls, aged 12 – 13 the weight evolved from 7,76 kg – 8,89 kg while height of boys aged 12 -13 evolved from 7,62 cm to 2,56 cm.

5. Recommendations

Somatic measurements will be conducted annually in schoolchildren of the 11-14 years age group, usually at the beginning of the school year, among the entire schoolchildren population and will be correlated with the data collected during the previous year.

The evaluations regarding organism growth and development level will be performed by correlating the somatic indicators levels with the schoolchildren's environmental and social factors.

The possible cases of under -, overweight and obese schoolchildren will be integrated into groups for preparation in order to eliminate the negative effects of the factors that caused these situations.

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