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SOMATOTYPE AND PHYSICAL DEVELOPMENT OF 11-YEAR-OLD GIRLS DURING HANDBALL TRAINING

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ABSTRACT
Nowadays, knowledge of body structure is increasingly attracting the interest of the scientific community, as it is known to be relevant to performance in sports. The present study is aimed at tracking the dynamics of anthropometric indicators and somatotype in 11-year-old girls. During their training in the subject "Physical Education and Sports" at school, a specialized handball training program was implemented. The research contingent is 100 girls aged 11 years. The subjects were tested at the beginning and at the end of the experiment, which was conducted during the academic year 2021/2022. The data were processed mathematically and statistically, applying variation analysis.

Key words: anthropometry, somatotype, handball, girls

INTRODUCTION

The sports game of handball with its emotional character, the rich content of spectacular technical and tactical skills makes it a favorite sports game for the youth of almost all countries. The game of handball has well-established traditions, leading its continuous development from the beginning of the 20th century to the present day in Bulgaria. The game wins and intrigues the youth with its dynamism, attractiveness and constantly changing game environment. It is part of the school education in the subject "Physical Education", falling into the compulsory area of study content and more specifically in the group of studied sports games.

The modern development of handball requires a deepening of knowledge about the structure of the human body. It is related to the need for a more detailed disclosure of the dependencies between body structure and function, with the improvement of research methods, with the creation of model somatotypological characteristics.

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One of the vital issues related to body weight, composition and structure is what is called somatotype. His study is considered one of the most important topics related to research work in this field. Its importance stems from its relationship to many components of motor and physical fitness. In addition, one of the important motives for studying somatotype is what has been achieved regarding the relationship between the structure of the body and its external behavior (1).

In connection with the theory of physical education, M. Malchev and N. Yordanova define physical development as: *"...a momentary state reached by the process of formation and modification of human bodily development*" (2). According to P. Slanchev, in this regard, the physical development of both an individual and a group of individuals can be considered as a momentary state of individual human development (3).

METHODOLOGY

The purpose of the present study is to determine the changes that occurred in the physical development and somatotype of 11-year-old girls working on a specialized handball training program (in accordance with the state educational standard).

To achieve the goal, we set the following tasks:
1. Revealing the theoretical foundations of the researched problem.

2. Analysis of the dynamics of physical development indicators and determination of the total somatotype profile of 11-year-old girls (determination of the somatotype according to the Heath-Carter method).
3. Analysis of the results and drawing conclusions.

The subject of the study are the dynamics of physical development and somatotype in girls at the age of 11 as a result of working with handball exercises.

The object of the research is the quantitative characteristics of the physical development of 11-year-old girls under the influence of handball means.

The subjects of the study were 100 girls at the age of 11, divided into two groups - CG (50) and EG (50). The experimental group works on a specialized handball training program. The control group works on standardized curricula of the Ministry of Education and Culture on the subject "Physical Education". The subjects were tested at the beginning and at the end of the experiment, which was conducted during the academic year 2021/2022.

ANALYSIS OF RESULTS

In connection with solving the second task of the present study, we followed the dynamics of the anthropometric indicators of 11-year-old girls. We grouped the data in variation tables separately for CG and EG. The values obtained at the beginning of the experiment are shown in the numerator, and those from the end of the study in the denominator.
In the analysis of the obtained results, we register certain differences for both the control (CG) and the experimental (EG) group **(Table 1 and 2).**

The measured height of the girls at the age of 11 at the first measurement was Av=152.3 cm for CG and Av=152.7 cm for EG. For the duration of the experiment, both groups increased their height as a natural course of their physical development. At the end of the school year, the height of the girls from CG is Av=155.48 cm, and the height of EG is Av=58.08 cm. From the values of the coefficient of variation, it is clear that both samples are homogeneous in terms of this indicator. The results, compared with previous studies over the years, show that the height of 11-year-old girls was: 145.1 cm (1972); 147.2 cm (1980 – 1982); 150 cm (1993 – 2000). (4,5,6). It is becoming clear that there is a trend towards increasing height among adolescent girls.

Regarding body mass, as an important anthropometric indicator, we notice a relative heterogeneity both in CG (V%=22.34% – 1st study; V%=23.88% – 2nd study) and in EG (V%=23.83% – 1st study; V%=21.72% – 2nd study). We register an increase in body mass in both groups, with an average of 3.56 kg increased in CG (respectively 8.29%), and by 4.76 kg EG (respectively 10.76%). Again, we observe a tendency towards an increase in body mass over the years (1970 = 38.2 kg; 1980 – 1982 = 39.3 kg; 1993 – 2000 ≈ 41 kg). (4,5,6)

The body mass index, as a well-known and modern method, brings us medico-biological information about the individual. At CG, we observe an increase of 3.59% on average, and at their first testing, the schoolgirls had a BMI of 18.38. This result is below the limit for normal weight. During the second testing, the sample already increased its body mass and height, already moving within the limits of normal and healthy weight (Av=19.04) according to the WHO.

Like CG, EG also, over the experimental period, increased its body mass index by 3.56%. The group is approximately uniform on this indicator, observing rank values of R=12.8; 13.4. We find that the EG girls at the beginning (BMI = 18.84) and at the end (BMI = 19.51) of the experiment fell within the normal and healthy weight range.

In three of the skin folds of the CG, we report a reduction of subcutaneous fat tissue, and in one, an increase in volume. The triceps skinfold was reduced by -1.99%, the subscapular skinfold was reduced by -3.23% and the calf skinfold was also reduced by -0.59%. We observed an increase in the subcutaneous fat tissue in the skin fold on the hip, which in the first test was Av=16.38 mm, and in the second test Av=17 mm. This positive difference is 3.56%. In Table 1, we observe a high coefficient of variation for all measured skinfolds, which is all above 30% and a large range between minimum and maximum results (R=from 23 to 40 mm). This gives us information about the strong heterogeneity of the group on these indicators.

Table 1. *Anthropometric indicators of 11-year-old girls – CG*

№	Examination	N	STUDY	STATISTICAL INDICATORS							
				X min	X max	R	Av	S	V%	Pt %	% Of Growth
1.	Height	50	I	136	168	32	152,3	7,60	4,99	99,99%	2,09%
			II	134	173	39	155,48	8,21	5,28		
2.	Body mass	50	I	25	75	50	42,96	9,60	22,34	99,99%	8,29%
			II	26	79	53	46,52	11,11	23,88		
3.	Triceps skinfold	50	I	7	30	23	17,12	6,05	35,34	62,7%	-1,99%
			II	6	31	25	16,78	6,62	39,46		
4.	Subscapular skinfold	50	I	3	41	38	14,86	9,74	65,56	74,1%	-3,23%
			II	3	40	37	14,38	9,26	64,37		
5.	Supraspinale skinfold	50	I	5	40	35	16,38	9,56	58,36	78,6%	3,79%
			II	4	44	40	17	10,26	60,36		
6.	Medial calf skinfold	50	I	3	40	37	16,94	7,67	45,28	19,5%	-0,59%
			II	4	41	37	16,84	7,91	46,95		
7.	Upper arm girth	50	I	17,2	32,5	15,3	24,17	3,16	13,06	99,9%	3,56%
			II	18	34,5	16,5	25,03	3,68	14,68		
8.	Calf girth (right)	50	I	26	42,5	16,5	31,76	3,59	11,30	99,9%	2,68%
			II	26,5	44,3	17,8	32,61	3,66	11,21		
9.	Biepicondylar breadth of the humerus (right)	50	I	4,5	6,7	2,2	5,34	0,45	8,50	99,99%	3,56%
			II	4,7	6,7	2	5,53	0,45	8,07		
10.	Biepicondylar breadth of the femur (right)	50	I	6,3	9,3	3	7,95	0,64	8,09	99,99%	2,01%
			II	6,4	9,6	3,2	8,11	0,64	7,90		
11.	BMI	50	I	13,5	28,6	15,1	18,38	3,12	16,99	99,0%	3,59%
			II	13,7	29,5	15,8	19,04	3,67	19,29		
12.	ENDO	50	I	1,92	8,93	7,01	5,05	2,01	39,89	77,9%	-2,17%
			II	1,90	9,16	7,26	4,94	2,05	41,52		
13.	MEZO	50	I	0,86	6,14	5,28	2,97	1,16	38,91	83,8%	5,05%
			II	0,76	6,63	5,87	3,12	1,28	40,89		
14.	ECTO	50	I	-0,46	6,44	6,90	3,51	1,68	47,98	72,0%	-4,27%
			II	-2,47	6,90	9,36	3,36	1,90	56,64		

In EG, we also observed a reduction of subcutaneous fat tissue in three of the skin folds and an increase in the volume of one during the experiment. Triceps skinfold reduced by -9.88%, subscapular skinfold reduced by -6.9% and calf skinfold by -17.06%. We observe much higher percentages of reduction of subcutaneous fat in girls from EG. We have not been able to positively influence the deposition of adipose tissue in the abdominal area, namely a reduction of the skin fold on the hip. At this skinfold we report an increase of 1.56%, which should be noted to be about 2% less than that of CG. The sample is highly inhomogeneous on this indicator with coefficients of variation above 30%.

The circumference of the upper arm underwent positive changes in both studied groups. The increase in girth in CG was by an average of 3.56% (Av=24.17 cm in the 1st study; Av=25.03 cm in the 2nd study), and in EG by 3.24% (Av=24.33 cm in the 1st study; Av=24.12 cm at 2nd study). According to the coefficients of variation observed in both tested groups, in both tests we have sufficient grounds to claim that the entire contingent of girls is generally homogeneous in this regard. We define this indicator as the main morphological sign related to the hypertrophy of the muscles of the upper limbs, as it is related to physical loads.

Table 2. *Anthropometric indicators of 11-year-old girls – EG*

№	Examination	N	STUDY	STATISTICAL INDICATORS							
				X min	X max	R	Av	S	V%	Pt %	% Of Growth
1.	Height	50	I	137	170	33	152,7	7,14	4,68	99,99%	3,99%
			II	139	177	38	158,08	6,86	4,34		
2.	Body mass	50	I	25	67	42	44,24	10,54	23,83	99,99%	10,76%
			II	28	71	43	49	10,65	21,72		
3.	Triceps skinfold	50	I	8	31	23	17,62	5,66	32,14	99,59%	-9,88%
			II	5	36	31	15,88	5,94	37,39		
4.	Subscapular skinfold	50	I	3	34	31	14,5	8,27	57,03	91,71%	-6,9%
			II	4	34	30	13,5	7,11	52,68		
5.	Supraspinale skinfold	50	I	6	40	34	17,88	9,15	51,18	34,50%	1,56%
			II	6	40	34	18,16	8,98	49,47		
6.	Medial calf skinfold	50	I	8	38	30	19,46	8	41,09	99,99%	-17,06%
			II	8	31	23	16,14	6,26	38,76		
7.	Upper arm girth	50	I	18,5	30	11,5	24,33	2,65	10,87	99,97%	3,24%
			II	19,5	30,5	11	25,12	2,64	10,49		
8.	Calf girth (right)	50	I	24	39,3	15,3	31,71	3,43	10,82	99,99%	3,56%
			II	25,5	40	14,5	32,84	3,54	10,77		
9.	Biepicondylar breadth of the humerus (right)	50	I	4,1	6,5	2,4	5,35	0,44	8,20	99,99%	4,49%
			II	4,8	6,7	1,9	5,59	0,37	6,62		
10.	Biepicondylar breadth of the femur (right)	50	I	5,2	9	3,8	7,72	0,64	8,24	99,99%	6,35%
			II	7,3	10	2,7	8,21	0,58	7,3		
11.	BMI	50	I	13,3	26,1	12,8	18,84	3,68	19,52	99,91%	3,56%
			II	13,7	27,1	13,4	19,51	3,61	18,49		
12.	ENDO	50	I	2,04	8,62	6,57	5,22	1,75	33,44	99,88%	-6,9%
			II	1,95	8,91	6,96	4,86	1,69	34,84		
13.	MEZO	50	I	0,02	5,1	5,98	2,79	1,29	46,14	93,96%	7,53%
			II	0,63	5,91	5,28	3	1,25	41,77		
14.	ECTO	50	I	-0,10	6,74	6,83	3,39	1,87	55,23	56,92%	-2,36%
			II	-0,03	6,95	6,98	3,31	1,86	56,23		

With the "Circumference of the right lower leg" indicator, we observe the development of the corresponding musculature of the lower limbs, related to the bounce and movements characteristic of the handball game. We report an increase in the muscle at CG by 2.68% or by 0.85 cm. At EG we register a slightly higher result of an increase of 3.56% (increase in volume by an average of 1.13 cm). It should be noted that in addition to an increase in muscle volume, there is also a reduction of subcutaneous fat in this area by -17.06%. The coefficients of variation in both groups give us reason to define the samples as homogeneous in this respect.

In the course of our physical development, and in particular the development of the musculoskeletal system, we observe an increase in the diameters of the elbow and knee joints. CG increased the diameter of the elbow joint by an average of 0.19 cm (increase of 3.56%), and of the knee joint by 0.16 cm (increase of 2.01%). With EG we observe similar results: an increase in the diameter of the elbow joint by an average of 0.24 cm (4.49% increase), and at the knee joint by 0.49 cm (6.35% increase).

Based on the anthropometric indicators in **Figures 1 and 2** we present the dynamics of the somatotype in 11-year-old girls – CG and EG.

The endomorphic component of CG at the first study has a score of Av=5.05, and this value falls within the limits of moderate. In the second test, we observe a slight reduction in the component related to fat deposition. The reduction is -2.17% or final result Av=4.94. The sample is highly heterogeneous in terms of this indicator – V%=39.89%; 41.52%.

A moderately expressed mesomorphic component is observed in CG. We report a score of Av=2.97 in the first testing and Av=3.12 in the second testing. The group has increased its mesomorphic component by 5.05%, while at the same time being heterogeneous on this indicator (V%=38.91%; 40.89%).

The ectomorphic component here is also within the limits of moderate expression. We observe a decrease in ectomorphy values (-4.27%) from Av=3.51 to Av=3.36. This component is affected by increasing or decreasing either of the other two components. In this case, we observe optimization of the musculature of the schoolgirls.

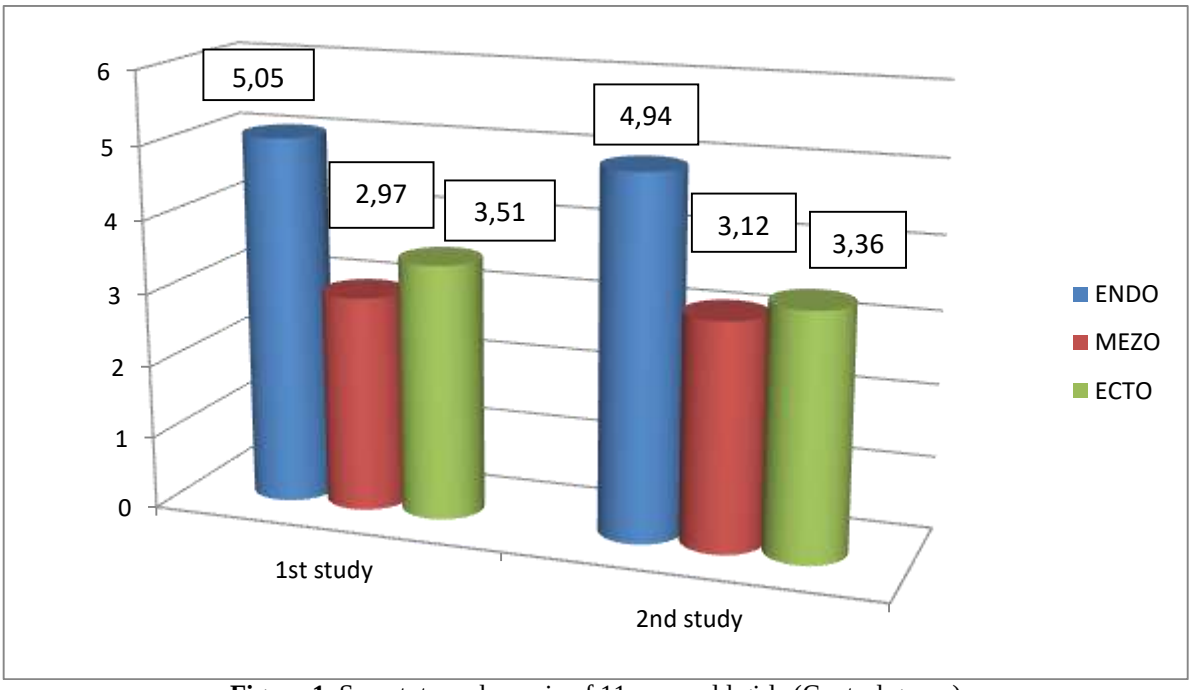

Figure 1. Somatotype dynamic of 11-years old girls (Control group)

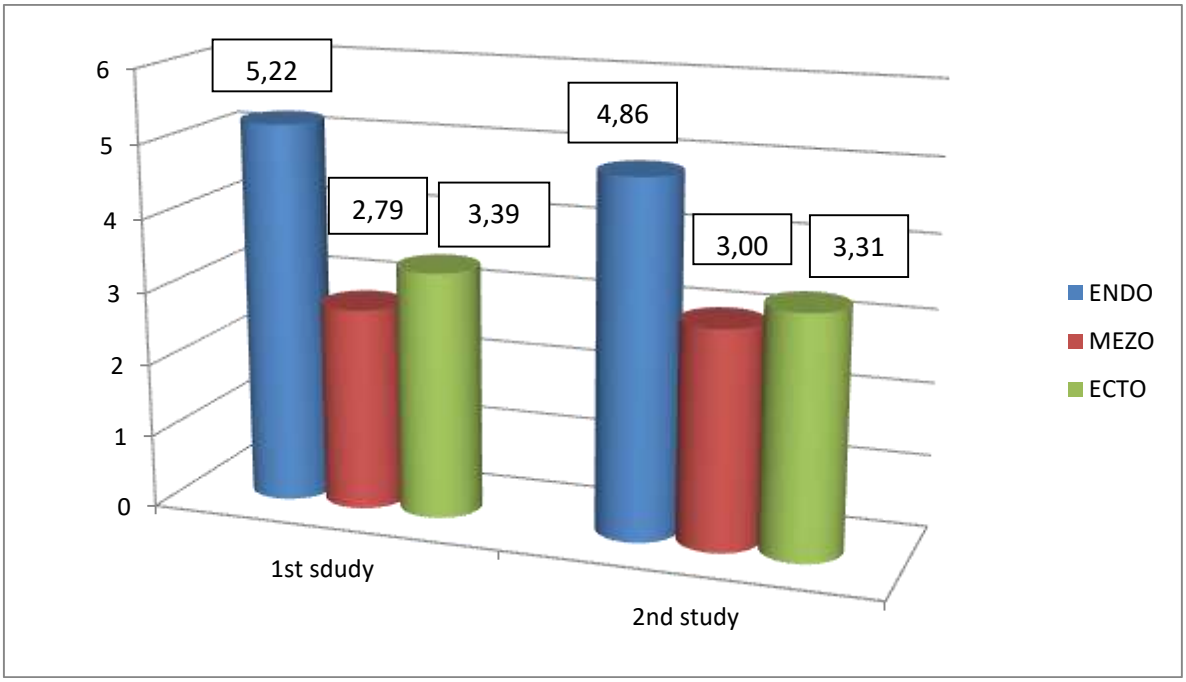

Figure 2. Somatotype dynamic of 11-years old girls (Experimental group)

With the endomorphic indicator of EG, we observe a positive effect, namely a decrease in the deposited subcutaneous fat on the body. It was reduced by -6.9%, as at the beginning of the experiment the endomorphic index was Av=5.22, and at the end Av=4.86. We should note that the starting value is at the upper limit of moderate to high expression. Values of R=6.57 were observed; 6.96, which is a difference of almost seven units between the minimum and maximum score, and a coefficient of variation higher than 30%, which defines the sample as heterogeneous on this measure.

As a result of the obtained results, we register a positive impact on the musculature of 11-year-old girls. At the beginning of the experiment, we observed a moderately expressed mesomorphic component of the somatotype Av=2.79. At the end of the experiment, we registered an increase of this component by 7.53% (Av=3.00). In connection with the obtained results, we reflect a positive dynamic of the component that is related to the development of the musculature, which is the result of the work and the impact with handball means.

We register a decrease in the ectomorphic indicator at EG, as at the beginning of the experiment it was Av=3.39, and at the end Av=3.31. Ectomorphy is reduced by -2.36%, which is a natural result after an increase in either of the other two components – in this case, an increase in mesomorphy by 7.53%.

Regarding this indicator, the studied group is highly heterogeneous (V%=55.23; V%=56.23).

CONCLUSIONS

- There is an increasing trend in average height and body mass compared to previous large-scale studies over the years among 11-year-old girls. In the present study, we can conclude that growth in height is due to both endogenous and exogenous factors.
- From the conducted research, it is clear that the reduction of subcutaneous fat tissue is successful with an appropriate motor regime of the students.
- Targeted work with handball means has had a positive effect on increasing the mesomorphic component of the somatotype.
- Working with handball means reduced the endomorphic component of the somatotype by -6.9% in the girls of the experimental group.

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ABBREVIATIONS

WHO – World health organization
CG – Control group
EG – Experimental group

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