

Somatotypological Characterization of Bulgarian Children and Adolescents (Smolyan Region)

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ABSTRACT

The aim of this study is to investigate age- and sex-related changes in somatotypological characteristics of Bulgarian children and adolescents from Smolyan region. The investigated sample in this work included a total 1086 (559 boys and 527 girls), aged 7–17 years and measured cross-sectional between 1998–2001. Standard anthropometric technique and instruments were used. The anthropometric variables of the weight (W), height (H), humerus and femur width, calf and arm flexed and tensed girth were measured by Martin-Saller's method (1957). The thickness of the four skinfolds – the triceps, biceps, subscapular and medial calf on the right side also were measured. These anthropometrical measurements were required for determining three Heath-Carter anthropometric somatotype components. Data processing and statistical analysis was made by Statistica software package using descriptive analysis and one –way ANOVA for the assessment of age- and sex differences between groups. The results show specific age- and sex-related changes in somatotype characters, mean somatotype and inter-sex differences between values of somatotype components of both sexes.

Key words: Heath-Carter somatotype components, somatotype categories, children

Introduction

It is known that on the basis of certain morphological peculiarities the individuals can be classified in body types. The somatotype is integral characteristic of the morphological status of the organism that gives a complex assessment of the form and structure of the body. The changes in the somatotypological characteristics with age as well as under the influence of different factors are an object of research by many authors^{2,3,7,9,14,15,18,20–24,27–29}. These questions continue to attract the attention of the specialists because the results have practical meaning in different directions: in sports practice they play an important role in assessing the somatotype of the different groups of sportsmen, in medicine in connection with the prevention of different diseases, and in age morphology to determine the individual and group variability and echo- sensitiveness of the different somatotype components, common somatotype and others.

With this connection the purpose of the current research is to study age and sex-related changes in the

somatotypological characterization of children and adolescents in the Smolyan region (Bulgaria).

Material and Methods

This research is a part of the complex anthropometrical investigation of growth and development of children and adolescents from Smolyan region, Bulgaria. The investigated sample in this work included a total 1086 (559 boys and 527 girls), aged 7–17 years and measured cross-sectional between 1998–2001. Standard anthropometric technique and instruments were used. The anthropometric variables of the weight (W), height (H), humerus and femur width, calf and arm flexed and tensed girth were measured by Martin-Saller's method¹¹. The thickness of the four skinfolds (triceps, biceps, subscapular and medial calf) on the right side were measured with a GPM calliper with constantly pressure 10 g/mm². These anthropometrical measurements required

for determining three Heath-Carter anthropometric somatotype components- the endomorphy, mesomorphy and ectomorphy^{3,4}. Data processing and statistical analysis was made by Statistica software package used descriptive analysis and one-way ANOVA for the assessment of age- and sex differences between groups.

To present the age changes in mean somatotype were used three-dimensional somatotypological graphics, by the model of M.Toteva²⁶. The constitution of this model is based on the equality of the three biometric components through their position on the axes in equal intervals as in the original methodology of Heath-Carter.

Results

The results of descriptive statistics (mean and standard deviations) of the somatotype components in the particular age periods for both sexes are given in Tables 1 and 2. The inter-sex and inter-age differences in the average values are also marked.

The first somatotype component-endomorphic, characterizes the relative development of the subcutaneous fat tissue in the body composition. The results show that the forming of the typical female structure for the girls, expressed in higher values of the endomorphic component is seen after the age of 7 (Table 1). Then the endomorphy increases significantly from 2.40 SU (somatotype unit) to 3.43 SU ($p < 0.05$). After this period the values decrease with some fluctuations but insignificantly till the age of 14. The second significant increase of the endomorphy for the girls is seen at the age of 15 ($p < 0.05$) when it reaches its peak of development (3.99 SU). After this age till the end of the research the values stay relatively stable and high (3.73 SU–3.95 SU). For the boys the first somatotype component increases smoothly and moderately till the age of 9 (2.05 – 2.48

SU). Between the age of 9–10 is seen a slow decrease in piling the subcutaneous adipose tissue at the expense of body segments that become longer (Table 2). A significant increase of this component ($p < 0.05$) is seen between the 10 – 11th year and for the 11 years old boys the values reach its peak of development (2.71 SU). After this age the values of the endomorphy decrease (2.08 SU), and in the period 14–17 years they have almost the same levels (2.10–2.29 SU).

The second somatotype component – the mesomorphic, characterizing the development of the muscular and bone system, is clearly expressed for the studied boys (Table 2), at the beginning of the age periods- 7–8 year (4.25 SU – 4.30 SU). It decreases insignificantly in the period before puberty- 9–10 year (4.09 SU – 4.06 SU) and after that at 12–13 year goes up again ($p < 0.05$) and reaches its peak at the age of 13 (4.67 SU). The values of the second somatotype component for the boys are high during the whole active puberty period and during the 15–17 year they stabilize and practically are the same (4.40 SU). For the girls (Table 1) the mesomorphy at the age of 7 is the lowest (3.32 SU). It increases in the period of 7–8 year (3.32 SU – 3.65 SU) and after that stays high, stable and with the same values in the period between 11–13 years (3.82 SU – 3.88 SU). A new increase of the mesomorphic component with 0.34 SU ($p > 0.05$) is seen between 14–15 year at the expense of decreasing the ectomorphy. During the 15–17 year the mesomorphic component for the studied boys has high and stable average values (4.07–4.15 SU).

For the 7 year old girls (table 1) the ectomorphy is moderately expressed (3.33 SU). Between the 7–8th year its values significantly decrease ($p < 0.05$) at the expense of endo- and mesomorphy. The third somatotype component increases again after the 8th year and between the 9–10 year the increase is with 0.65 SU ($p < 0.05$) and reaches its maximum of 3.99 SU for the 10 year old girls.

TABLE 1
DESCRIPTIVE STATISTICS IN SOMATOTYPE COMPONENTS OF THE GIRLS

Age (yrs)	N	GIRLS					
		Endomorphy		Mesomorphy		Ectomorphy	
		\bar{X}	SD	\bar{X}	SD	\bar{X}	SD
7	63	√ 2.40	0.55	3.32	0.85	√ 3.33	1.02
8	51	√ 3.43*	1.74	3.65	1.02	2.81*	1.76
9	47	√ 3.25	1.44	3.77	0.85	3.34	1.48
10	53	√ 2.99	1.04	3.54	0.96	3.99*	1.25
11	48	√ 3.35	1.83	3.82	1.51	3.74	1.75
12	52	√ 2.92	1.26	3.88	1.13	3.73	1.42
13	49	√ 3.25	1.31	3.82	0.97	3.73	1.42
14	55	√ 3.21	1.15	3.73	1.17	3.55	1.74
15	62	√ 3.99*	1.68	4.07	1.17	3.12	1.71
16	64	√ 3.73	1.40	4.05	1.28	3.10	1.53
17	45	√ 3.95	1.23	4.15	1.16	2.83	1.42

TABLE 2
DESCRIPTIVE STATISTICS IN SOMATOTYPE COMPONENTS OF THE BOYS

Age (yrs)	N	BOYS					
		Endomorphy		Mesomorphy		Ectomorphy	
		\bar{X}	SD	\bar{X}	SD	\bar{X}	SD
7	48	2.05	0.61	√ 4.25	0.80	2.88	0.95
8	56	2.30	0.85	√ 4.30	0.96	3.24	1.06
9	56	2.48	1.30	4.09	1.18	3.56	1.51
10	55	2.26	1.40	√ 4.06	1.43	3.97	1.71
11	39	2.71*	0.98	4.32	1.28	3.65	1.45
12	49	2.08*	0.94	4.13	1.05	4.18	1.37
13	48	2.42	1.26	√ 4.67*	1.40	3.70	1.88
14	46	2.11	1.01	√ 4.22	1.29	√ 4.29	1.38
15	41	2.29	1.02	4.41	1.21	√ 4.03	1.23
16	49	2.19	0.96	4.40	1.09	3.66	1.27
17	44	2.10	0.80	4.41	1.33	√ 3.93	1.38

* inter-age differences ($p \leq 0.05$), √ inter-sex differences ($p \leq 0.05$)

During the 11–13th year the values of the third somatotype component stay relatively high and practically the same (3.73 SU) and after this age they gradually decrease and at the end of the period reach 2.83 SU. In the group of boys (table 2) the ectomorphic component is with the lowest values among the 7 years old (2.88). During the following three years it increases and at the age of 10 it reaches 3.97 SU. Between the 10–11th year is seen decreasing of the ectomorphic component at the expense of the significant increase of the values of the endomorphy as well as mesomorphy. The linearity of the body segments and proportions for the boys go up between 11–12th year ($p > 0.05$) which is at the expense of reliable decrease ($p < 0.05$) of the fat tissue in the composition of the body mass. Between 12–13th year the form and the structure of the body of the studied boys change again and the values of the ectomorphic component decrease ($p > 0.05$) and at the same time the values of the mesomorphic ($p < 0.05$)

and endomorphic component go up. In the period of active puberty (14–15 year) which is connected with lengthening the proportions of the body the boys are characterized with high values of the third somatotype component (4.03–4.29 SU). After the 15th year the ectomorphy goes down insignificantly and stays high especially at the age of 17.

The variations in mean somatotype in period of growth are presented in figure 1–11. With age studied girls change their mean somatotype and at the start of the period i.e. during 7th, 10th and 12th year they are characterized with the same development of the second and third somatotype component (Figures 1 and 4), and it determines the type as mesomorph-ectomorph. The mean somatotype among 8 year old girls is mixed – mesomorph – endomorph (Figure 2), during 9th, 11th, 13th and 14th year i.e. in the period before puberty and puberty, the adipose tissue, bone-muscular system and the linearity of the

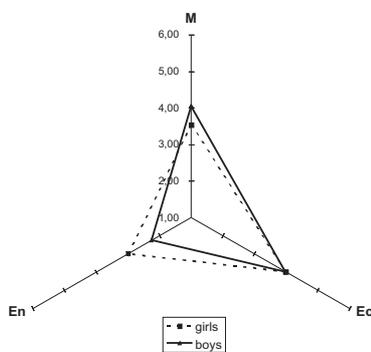


Fig. 1. 7 year; Girls: Mesomorph-ectomorph, Boys: Ectomorphic mesomorph.

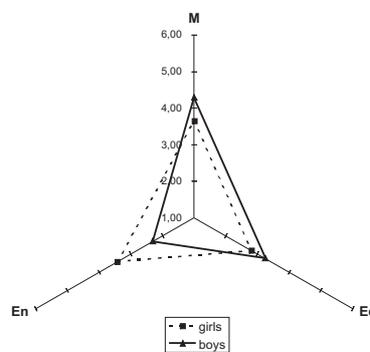


Fig. 2. 8 year; Girls: Mesomorph-endomorph, Boys: Ectomorphic mesomorph.

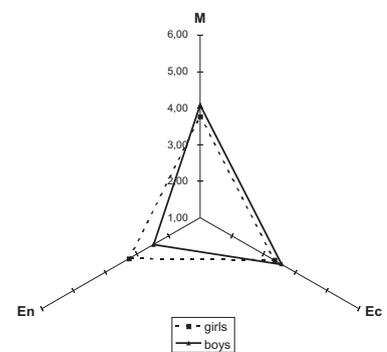


Fig. 3. 9 year; Girls: Central, Boys: Ectomorphic mesomorph.

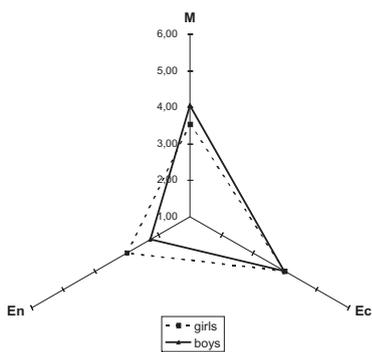


Fig. 4. 10 year; Girls: Mesomorph-ectomorph, Boys: Mesomorph-ectomorph.

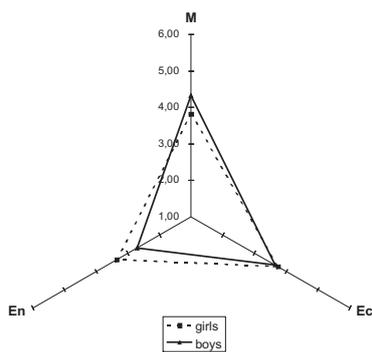


Fig. 5. 11 year; Girls: Central, Boys: Ectomorphic mesomorph.

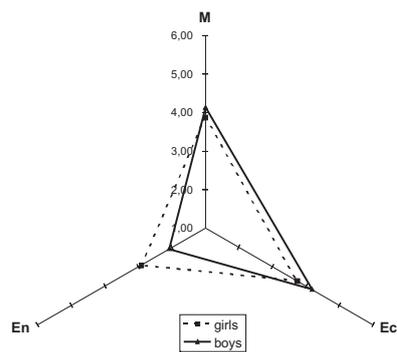


Fig. 6. 12 year; Girls: Mesomorph-ectomorph, Boys: Mesomorph-ectomorph.

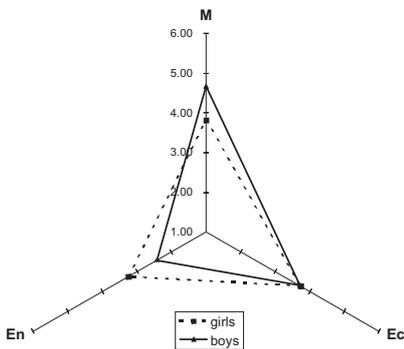


Fig. 7. 13 year; Girls: Central, Boys: Ectomorphic mesomorph

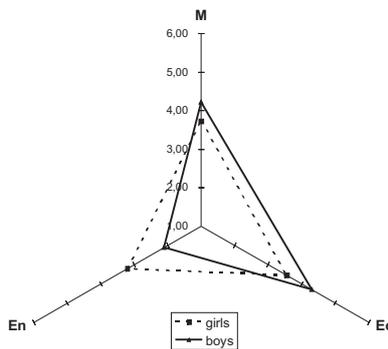


Fig. 8. 14 year; Girls: Central, Boys: Mesomorph-ectomorph

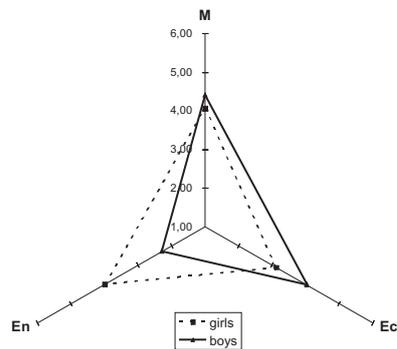


Fig. 9. 15 year; Girls: Mesomorph-ectomorph, Boys: Mesomorph-ectomorph

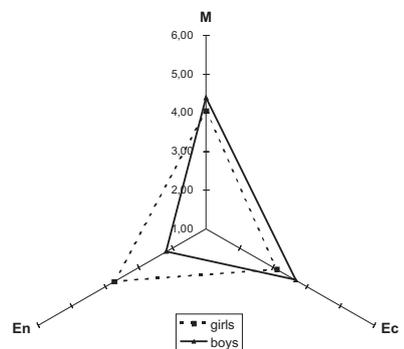


Fig. 10. 16 year; Girls: Mesomorph-ectomorph, Boys: Ectomorphic mesomorph.

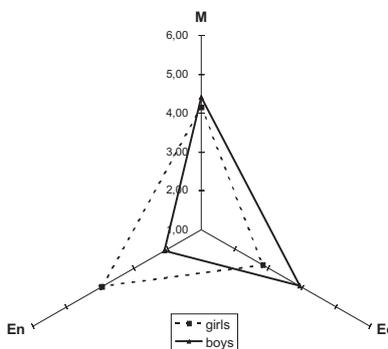


Fig. 11. 17 year; Girls: Mesomorph-ectomorph, Boys: Mesomorph-ectomorph.

Fig. 1-11. Mean somatotypes of boys and girls.

body segments are moderately expressed so the girls at these ages have central somatotype (Figures 3, 5, 7, 8). After the puberty – 15–17th year (Figures 9, 10, 11) the somatotype of the studied turns into mixed mesomorphic–endomorphic type due to the harmonious development of adipose tissue, bone skeleton and the muscles.

For the boys the mean somatotype from 7th to 9th year as well as 11th, 13th and 16th year is ectomorphic mesomorph (Figures 1, 2, 3, 5, 7, 10). This is connected with the dominating development of the muscles and bones in a combination with good linearity and proportion of the body. During all the other periods the somatotype turns

into the mixed type mesomorph-ectomorph (Figures 4, 6, 8, 9, 11).

Using this graphic models the specific inter – sex’s differences in the common somatotype characteristics are visualized very well in the period 7–17 years. As it is seen on Figure 1 during the child age 7 years, the form and the structure of the body for both sexes is similar and the three somatotype components are better developed for boys which are clearly expressed for the mesomorphic component. With better development of the adipose tissue are 8 year old girls and the boys at the same age are with better muscular-bone development and linearity of

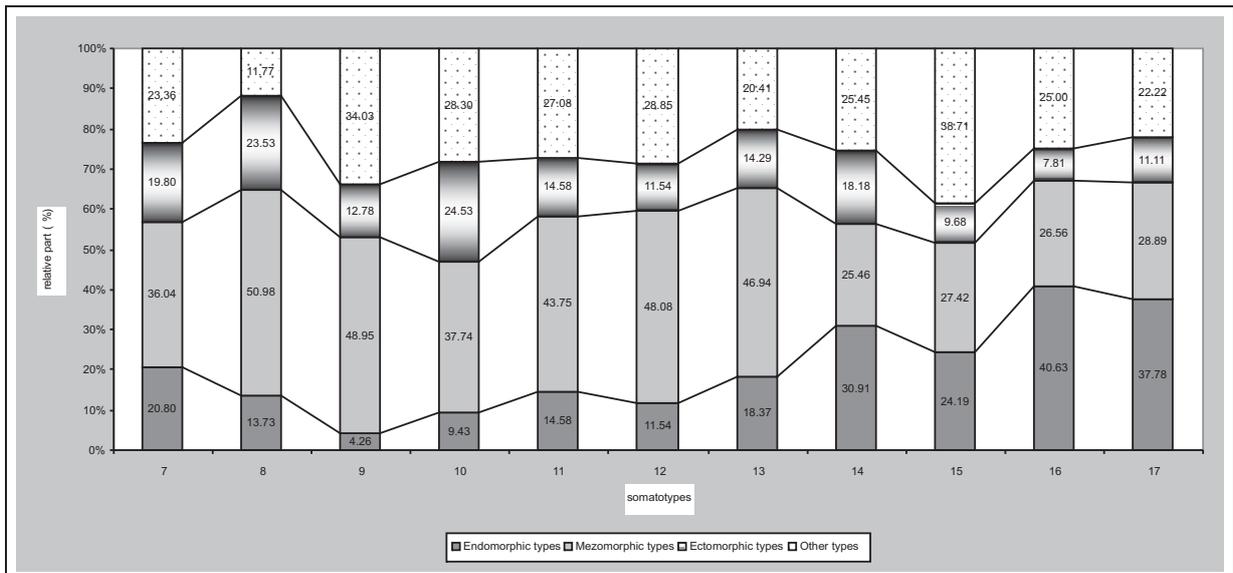


Fig.12. Distribution of different categories somatotype among group of girls.

the body segments (Figure 2). Analogical is the situation for 9, 10 and 11 years old children (Figures 3, 4, 5), but they are characterized with similar linearity and proportions of the body. With coming the puberty the inter-sex differences in the form and structure of the body increase and at the age of 12 the girls are again more endomorphic and the development of the other two components for both sexes is still relatively the same (Figure 6). At the age of 13 the girls have better development of the adipose component and the boys with better development of the skeleton and muscles (Figure 7). At the age of 14 the differences between the sexes increase not only to the reference of the first and second somatotype component but in the reference to the third and the axis of

the ectomorphy for the boys draws out to the right that changes the form of the triangle (Figure 8). At the end of the studied period – 15–17 years the adolescent boys and girls have perfectly different body form and structure (Figures 9, 10, 11). The girls at these ages differ from the boys with better development of the adipose tissue and the boys with more expressed proportions and linearity of the body. At these periods both sexes are characterized with similar development of the skeleton and muscles that is seen from the near location of the peaks of the two triangles.

The percent distribution of 13 somatotype categories on Heath-Carter, united in four big groups – endomor-

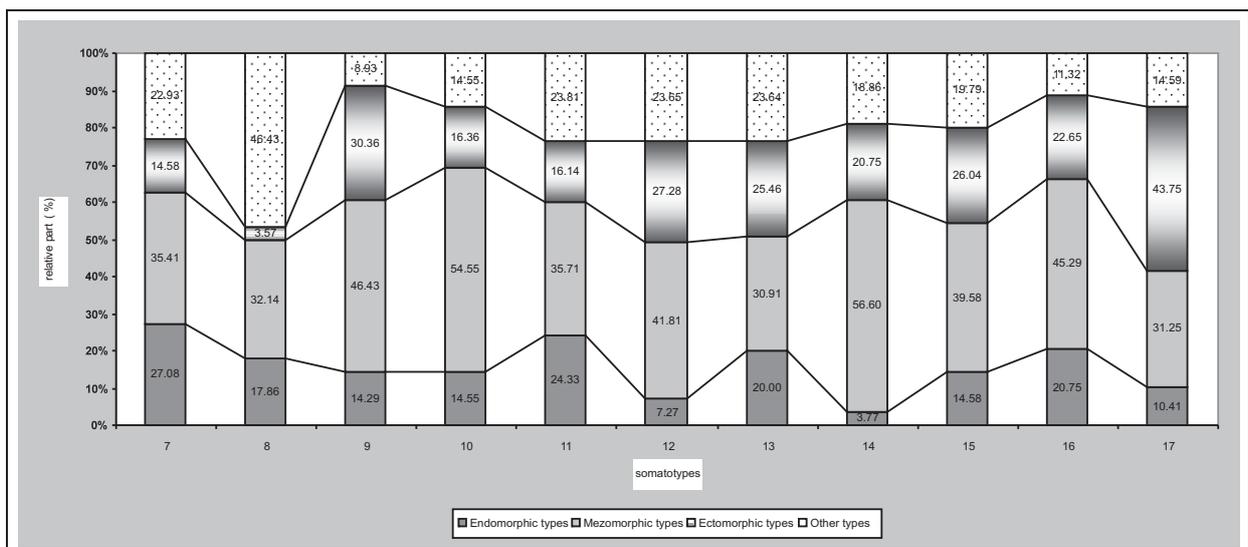


Fig.13. Distribution of different categories somatotypes among group of the boys.

phic types, mesomorphic types, ectomorphic types and other types are present on Figures 12 and 13.

The girls at the age of 7–8 (Figure 12) are classified relatively equal in the three of the big groups – endo- and ectotype and the group »others«, that unites the rest somatotypes. With the biggest percentage at these ages are the girls with mesomorphic body structure types (36.41%–50.98%). In the following 5 years (9–13 years) the percentage of the mesomorphic types stays high and dominates the other group's body types (37.74%–48.95%). During 13th year, in the period of active puberty, the adipose component in the composition of girls' body starts increasing and determines the character of body forming. It determines the significant decrease of the percentage of the mesomorphic types during the following ages (14–17) and the sudden increase of the part of the endomorphic types. So at the end of the growing period (16–17 years) with endomorphic structure are more than one third of the studied girls (37.78%–40.63%). Among the studied girls most frequently met types till the age of 13 after the mesomorphic are the mixed ones and those with equal somatotype components united in the group »others« body types. Their percentage is the highest among 9 and 15 years old girls and the lowest among 8 years. Relatively less frequently during the studied period are met girls with ectomorphic type (7.81%–24.53%).

For the male representatives (Figure 13) most of them at the age of 7 belong to the mesomorphic (35.41%) and endomorphic body types (27.08%). At the age of 8 among the boys is the highest the percentage of the types with equal participation of three or two somatotype components (46.43%) followed by mesomorphic (32.14%) and endomorphic categories (17.86%). The percentage of the ectomorphic types at this age is insignificant (3.57%). The tendency for the leading role of the mesomorphic body structure for the boys stays in a place during the whole growing period and during the following ages (9–16 years) it is again with the highest percentage (30.91%–54.55%). On the second place at these ages are the ectomorphic types (16.14%–30.63%), followed by the mixed body types (8.93%–23.81%), and relatively less frequently are the boys from the group of the endomorphic types (3.77%–24.33%). At the end of the studied growing period (17 years) can be seen the biggest variation of individual typological characteristics. The mesomorphic types significantly decrease (31.25%) at the expense of ectomorphic (43.75%). The percentage of the endomorphic as well as the other categories somatotype at this age is between 10.41% and 14.59%.

Discussion

In the investigated growth period occur specific age changes in different somatotype components for both sexes.

Forming of the typical female structure for the investigated girls, expressed in higher values of the endomorphic component is seen in all growth period (Tables 1 and 2). In group of the boys decrease of endomorphy af-

ter 11th year is seen. For similar age and sex changes in endomorphy, as well as for decreasing in endomorphy after prepuberty period in boys reported Ozener, Duyar¹⁶, Toteva²⁶, Walker, Tanner³¹, Claessens et al.⁶ and others. This fact according to Claessens et al.⁶ can be explained with the decrease of the quantity of the subcutaneous adipose tissue in the lower limbs at these age periods which reflects on the endomorphy of the individual. During the puberty and after puberty among studied boys decrease the quantity of the subcutaneous fat tissue of the upper and lower limbs, the back and lower part of the torso and at the same time the increase of the height of unit body mass can be explained with the lowest values of the endomorphy during these periods.

Our results of the analysis of the inter-sex differences in endomorphic component show that during the studied growing period the girls are significantly more endomorphic than boys and this fact is more pronounced after 8th, 9th and 12th years. At the end of the growing period the differences between both sexes are 1.85 SU ($p < 0.05$). For similar sex differences in reference to the values of the first somatotype component and its better development for the girls compared to the boys and especially in the period of puberty and the late stages of maturity announce many authors^{1,7,8,10,12,13,18,22,24,26}.

Our results also confirm literature data^{1,10,12,13,24} about higher mesomorphy in group of boys, compared with girls. So during the whole studied period the Smolyan boys have higher average values of the mesomorphy compared with Smolyan girls, with the exception of 8th and 9th year. This fact show better configuration and development of bone and muscles of the limbs in male individuals. In general our children and adolescents are characterized with very good development of the muscles and bone skeleton and it is demonstrated by the values of the mesomorphic component (4.06 – 4.67 SU for the boys, 3.32 – 4.15 SU for the girls). The reasons for the leading development of the bone and muscular system in the body configuration of Smolyan boys and girls probably is hidden in the specific genetic peculiarities of the population modified under the influence of environmental conditions of life. In this connection it is announced in literature data for the high hereditary determination of the boys mesomorphy followed by the ecto- and endomorphy⁵, as well as the influence of the hereditary factors and economic conditions of life, the way of feeding, the active physical exercises upon the different somatotype components and the mean somatotype^{7,22,25}.

The third somatotype component – the ectomorphic expresses the relative linearity of the body segments and the proportion of the body. Our results show that during the formation of the body type of the studied children and adolescents according the quantity of the absolute average values the ectomorphy has it ranks the second after the mesomorphic component.

In group of girls the third somatotype component is good expressed in the start of the growth period. In the next years the ectomorphy increases with some fluctuations and between the 9–10 year the increase is with 0.65

SU ($p < 0.05$) and reaches its maximum of 3.99 SU for the 10 year old girls. The observed significant increase of the length of the body segments and proportions of the body at this period is connected with the growing leap in height that comes between the 9–10th year for the studied population of girls (8.55 cm). After age of 13 this values gradually decrease and at the end of the period reach 2.83 SU. Analogical results for decreasing the values of this component for Slovenian girls announce Tomazo-Ravnik et al.²⁴ and others. In the group of the boys the values of ectomorphic component vary between 2.88–4.29 SU in age period 7–17, as the highest are the values at the end of puberty. The described changes in the form and structure of the body are connected with the start of the puberty accompanied with lengthening the proportions as well as with the quantity of the body mass related to height.

The inter – sex differences in reference to the development of the third somatotype component are seen during the whole growing period and according to our results they are in favour of the boys almost during the whole studied period. Statistically significant inter – sex differences in reference to the linearity of the body segments and proportions can be seen at the beginning of the period and especially after the 13 year in the period of puberty ($p < 0.05$).

The comparison of our facts to those for other populations of Bulgarian children (Sofia, Plovdiv) shows that Smolyan boys and girls most commonly have lower endomorphy, lower or similar mesomorphy and higher ectomorphy^{1,26}.

The comparison done between our facts and those of the research of R.Stoev²², made in 1986 among Smolyan's boys and girls at the age of 10 – 16, showed decreasing of the values of the endomorphy and increasing the values of the ectomorphy for both sexes as well as better development of the mesomorphy for girls. The changes in the values of the somatotype component are probably connected with better social-economic conditions of life in the population, the changes in the regular diet, exercises, as well as the influence of other environmental determinants.

The other important task of this research was to analyze the age changes in mean somatotype. According to many authors the individual somatotype changes with age and the changes are modified through a regular diet or specific physical exercises. For similar dynamics of the somatotype during the growth announce some authors^{3,7,8,14,17–19}.

In order to receive more objective idea of these processes we made three-dimensional somatotypological graphics, using the model of M.Toteva²⁶. They show dynamic changes in mean somatotype in both sexes (Figures 1-11). The type and structure of the body in girls are change from the type mesomorph-ectomorph at the start of period in the central somatotype in middle age period to the mesomorphic endomorphic type at the end of growth period. In all growth period the forming of the female body type is distinctly outlined which is demon-

strated by the leading role of the endomorphic component in forming the body structure. For the boys the mean somatotype changes from type ectomorphic mesomorph to the mixed type mesomorph-ectomorph. During all the other periods the somatotype turns into the mixed type mesomorph-ectomorph.

These results confirm the literature data about the changes in the mean somatotype during the time of growing and they are close to the facts of Eiben⁷ for the Hungarian children– from 6th to 18th year of their development the Hungarian boys change their mean somatotype from ectomorphic mesomorph to mesomorphic ectomorph and the Hungarian girls from type ectomorphic mesomorph at the beginning of the period pass through central type and at the age of 18 turn into mesomorphic endomorph. Similar are the facts of Procopec and Stehlik¹⁸ for the Czeck children and Tomazo-Ravnik²⁴ for the Slovenian children.

There are a lot facts in literature which report that age belonging doesn't have an important influence on the changes of the main somatotype and it stays in one and the same zone in the whole life time of the individual. The changes with age are mainly in turning into neighboring somatotype categories that are explained with changes in the values of the three somatotype components during the different age periods affecting the determined eco-sensibility of the different tissues and systems in the human organism^{7,13}.

For changes in the mean somatotype of Bulgarian children from Plovdiv during the growth announce Andreenko, Bojadjiev¹. The comparison of our facts to those of R.Stoev²² for the generation of Smolyan children in 1986 gave us the possibility to see the changes in the mean somatotype. For the period of 15 years, i.e. the period between the two researches, parallel with the changes in the mean somatotype of the three components the mean somatotype also changes. Most commonly the boys at the age of 10–16 go from category balanced mesomorph to categories mesomorph-ectomorph and ectomorphic mesomorph, and shows that the type of the body structure hasn't changed fundamentally. But the body form of the girls has undergone fundamental transformations and from the category mesomorphic endomorph they turn into the categories mesomorph-ectomorph, central, mesomorphic ectomorph and mesomorph-endomorph.

Using these graphic models the specific inter-sex differences in the common somatotype characteristics are visualized very well in the period of growth. As it is seen on the Figures 1-11 at the start of investigated period the form and structure of the body in both sexes are similar. During of 14 year the differences between the sexes increase and at the end of the studied period the boys and girls have perfectly different body form and structure. The girls at these ages differ from the boys with better development of the adipose tissue and the boys with more expressed proportions and linearity of the body. At these periods both sexes are characterized with similar development of the skeleton and muscles that is seen

from the near location of the peaks of the two triangles. Similar facts for inter – sex differences in the somatotypological characteristic of the Bulgarian boys and girls from Sofia announce Nacheva, Toteva¹³.

Of interest to us is the percentage division and frequency of meeting the different categories somatotype for both sexes in particular age periods. In order to revise the information and to get more objective idea about that we united the 13 categories somatotype on Heath-Carter in four big groups: endomorphic types-including body types where dominating is the endomorphic component; mesomorphic types-including body types with leading mesomorphic component and ectomorphic types-body types with dominating ectomorphic component. In the last group »others« or are all the other somatotypes where two or three somatotypes have equal part. The frequency of meeting the four big groups body types during the different stages of growing is given in percentage division at age for both sexes on Figures 12 and 13. As can be seen from Figures 12 and 13 among the girls till to 13 year predominate mesotypes, followed of mixed and central somatotypes. After 13 years among the studied girls most frequently met endomorphic types. In group of boys during the all observed growing period predominate mesomorphic types, followed by the ectomorphic, mixed and central body types and least frequently are met boys with leading endomorphic component

The studies in literature concerning the frequency of meeting the 13 somatotype categories on Heath-Carter in the different territorial and age groups shows that analogically to our facts among the boys from Plovdiv, with small exceptions, at the age of 7–17 the highest is the percentage of the mesomorphic types. In contrast to Smolyan girls among whom during the whole growing period the mesomorphic forms predominate, among the girls from Plovdiv at the beginning of the period the highest is the percentage of the mesomorphic types, in the period before puberty-ectomorphic types, and in the period of puberty and after it – endomorphic types¹. According to the facts of Tomazo-Ravnik²⁴ among the Slovenian boys at the age of 14–18, analogically to our facts, the mesomorphic types predominate, and among the Slovenian girls-respectively the endomorphic types. But among the Estonian boys³⁰ at the age of 12–15, most frequently are seen the mesomorphic ectomorphs, and among the girls- the ectomorphic types and those with central body type.

The results from this comparison once again confirm the fact that each population has its unique somatoty-

pological profile which is determined by the specific genetic and environmental factors.

In conclusion, the results of this research show that:

- There are age- and sex-related changes in the average values of the three somatotype components, mean somatotype and the individual somatotypological characteristics.
- During the studied growing period the girls are significantly more endomorphic and the boys are more mesomorphic and more ectomorphic than their coevals from the other sex. With age there is an increase of the endomorphy for the girls during the whole period, and for the boys till the age of 11 after that it decreases. The mesomorphy and ectomorphy also increase with age for both sexes, but while the mesomorphy increases till the end of the period, the ectomorphy increases till puberty and after that it decreases more significantly for girls and more insignificantly for the boys. The described differences and changes in the form and structure of the body of the studied children are probably connected with different influences in the process of growing and maturity and with the different echo-sensitiveness of the organism.
- Leading role in the forming of the body form of the studied children has the bone and muscular system followed by the linearity and proportions of the body. The adipose tissue has the meaning of second leading component at the beginning of the period as well as in the period of puberty and after it.
- Mean somatotype components for both sexes change with age, and for the boys are typical the relatively higher stability while for the girls the somatotype is more eco-sensitive and less stable. For both sexes changes in mean somatotype are seen mainly in the period before and at puberty as well as after it for the girls. Inter – sex differences in reference to mean somatotypological characteristics are seen during the whole studied period but they are especially good expressed during the puberty and after it.
- The division of the somatotype categories shows that for both sexes during the different age periods of growing predominate the mesomorphic types followed by ectomorphic and mixed body types. Less frequently met for the boys are the endomorphic forms while for the girls their relative part dominates the others after puberty.

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SOMATOTIPOLOŠKA KARAKTERIZACIJA BUGARSKE DJECE I ADOLESCENATA (REGIJA SMOLYAN)

S A Ž E T A K

Cilj ove studije je istražiti promjene u somatotipološkoj karakterizaciji bugarske djece i adolescenata iz regije Smolyan, s obzirom na dob i spol. Istraživani uzorak uključivao je ukupno 1086 (559 dječaka i 527 djevojčica), u dobi od 7 do 17 godina i mjereno je transverzalno u periodu 1998.–2001. godine. Korištene su standardne antropometrijske metode i instrumenti. Antropometrijske varijable težine (W), visine (H), širine nadlaktične i bedrene kosti te opsega stegnutog lista i ruke mjerene su Martin-Sallerovom metodom (1957). Također je mjerena debljina četiri kožna nabora – tricepsa, bicepsa, subskapularnog nabora i nabora unutarne strane liste. Ove antropometrijske mjere bile su potrebne za utvrđivanje tri Heath-Carter antropometrijske somatotipne komponente. Obrada podataka i statističke analize su rađene Statistica softverskim paketom, koristeći deskriptivne analize i jednosmjernu ANOVA-u za procjenjivanje dobnih i spolnih razlika među skupinama. Rezultati pokazuju specifične promjene u somatotipnim karakteristikama s obzirom na spol i dob, srednji somatotip i razlike u vrijednostima somatotipnih komponenti unutar spolnih skupina, kod oba spola.