

BODY COMPOSITION OF CHILDREN AND ADOLESCENTS FROM PLOVDIV

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ABSTRACT. The aim of the present study is to make a comparative between-group and between-gender analysis of the Heath-Carter somatotype characteristics, incidence of individuals with normal weight, overweight and obesity in 8-13-year-old children from the town of Plovdiv. Body nutritional status was evaluated using the body mass index and the overweight and obese children were determined according to Cole et al. classification (2000). The correlation between the somatotype, overweight and obesity was analyzed.

The results show specificity of the body nutritional status in age and gender aspect. Age alterations in the somatotype as well as the correlation between the body built and obesity are associated with the period of sexual maturation of the growing body.

KEY WORDS: schoolchildren, somatotype, body nutritional status

INTRODUCTION

Human body is integrity of morpho-functional components that form the individual's characteristics. The phenotypic expression of these components is the constitution. Its morphological attribute – the somatotype – characterizes the body shape and body composition at any moment of human ontogenesis. The study of the individual characteristics of the body built can be useful only on the basis of the knowledge of general regularities in the relationship between the basic somatic components and their age and gender changes. Presently the specialists study the different aspects of the relationship between somatotype and individual's health, as well as its connection with overweight and obesity as a possibility of health control.

The aim of the present study is to make a comparative between-group and between-gender analysis of the individual somatotype characteristics, incidence of individuals with normal weight, overweight and obesity and correlation between somatotype, overweight and obesity in children and adolescents from the town of Plovdiv.

MATERIAL AND METHODS

The data presented are part of a research project studying the anthropological characteristics of the children and adolescents from the town of Plovdiv funded by the National Fund Scientific Research. The present study includes 620 healthy children and adolescents (320 girls and 300 boys) aged between 8 and 13 years divided into 6 age groups at one-year interval.

Of all over 50 anthropometric measurements obtained (including lengths, widths, circumferences and skin folds) height, weight, biepicondylar diameters of the humerus and femur, circumferences of the arm and leg and four skin folds – triceps, subscapular, suprailiac and medial calf, were analyzed in the present study. Body mass index (BMI) and the somatotype components endomorph, mesomorph, and ectomorph were computed.

The measurements were obtained following the Martin-Saller's rules of anthropometry, caliperometry was done with GPM caliper, somatotype was determined after the Heath-Carter' method (1990), BMI was computed using the formula weight (kg)/height (m).

The data were processed using SPSS 11.0. The between-gender differences were analyzed with Student's t-test (at level of significance $p < 0.05$) and between-age differences in BMI with ANOVA analysis. The overweight and obese individuals were determined according to the Cole et al. classification (2000).

RESULTS AND DISCUSSION

The Heath-Carter's somatypology is an integral characteristic of the weight-height ratio and the body component content. Hence it could be expected that the between-group characteristics in the somatotype distribution correlate with the corresponding components of the body composition – fat tissue content (endomorph component), "active" body mass (mesomorph component) and BMI (ectomorph component – characterizing the body relative lengthening).

The mean somatotype components of the subjects from the different groups examined according to Heath-Carter method are presented in Table 1.

Table 1. Means of Heath – Carter anthropometric Somatotype

Boys							
		endomorph		mesomorph		ectomorph	
Age	n	X	SD	X	SD	X	SD
8	50	4,99	1,72	4,30	1,05	2,86	1,65
9	50	3,56	1,34	4,16	1,06	2,87	1,50
10	50	3,05	1,02	4,06	1,17	3,05	1,01
11	50	2,05	1,21	4,15	0,96	3,58	1,62
12	49	3,74	2,61	3,90	1,28	3,07	1,04
13	50	3,64	2,79	3,75	1,36	2,97	1,43
Girls							
		endomorph		mesomorph		ectomorph	
Age	n	X	SD	X	SD	X	SD
8	52	5,11	1,42	3,64	1,20	2,45	1,40
9	69	4,25	1,10	4,05	1,11	2,56	1,06
10	50	4,18	1,08	4,33	0,79	2,58	1,09
11	50	3,30	1,75	4,15	1,53	3,34	2,30
12	50	3,82	1,92	3,43	1,10	3,03	1,47
13	50	2,99	2,27	3,10	1,09	3,25	1,37

In the boys the endomorphic component decreases significantly with age. It has the lowest value in the 11-year-old boys but increases with 0.5 units at the age of 12 related to the beginning of puberty. The girls have higher mean values of the endomorphic component than the boys but show the same age tendencies. The between-age difference in the mesomorphic component is less than 0.5 unit, excluding the groups of the 11- and 12-year-old girls, where the difference is greater than 0.5 unit. The ectomorphic component increases slowly with age and significant difference between 10- and 11-year-old children is found in both genders.

The somatotype of the 8-year-old boys and girls is mesomorphic endomorph. The somatotype of the boys aged from 9 to 11 years is dominated by mesomorphy (endomorph mesomorph, balanced mesomorph, ectomorphic mesomorph) and 12- and 13-year-old boys are mesomorph-endomorphs. The somatotype of the 9- and 10-year-old girls is mesomorph-endomorph, at the age of 11 years changes to balanced mesomorph and at the end of the age period is central.

Figures 1 and 2 present the percentage of the examined individuals distributed by age and gender in three somatotype categories: endomorphic, including the three somatotypes with leading endomorphy; mesomorphic, including the three somatotypes with leading mesomorphy; and ectomorphic, including the three somatotypes with leading ectomorphy.

At the age of 8 the endomorphic somatotype dominates in both genders but in much higher rate in the girls. At the age of 9 and 10 years the somatotype with well-expressed mesomorphy is dominant.

Between-gender differences are found after the age of 10 years. At the age of 11 mesomorphy is dominant in the boys and ectomorphy in the girls. At the age of 12 the girls present with leading endomorphic somatotypes and in the boys the somatotypes with well-expressed endo- and mesomorphic components are almost

equally presented. At the end of the growing period the percent of the somatotypes with dominating ectomorphy increases associated with decrease of the endomorphic somatotypes in the girls and endo- and mesomorphic somatotypes in the boys.

One of the most disputable problems nowadays is obesity in childhood (Malina,R.M. et al.1999; Vignerova,J.P. et al.2000; Nacheva, A. et al.2003). Open for discussion is also the classification of body nutritional status. In the recent years BMI has been most frequently used. In the present study the classification of th overweight and obese individuals is made on the base of the cut off points introduced by Cole,T. et al. (Table 2).

Table 2. International cut off points for BMI for overweight and obesity by sex between 8 and 13 years, defined to pass through BMI of 25 and 30 kg/m² at age 18

Age, years	Overweight		Obesity	
	Boys	Girls	Boys	Girls
8	18.4	18.3	21.6	21.6
9	19.1	19.1	22.8	22.8
10	19.8	19.9	24.0	24.1
11	20.6	20.7	25.1	25.4
12	21.2	21.7	26.0	26.7
13	21.9	22.6	26.8	27.8

Table 3 present the statistical data of BMI of the examined children. For a 6-year period the index increases with 2.92 units in the boys and with 2.82 units in the girls.

Table 3. Statistical data and Anova Tykey multiplecomparation test of BMI

Age, years	Boys			Age, Years					
	n	X	SD	8	9	10	11	12	13
8	50	16,8	2,95						
9	50	17,42	3,27						
10	50	16,6*	2,38						
11	50	17,9*	1,83						
12	49	19,31	3,56	< 0.5	< 0.5	< 0.5			
13	50	19,72	2,68	< 0.5	< 0.5	< 0.5			
Age, years	Girls			Age, Years					
	n	X	SD	8	9	10	11	12	13
8	52	16,1	2,28						
9	69	17,28	2,32						
10	50	17,97*	1,85	< 0.5					
11	50	18,73*	3,56	< 0.5					
12	50	19,09	2,71	< 0.5	< 0.5				
13	50	18,92	2,39	< 0.5	< 0.5				

* P < 0.05 (♂/♀)

The between-gender differences can be classified in three types. At the age of 8 and 9 years the values of BMI are equal and slightly higher in the boys. Statistically significant between-gender differences in BMI are found at the age of 10 and 11 years. At the age of 10 the index is higher with 1.37 units in the girls than in the boys

and with 0.83 units at the age of 11. At the age of 12 and 13 years BMI is higher in the boys, i.e., they have greater mass per unit height than the girls, but the between-gender differences fail to reach statistical significance.

The described between-gender differences in the mean values of BMI at different ages can be related to the physiological characteristics of both genders, i.e., the rate of the processes of sexual maturation. The mean age of menarche in the girls from Plovdiv is 10 years and 2 months, which explains the greater body mass per height unit and deficit in the body weight in the same age boys. The sexual maturation in the boys begins a year later and the body mass per height unit in the 11-year-old boys is greater than in the same age girls.

In Table 4 is shown the frequency of normal body weight, overweight, and obese school-age children. The frequency of the school-age children with normal body weight shows no statistically significant between-gender differences between the age of 8 and 13 years. Excluding the age of 8 years, the percentage of normal weight children is greater in the boys with than in the girls and this between-gender difference is preserved to the end of the examined period, when a reversed relationship is established (at the age of 12 and 13 years).

The overweight school-age children show reverse between-gender differences compared with the normal weight children. Excluding the age of 8 years, the percentage of the overweight boys is significantly lower than that of the girls till the age of 12. At the age of 12 and 13 years the percentage of the overweight children is significantly greater in the boys than in the girls.

Table 4. Anthropometric nutritional status of 8-13 years old schoolchildren

Age, years	Not overweight and not obesity		Overweight		Obesity	
	n	%	n	%	n	%
Boys						
8	36	72	11	22	3	6
9	41	82	6	12*	3	6
10	46	92	4	8*		
11	46	92	4	8*		
12	38	77,6	7	14,3*	4	8,2
13	36	72	13	26*	1	2
Girls						
8	44	84,6	8	15,4		
9	56	81,2	12	17,4*	1	1,4
10	43	86	7	14*		
11	40	80	8	16*	2	4
12	45	90	4	8*	1	2
13	47	94	3	6*		

* P < 0.05 (♂/♀)

The obese school-age children are more frequently found in the boys than in the girls.

The summarized results show that accumulation of body mass per height unit in the growing body is associated with the morphological changes occurring during the growth and development of the body.

The relationship between the somatotype categories and the three weight categories referred to BMI shows that the ectomorphic school-age children have normal body nutritional status.(Table 5) Over 80% of the mesomorphic children of both genders have normal weight but both degrees of over normal weight are also seen. Of the last the percentage of overweight children is greater that of the obese children (12-13% vs. 2-3%) and boys are more readily presented than the girls .

Table 5. BMI distribution within the somatotype categories

Boys								
Somatotype	Not overweight and not obesity		Overweight		Obesity		Total	
	n	%	n	%	n	%	n	%
endomorph	30	45,45	26	39,39	10	15,15	66	100
mesomorph	84	84,85	13	13,13	2	2,02	99	100
ectomorph	57	100					57	100
Girls								
Somatotype	Not overweight and not obesity		Overweight		Obesity		Total	
	n	%	n	%	n	%	n	%
endomorph	76	75,25	23	22,77	2	1,98	101	100
mesomorph	57	82,61	10	14,49	2	2,9	69	100

Half of the endomorphic boys are overweight and obese while the girls show significantly lower percentage in these weight categories.

CONCLUSION

The results of the present study show that age and gender differences in the frequency of overweight and obesity during the growing period in the children from Plovdiv is somewhat an indicator of morphological maturity. Age alterations in the somatotype as well as the correlation between the body built and obesity are associated with the period of sexual maturation, when the body components are rearranged probably as a result of the adaptation processes in the body of the children and adolescents.

The present results are part of an investigation project financed by the National Science fund.

The authors thank for the financial support.

REFERENCE

- CARTER, J.E., B.H.HEATH. 1990. Somatotyping – development and applications. Cambridge university press.
- COLE, T.J., M.C.BELLIZZI, K.M. FLEGAL, W.H.DIETZ. 2000. Establishing a standard definition for child overweight and obesity worldwide international survey. Brit.Med.J. v.320,1-6
- MALINA, R.M., P.T. KATZMARZYK. 1999. Validity of the body mass index as an indicator of the risk and presence of overweight in adolescents. Am. J. Clin. Nutr.70, 131-168
- MARTIN, R., K. SALLER. 1957. Lehrbuch der Anthropologie in systematischer Darstellung. Stuttgart, Gustav Fischer Verlag, 308-385
- NACHEVA, A. E.LAZAROVA, L.YORDANOVA. 2003. Body nutritional status in 7-17 years old schoolchildren from Sofia (longitudinal) study 1993-2001). Journal of Anthropology, vol.4,21 -33
- VIGNEROVA, J., P.BLAHA, J. KOBZOVA, L. KREJCOVSKY, M. PAULOVA, J. RIEDLOVA. Growth and development of schoolchildren. Cent.- Eur. J. publ. Health. 8, 21-23

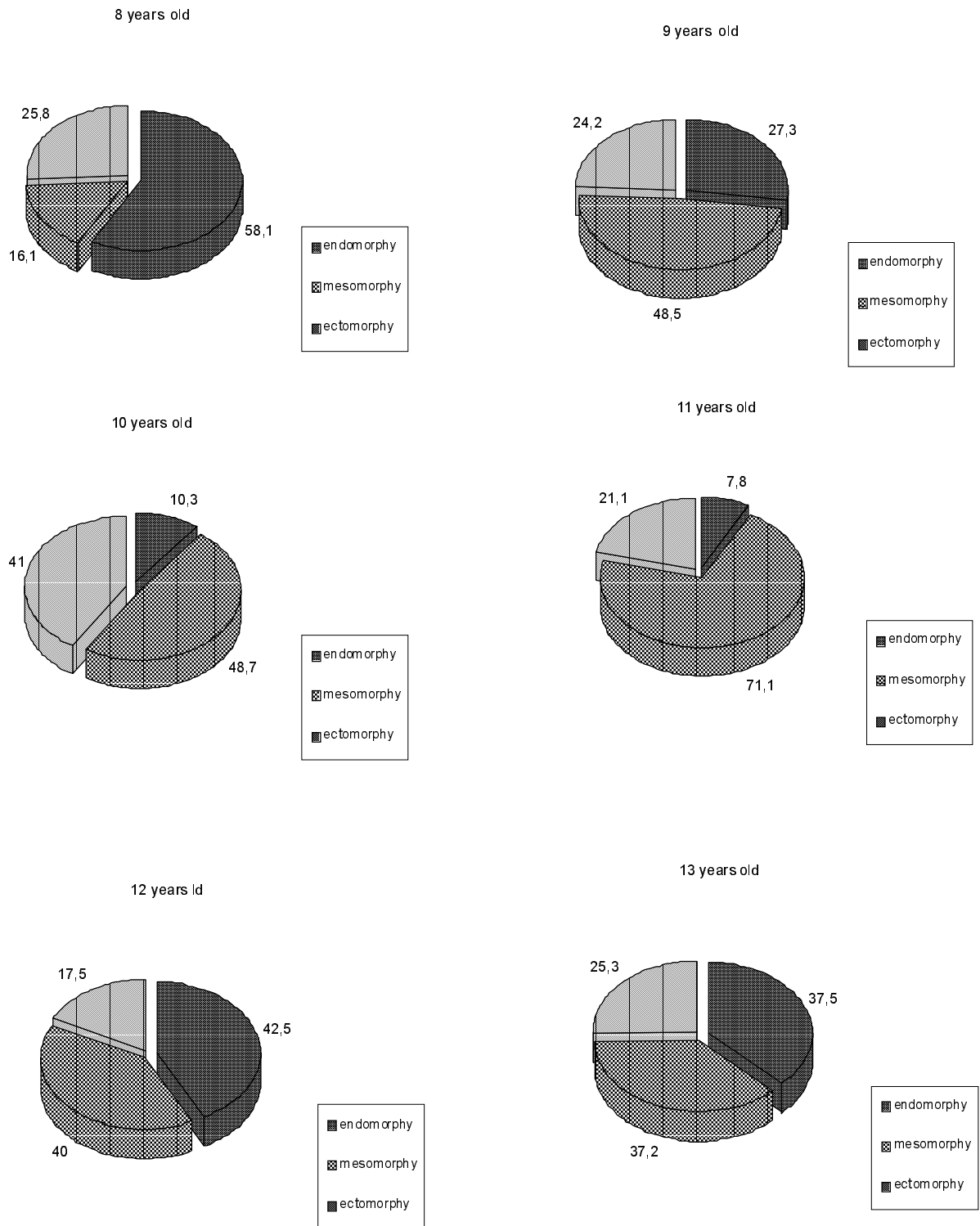


Figure 1. *Distribution of the boys into Somatotype Categories by age groups*

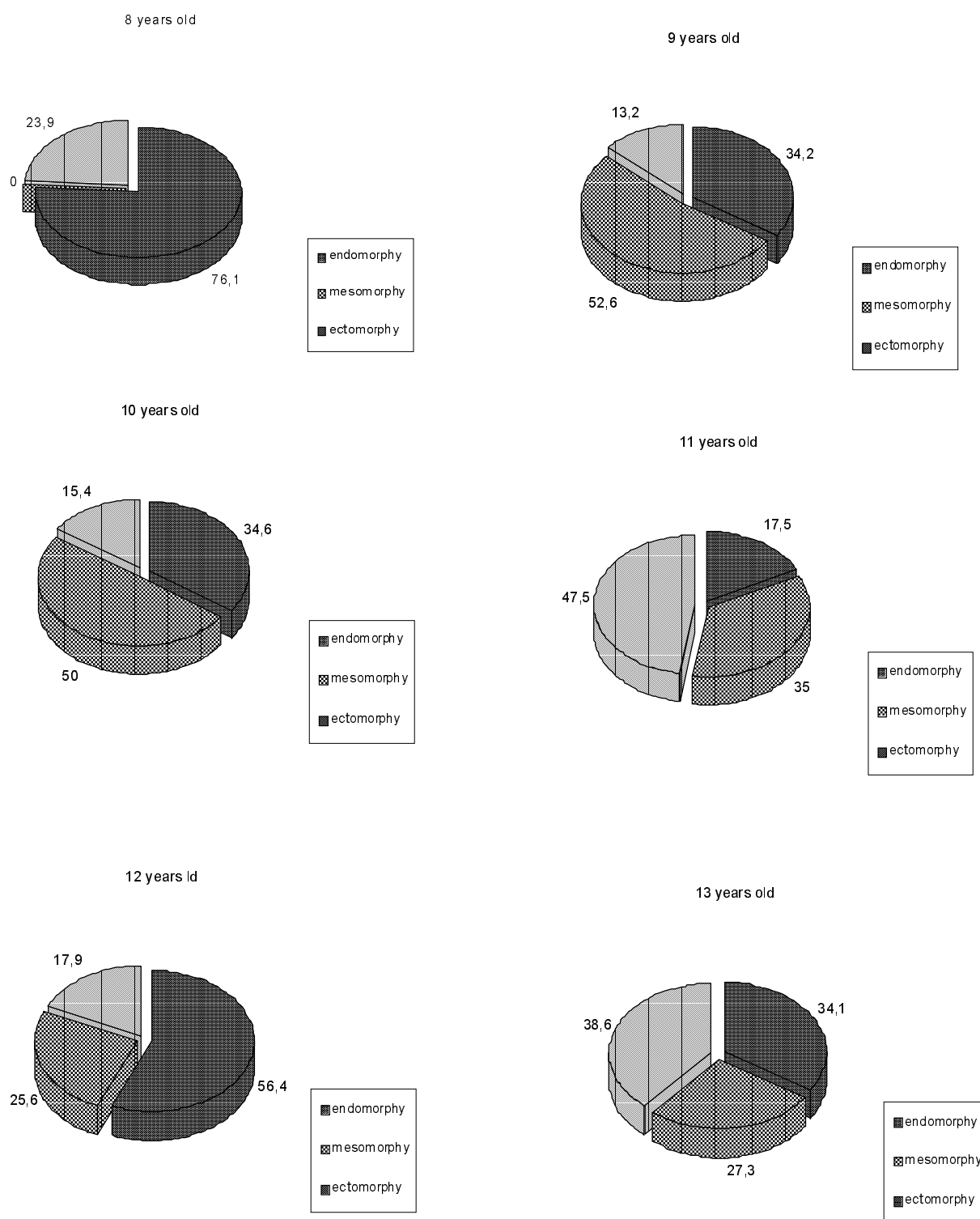


Figure 2. Distribution of the girls into Somatotype Categories by age groups