

Puberty and Body Composition of Plovdiv Boys and Girls

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The aim of the following research is to study the body composition of adolescents – boys and girls from Plovdiv with different rate of sexual and biological maturity. The rate of sexual development among the adolescents is determined by 3-rate on the basis of Me- percentiles among girls and on the basis of the time of appearing of the pubis and axilars hair among boys. The body composition of the studied groups (610 boys and 477 girls, aged 12-17, from Plovdiv), in the following work is given by using 22 body indexes, of which 2 total body indexes, 5 total diameters of the body, 5 circumferences, 6 skinfolds in different parts of the body and limbs and the 4 components of the body mass. The results of this study showed that during the puberty period for both sexes with the best development of the body composition are the children with early puberty, compared with children from other two groups. Body composition during the puberty undergoes essential changes. They are clearly expressed at the age of 14 for both sexes. There is sexual dimorphism in reference to the changes in the body composition during puberty.

Key words: early, normal and late puberty; sexual development; body composition.

Introduction

During the puberty the hormonal changes and the fast growth lead to changes in the body composition. The total body indexes, diameters, girths are changed and of course the components of the body weight – body fats, active body mass, total water and mineral content and others. The body composition during the puberty is connected with the rate of children's biological maturity of different chronological age, too. It is announced that children with higher rate of biological maturity have better development of the components of the body composition compared to those of chronological one as well as a connection between early sexual maturity and different factors as a ь some metabolic and heart diseases, obesity, diabetes, psychococialq as well as a socioeconomical living conditions and other [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14].

In this connection the monitoring of the changes in the body composition among the adolescents with different biological and chronological age during the puberty is exceptionally important not only for pedagogics but for medicine too for the right prevention of these diseases.

With connect to this the **AIM** of the following research is to study the body composition of adolescents – boys and girls from Plovdiv with different rate of sexual and biological maturity.

Material and Methods

The following work is a part of a complex, transversal study of the growth processes among the children and adolescents of Plovdiv. The study is conducted transversely, during the period of 2005-2008 year. The rate of sexual development /biological maturity/ among the adolescents of the two sexes is determined by 3-rate scale – accelerated, normal and retarded development /early, normal and late puberty/ on the basis of Me-percentiles among girls, and on the basis of the time of appearing of the pubis and axilaris hair among boys. The body composition of the studied groups of adolescent, of which 610 boys and 477 girls, age from 12 to 17 years, in the following work is given by using 23 body indexes, of which two total body indexes (height, weight, and the index of the body mass), 5 total diameters of the body (biacromial, bicrystal, bithrohanterial, sagital and transversal chesr diameter), 5 circumferences – one of the body and four of the limbs (chest circumference in pause and circumferences of the limbs), 6 skinfolds in different parts of the body and limbs (under the shoulder blade, above the flank(hips), the abdomen, the armpit, the place in front of the armpit, the thigh and the place below the thigh) and the components of the body mass (absolute and relative quantity body fats, active body mass and absolute quantity of subcutaneous adipose tissue). The anthropometric indexes are given using Martin-Saller's method (1959), and the indexes and derivatives are calculated by using different formulas. The information is processed by the method of descriptive statistics, ANOVA, probit analysis, inter-group differences are estimated by the test for a multiple comparisons of Sheffe.

Results and Discussion

The body composition of the three groups of **girls** (Table 1) – with early, normal and late puberty, shows the following peculiarities: with the highest values of the studied indexes are the girls with early puberty. They have a reliably higher weight, BMI, skin fold under the shoulder blade and components of the body weight, compared to the girls of the other groups. All the indexes for the groups of girls with normal puberty are with values above the average for the relevant age, with the exception of front – back diameter of the chest. It is with unimportantly less value of the other two groups. The girls from this group are with the highest stature, and the inter-group differences are significant only between the normally and late matured. Also the girls with late puberty are characterized with values of the studied indexes below the average. Exception is the relative part of the heaped body fats. The differences between the groups of girls with normal and late puberty are significant in reference to greater part of the studied indexes.

The Table 2 showed that among **the boys** with the best development of the studied indexes is the group of early matured which is with highest values of all the indexes. Reliable differences between the early matured and the boys with normal and late puberty can be seen for all the indexes with the exception of the thickness of the most of the studied skin folds, which is significantly higher for the late matured girls and these with normal and early puberty. The differences in the values of the studied indexes between the girls with normal development and the accelerated ones are great, also the

Table 1. Statistical parameters of body measurements of the girls (Z-score values)

Measurement	Groups			Normal maturity			Late maturity			Significance between groups (p< 0.05)		
	Early maturity			N	Mean	SD	N	Mean	SD	Y/N	N/L	Y/L
Total body size and indices												
Weight (kg)	104	0.41	1.18	188	0.11	0.98	185	- 0.18	0.86	*	*	*
Height (cm)	104	0.13	1.00	188	0.18	0.98	185	- 0.12	1.01		*	
BMI (kg/m ²)	104	0.40	1.23	188	0.05	0.97	185	- 0.15	0.86	*		*
Body diameters												
Biacromial diameter	104	0.20	0.93	188	0.07	0.94	185	- 0.19	0.99			*
Bicrystal diameter	104	0.19	1.05	188	0.02	0.87	185	- 0.47	1.05			
Bitrochanterial diam	104	0.30	1.12	188	0.01	0.92	185	- 0.15	0.93			*
Sagital chest diam.	104	0.11	1.09	188	- 0.05	0.85	185	0.00	1.01			
Transver.chest diam.	104	0.15	1.09	188	0.56	0.89	185	- 0.87	0.99			
Circumferences												
Chest circum.(pause)	104	0.24	1.01	188	0.05	0.97	185	- 0.11	0.99			*
Circumfer.upper arm	104	0.34	1.10	188	0.08	0.99	185	- 0.16	0.89			*
Circumfer. forearm	104	0.27	0.98	188	0.17	1.03	185	- 0.17	0.94		*	*
Circumference thigh	104	0.36	1.16	188	0.13	0.96	185	- 0.18	0.90		*	*
Circumference calf	104	0.34	1.09	188	0.11	0.98	185	- 0.17	0.90		*	*
Skinfolds												
SF subscapular	104	0.25	1.05	188	0.03	0.92	185	- 0.12	0.97			*
SF supraillac	104	0.22	1.03	188	0.05	0.97	185	- 0.15	0.98			*
SF abdomen	104	0.14	0.95	188	0.07	0.95	185	- 0.10	1.02			
SF biceps	104	0.12	1.05	188	0.06	1.05	185	- 0.10	0.88			
SF thigh	104	0.27	1.05	188	0.08	0.91	185	- 0.19	1.00			*
SF calf	104	0.28	1.04	188	0.04	0.97	185	- 0.19	0.96			*
Components of body weight												
Body fat	104	0.296	1.12	188	0.067	0.95	142	- 0.162	0.90			*
% Body fat	104	0.213	1.04	188	0.050	0.91	142	- 0.145	0.99			*
Fat free mass	104	0.399	1.21	188	0.133	0.96	142	- 0.173	0.91		*	*
Subcutaneous fat	104	0.291	1.07	188	0.089	0.98	142	- 0.188	0.91			*

Table 2. Statistical parameters of body measurements of the boys (Z-score values)

Measurement	Groups		Early maturity			Normal maturity			Late maturity			Significance between groups (p-level 0.05)		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	Y/N	N/L	Y/L		
Total body size and indices														
Weight	90	0,74	1,18	366	0,12	0,99	154	-0,42	0,75	*	*	*		
Height	90	0,82	0,84	366	0,08	0,96	154	-0,38	0,93	*	*	*		
BMI	90	0,53	1,23	366	0,12	1,02	154	-0,32	0,80	*	*	*		
Body diameters														
Biacromial diameter	90	0,37	1,15	366	0,05	0,94	154	-0,38	0,85	*	*	*		
Bicristal diameter	90	0,62	1,13	366	0,10	1,03	154	-0,20	0,73	*	*	*		
Bitrochanterial diam.	90	0,62	1,18	366	0,09	1,01	154	-0,21	0,78	*	*	*		
Sagital chest diam.	90	0,52	1,13	366	0,08	1,05	154	-0,21	0,77	*	*	*		
Transver. chest diam.	90	0,56	1,06	366	0,06	1,01	154	-0,22	0,95	*	*	*		
Circumferences														
Chest circum.(pause)	90	0,54	1,15	366	0,05	1,02	154	-0,40	0,77	*	*	*		
Circumfer. upper arm	90	0,63	1,13	366	0,14	0,97	154	-0,34	0,82	*	*	*		
Circumfer. forearm	90	0,65	1,07	366	0,14	0,99	154	-0,44	0,78	*	*	*		
Circumference thigh	90	0,63	1,14	366	0,09	0,95	154	-0,31	0,82	*	*	*		
Circumference calf	90	0,69	1,14	366	0,10	0,96	154	-0,36	0,85	*	*	*		
Skinfolds														
SF subscapularis	90	0,36	1,18	366	0,08	1,01	154	-0,33	0,69	*	*	*		
SF suprailiaca	90	0,33	1,08	366	0,07	1,02	154	-0,27	0,81		*	*		
SF abdomen	90	0,33	1,08	366	0,08	1,00	154	-0,28	0,84		*	*		
SF biceps	90	0,21	1,07	366	0,07	1,03	154	-0,22	0,79		*	*		
SF thigh	90	0,28	0,96	366	0,04	1,01	154	-0,15	0,92			*		
SF calf	90	0,31	1,09	366	0,03	0,98	154	-0,14	0,94			*		
Components of body mass														
Body fat	90	0,455	1,23	366	0,07	0,99	154	-0,34	0,69	*	*	*		
% Body fat	90	0,312	1,07	366	0,06	1,00	154	-0,26	0,85		*	*		
Fat free mass	90	0,702	1,00	366	0,08	0,96	154	-0,49	0,81	*	*	*		
Subcutaneous fat	90	0,428	1,16	366	0,06	1,00	154	-0,29	0,78	*	*	*		

differences in the values of height, weight, BMI, diameters of the body, girths of the limbs and the relative part of the body fat are the greatest. With values of the body sizes below the average for the relevant age are the boys with late puberty. They are with reliably lowest, slightest and the smallest biacromial diameter and relative part of the body fats. The smallest inter-group differences among the boys can be seen in the values of the thickness of the skinfolds.

The adolescents from different age groups are characterized with specific features in their body composition. During the 12th and 13th year of their growth and development, the girls with early puberty are with higher values of the indexes of the body composition, compared to those with normal and late puberty. They are show the best development of the total body sizes, chest and limbs measurement and active body mass, the chest circumferences and circumferences of the limbs during the 12th year, as well as subscapular skinfold during the 13th year. The differences in the values of the indexes between the groups of 12-year-old girls are statistically insignificant, but significant differences are show between early and late maturity 13-year-old girls. Values below the average can be seen among 12-year-old girls matured in normal terms and among 13-year-old girls, matured in late terms.

The 14th year for girls is characterized with transformation in the body composition for the three groups due to a sudden change in the direction and values of the studied indexes. Early matured girls who up to their 13th year have the highest values of all the studied indexes slow down the growth of more features and the values reach a level below the average for the age. At this age increase the growth of the girls matured in normal terms and practically they have the highest values of these indexes, compared to the other two groups. In group of girls, matured in late terms increase the growth of shoulders and chest circumference. Significant inter-group differences among the 14 years old girls are not seen ($p>0.05$).

Between the 14th and 15th year the transformation of the body composition continues and the 15-year-old girls with early puberty are again with the highest values of the studied indexes. But they seriously decrease the growing in height and practically their height at this age is lower than the height of the late matured ones ($p<0.05$). At this age can be seen acceleration in height growth for late matured girls and the values of the index reach a level above the average. For the 15-year-old girls significant inter-group differences in the values of the other indexes of the body composition are seen mainly between early and late matured girls.

During the period of maturity the early matured boys are reliably heavier, higher, with bigger quantity of subcutaneous adipose tissue in the abdomen and back as well as with greater absolute quantity body fats and active body mass than the ones who matured late. At this age periods the boys with late puberty have values of all the indexes below the average with the exception of the diameter of the chest during the 12th year, some skinfolds and percent fat tissue during the 14th year.

At the age of 13 the biggest and statistically significant are the intra-group differences in the values of height, weight, active body mass and chest circumferences in pause between the boys with accelerated and retarded development. During the 14th year are show change in the body composition of normal maturity boys. The growth of the shoulder width, the transverse diameter of the chest and the chest measurement in pause, the active body mass and the absolute quantity of the body fats is retarded for the boys with normal puberty and the values of these indexes decrease below the average for this age. At this age there are significant differences between the boys who matured early and normally, as well as between them and late matured in reference to height, shoulder width and active body mass ($p<0.05$). During 15th year statistically significant for all the studied indexes with exception of the skin folds in the place of abdomen and lower limb are the differences between them and the boys with late puberty.

As a result of the study of the connection between the puberty development and the changes of the body composition at this period we can do the following **CONCLUSION**:

- As a whole during the puberty period for both sexes with the best development of the body composition are the children with early puberty. Boys and girls matured in normal terms are with values of the studied indexes above the average for their age and those who matured late with values below the average. There is an exception for the 14 years old children. There are significant inter-group differences in values of the studied indexes between children at the same age.

- During the puberty the body composition undergoes essential changes. They are clearly expressed at the age of 14 for both sexes when the children with early puberty retard in their growth at the expense of normally and later matured boys and girls.

- There is sexual dimorphism in reference to the changes in the body composition during puberty. The boys react to the hormonal and other influences with bigger fluctuation in the growth speed that lead to statistically significant differences in the values of most of the studied body sizes and once again verifies the greater ecosensibility of the males.

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