

## BASIC BODY DIAMETERS IN 3-6 YEARS OLD CHILDREN (Preliminary data)

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**ABSTRACT.** The aim of the present work is to characterize the widthwise body diameters in children during the period 3–6 years of age on the base of data about six basic anthropometrical diameters. The data analyzed are for 6 basic body diameters as follows: biacromial, transversal and sagital chest diameters; bicristal, bispinal and bitrochanterial diameters in 440 children (210 boys and 130 girls) aged 3, 4, 5 and 6 years from kindergartens in Sofia town. During the period 3-6 years, the boys have bigger values for all investigated features with exception of bitrochanterial diameter, which in the 4 and 6 years old girls is bigger. The summarized increment of the diameters during the entire period is nearly equal in both sexes, slightly greater in girls. The growth velocity of the features is biggest during the age periods 3-4 and 5-6 years. Throughout the 4-th and 5-th year the growth velocity decreases with different degree for the separate diameters in both sexes, but more tangibly in girls. At 6 years of age the differences in body constitution in both sexes, evaluated by the studied features, are considerably smaller than they are in the 3 years old children due to the more intensive growth velocity and the bigger increase of body diameters in girls.

**KEY WORDS.** children, anthropometrical body diameters, sexual differences, year's increment, growth velocity.

### INTRODUCTION

The investigations of physical development in children and adolescents are very important for the pediatrician and pedagogical practice. They ensure data for the assessment of growing up dynamics in the child's organism and are a base for the determination of deviations occurring in by different diseases or unfavorable conditions of life. The growing up and developmental processes in children and adolescents could be traced and evaluated studying the changes in the measurements of human body with ages during childhood and youth [3, 5]. The investigation of basic anthropometrical features could give possibility for the morphological and

functional peculiarities of child's organism and the influence of the environmental factors to be characterized [1, 2, 6].

The aim of the present work is to characterize the widthwise body diameters in children during the period 3–6 years of age on the base of data about six basic anthropometrical diameters.

## MATERIAL AND METHODS

Object of the anthropological investigation were 440 children (210 boys and 230 girls) at the age 3, 4, 5, and 6 years from kindergartens in Sofia town (June 2004 – March 2005). The data analyzed are for the following six fundamental body diameters: biacromial; transversal and sagittal chest diameters; bicristal, bispinal and bitrochanterial diameters. The study is made by the classical methods of Martin-Saller [4].

Since the investigation is not finished, the data presented are preliminary.

The intersexual differences are quantitatively evaluated by the relative Index of Sexual Differences (ISD) and given in Index Units (IU).

$$ISD = [2 \times (\bar{x} \text{ males} - \bar{x} \text{ females})] \times 100 / (\bar{x} \text{ males} + \bar{x} \text{ females})$$

The ISD values above zero IU show priority for boys, and under zero IU – for girls.

The absolute year's increment and the growth velocity of each feature were calculated, as well. For the evaluation of growth velocity is used the following formula:

$$(\bar{x} 2 - \bar{x} 1) \times 100 / \bar{x} 2 + \bar{x} 1$$

The data are statistically computed and the established differences are assessed by the t-test of student at  $p < 0,05$ .

## RESULTS

### Metrical characterization and year's increment

#### *Biacromial diameter (Tables 1, 2, 3; Fig. 1)*

The biacromial diameter characterizes the shoulders breadth. During the period from 3 till 6 years of age it has nearly equal values in both sexes, being a little bit larger in boys. Statistically significant are only the sexual differences in the 3 years old children. The year's increment of the feature is comparatively uniform being nearly equal for both sexes. Between the 4-th and 5-th year, a reduction of the increment is available, more clearly expressed in girls. The year's increment in boys is biggest during the period 5-6 years, and in girls – during 3-4 years. For the entire period under investigation the total increment in boys is 4,2 cm and in girls – 4,4 cm.

#### *Chest diameters:*

#### *Transversal chest diameter (Tables 1, 2, 3; Fig. 2)*

The metrical characterization of transversal chest diameter defines the widthwise development of chest. The absolute measurements of this feature are bigger in the boys from 3 till 6 years of age, as only in the 6 years old children, the sexual differences are not statistically significant. The year's increment of transversal chest diameter is uniform in boys, while in girls from 4 till 5 years of age is observed a

reduction of the increment, which is compensated from the considerably big increase during the period 5-6 years. In the period 3-6 years the transversal chest diameter grows up in boys with 2,0 cm and in girls – with 2,4 cm.

*Sagital diameter (Tables 1, 2, 3; Fig. 3)*

For this diameter, characterizing the chest development in frontal-posterior direction, the boys have reliably larger values than girls at 3, 4 and 6 years of age. The year's increment in girls is bigger till 5 years of age, being responsible for the decrease of sexual differences in the sagital diameter at this age. Between 5 and 6 years, the year's increment reduces in girls but in boys it raises, and the differences in both sexes at 6 years of age increase once again. The total increment of sagital diameter in the period 3-6 years of age is the same in both sexes – 1,3 cm.

During the period 3-6 years, the chest of boys and girls increases more intensively in the widthwise direction than in the frontal-posterior one.

***Pelvis diameters:***

***Bicristal and bispinal diameters (Tables 1, 2, 3; Fig. 4, 5)***

Both diameters have higher values in boys than in girls, but statistical significant are the intersexual differences only for the bispinal diameter in the 3, 4 and 5 years old children. The year's increment is equal in both sexes between 3 and 4 years, after which till the 6-th year the increment in boys gradually falls. Slightly reduce of the year's increment in girls is observed in the age period 4-5 years, but between 5 and 6 years of age it again increases being higher from those in boys. As a result the 6 years old girls and boys have almost equal values for both pelvis diameters. In boys the bicristal and bispinal diameters during 3-6 years of age show an increment with 2,6/2,2 cm, and in girls – with 2,9/2,4 cm.

*Bitrochanterial diameter (Tables 1, 2, 3; Fig. 6)*

For all the investigated age groups, the boys and girls have very close values of bitrochanterial diameter. In 3 years old children the diameter is bigger in boys but at 4, 5 and 6 years its values are bigger in girls. The sexual differences are not statistically significant at any studied age. The year's increment reduces bit by bit in girls with the age, but its values are higher from those in boys till 5 years of age. At the age of 6, the year's increment in boys is bigger and the intersexual differences decrease, but the diameter's values remain higher in girls, even if not considerably. The common increase of bitrochanterial diameter for the entire period under study is 2,9 cm in boys and 3,3 cm in girls.

**Growth velocity (Table 4; Fig. 7, 8, 9, 10, 11, 12)**

The growth velocity of biacromial breadth remains relatively big during the entire investigated period but the intensity being mostly well expressed during 3-4 years of age in both sexes. In the age period 3-5 years, the biacromial diameter grows more intensively in girls. As a result, the differences of feature's values decrease at the age of 4 and remain the same till the 6-year, when the growth velocity is the same in both sexes.

The growth velocity of transversal chest diameter in boys is relatively equal during 3 and 6 years of age. In girls, the widthwise increment of chest is more intensive in the

periods 3-4 and 5-6 years, and spite of the fall in the growth velocity between 4 and 5 years of age, at 6 the differences in the sizes of transversal chest diameter for both sexes reduce.

The growth velocity of sagital diameter in both sexes reduces till 5 years of age more emphasized in girls. During the age period 5-6 years the growing up intensity in girls continually falls, while in boys it hastens. This result shows probably that after 5 years of age, the formation of a deeper chest thates typical for males' body constitution begins.

In girls the growth velocity of bicristal and bispinal diameters reliably increases during the period 5-6 years, which is most likely connected with the beginning in the formation of pelvis structure, characteristic for the adult women. In boys the growth velocity of these two features decreases with the age, and as a result of this fact at 6 years of age the children from both sexes have nearly equal values of bicristal and bispinal diameters.

Differences between both sexes are observed for bitrochanterial diameter whose growth velocity in boys remains relatively equal during the entire studied period. In girls the bitrochanterial diameter increases most intensively between the 3-th and 4-th year. During the period 3-5 years the growth velocity decreases in both sexes, its values being higher in girls. The growthing up velocity between 5 and 6 years of age reduces continuously in girls, while in boys it increases.

In both sexes the body diameters grow up most intensively during the periods 3-4 and 5-6 years of age. Between the 4-th and 5-th year, the growth velocity decreases in different degree for each diameter in both sexes, more tangible in girls. Nevertheless, during the 3 years period under investigation, as a whole the growth velocity of body diameters in girls is more hastened compared to boys. The bigger increase of the features' values in females is due to this fact. In consequence at 6 years of age the differences between body constitutions of both sexes are reliably smaller than those in the 3 years old children.

### **Sexual differences (Table 5; Fig. 13, 14)**

The ISD data analyses shows that more clearly expressed are the sexual differences for chest diameters – transversal and sagital. At the separate ages the ISD values are between 1,52 IU and 4,88 IU in favor of boys. For both diameters the differences are biggest in the 3 years old children. The sexual differences for transversal chest diameter are smallest in the 6 years old children, and for sagital one – in the 5 years old ones. The differences of bicristal and bispinal diameters follow by intensity – between 0,52 IU and 3,70 IU (for the bicristal diameter at 6 years of age, for the bispinal one at 5 years of age). In inter age aspect, the ISD values for both diameters are with priority in boys at 3, 4 and 5 years of age (between 2 and 3 IU), at 6 years of age the intersexual differences are smallest, displaying the relative equalization of pelvis sizes between both sexes.

The intersexual differences of biacromial diameter are more slightly expressed – between 1,50 IU at 6 years of age and 2,69 IU at 3 years of age. Of a special interest are the intersexual differences of bitrochanterial diameter, which in spite of having

less ISD values, illustrate the tendencies in the structure differentiation on those area. At 3 years of age the ISD data show that the pelvis diameter is with 1,66 IU bigger in boys (1,66 IU). After this age, however, this sexual differences are in girls' favor indicating the beginning in the formation of a bigger pelvis breadth, characteristic for the adult women.

### CONCLUSIONS

During the 3-6 years period, the boys have greater values for all investigated features with the exception of bitrochanterial diameter, which is larger in girls between 4 and 6 years of age.

The growth velocity of the studied features is biggest in the periods 3-4 and 5-6 years. Between the 4-th and 5-th year, the growth velocity decreases in different degree for each diameter in both sexes, better expressed in girls.

The common diameters' increase during the entire investigated period is nearly equal in both sexes, slightly bigger in girls.

The differences of body constitution, determined by the investigated features, are considerably less in both sexes at 6 years of age than they are at the 3 years old ones, due to the more intensive growth of body diameters in the female children.

### REFERENCE

1. БОБЕВ, ДР., Е. ГЕНЕВ. 2000. Педиатрия, София.
2. КОНДОВА, Н., ЗЛ. ФИЛЧЕВА. 1999. Възрастови промени в кефалометричната и кефалоскопична характеристика на софийски деца в периода 7-11 години, *Journal of anthropology*, vol.2, София, 117-124.
3. KAZAKOVA, Ts., L. YORDANOVA, E. LAZAROVA. 1999. Basic anthropometrical data – sex and age differences in children aged 7-10 years, *Journal of anthropology*, vol.2, Sofia, 107-116.
4. MARTIN, R., K. SALLER. 1957. *Lehrbuch der Anthropologie in systematischer Darstellung*, Bd. I. Stuttgart, Gustav Fischer Verlag.
5. NACHEVA, A., E. LAZAROVA, L. YORDANOVA. 2000. Physical development and secular trend in 7-13 old schoolchildren from Sofia-town, *Journal of Anthropology*, vol.3, Sofia, 17-30.
6. YANKOVA, I. 2004. Basic body proportions and indexes in newborns from Sofia at the beginning of the 21st century, *Acta morphologica et anthropologica*, 9, Sofia, 128-134.

Fig. 1 Biacromial diameter

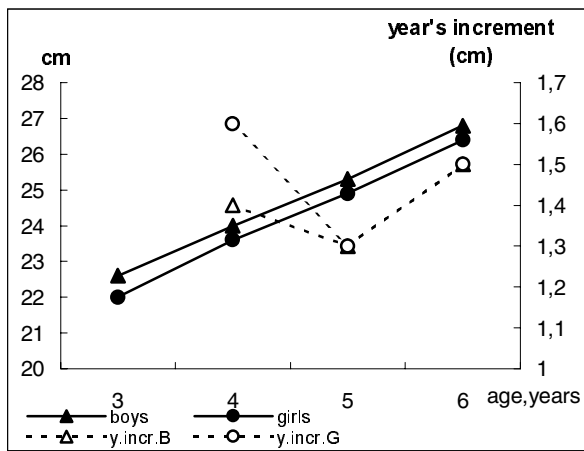


Fig. 2 Transversal chest diameter

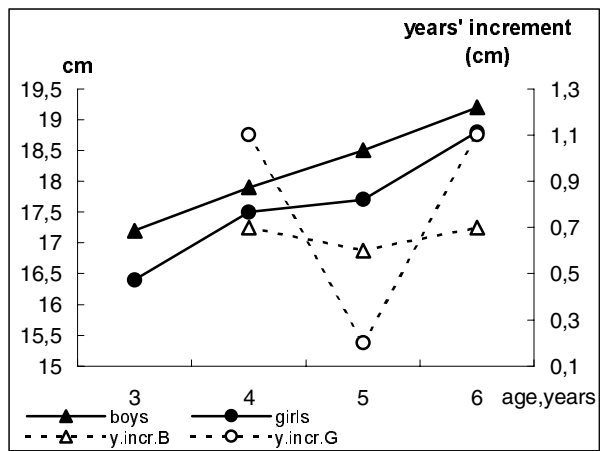


Fig. 3 Sagittal chest diameter

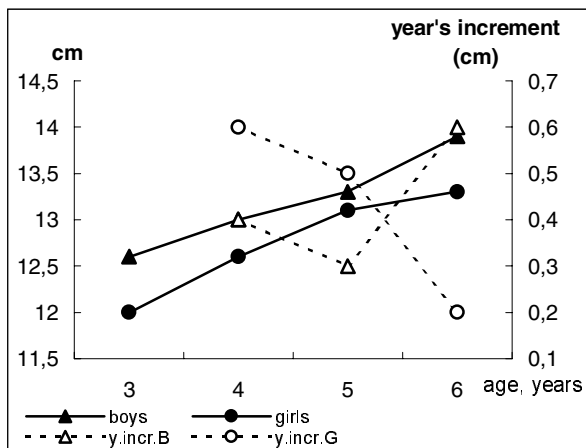


Fig. 4 Bicristal diameter

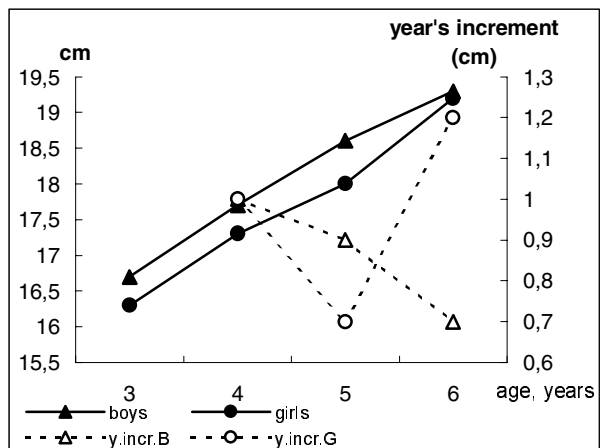


Fig. 5 Bispinal diameter

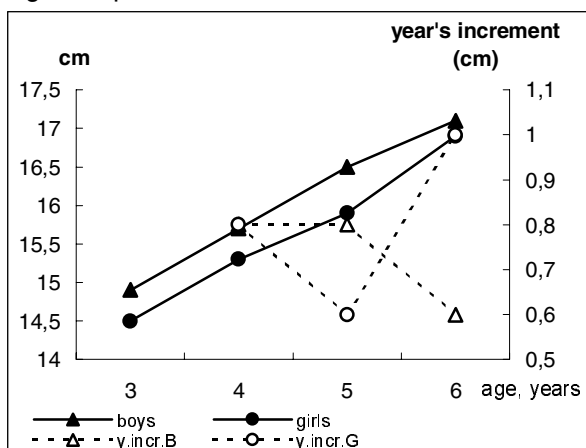


Fig. 6 Bitrohanterial diameter

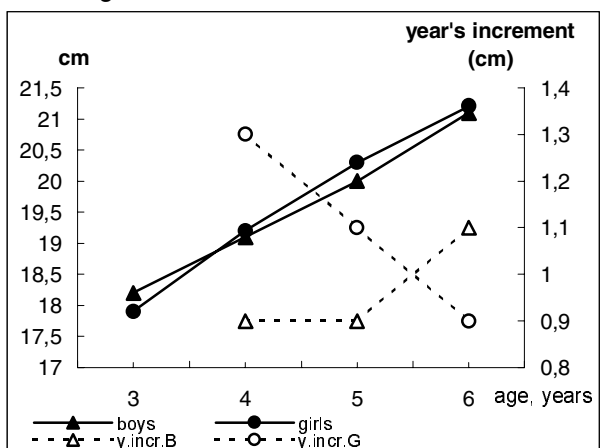


Fig.7 Growth velocity

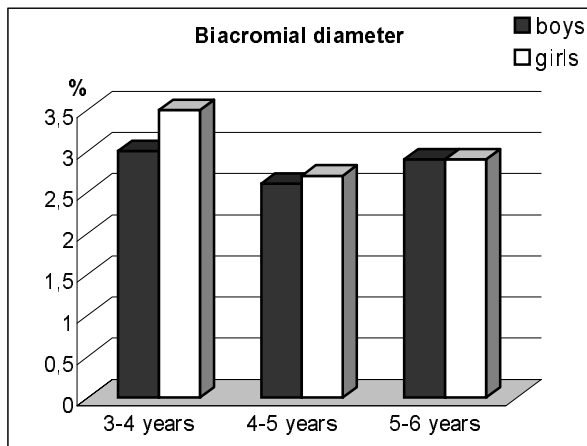


Fig. 8 Growth velocity

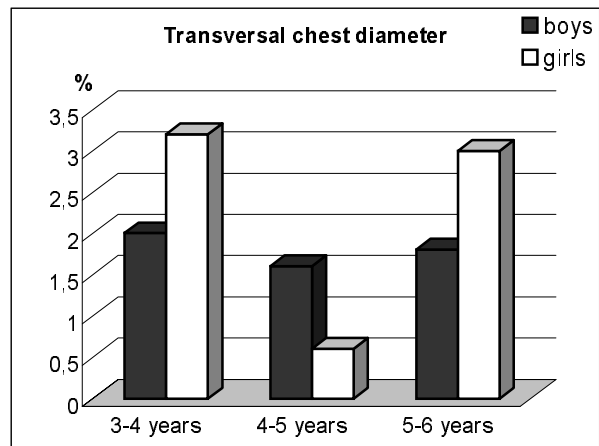


Fig. 9 Growth velocity

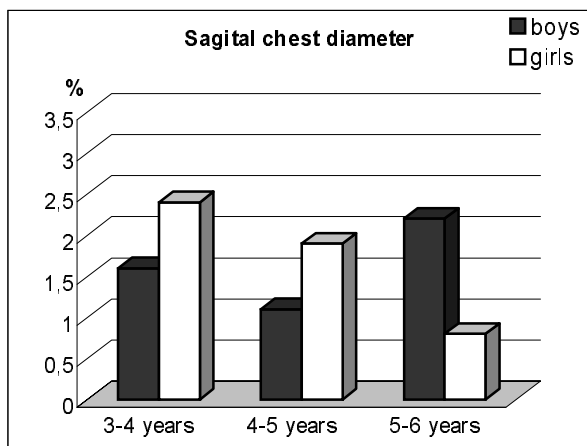


Fig. 10 Growth velocity

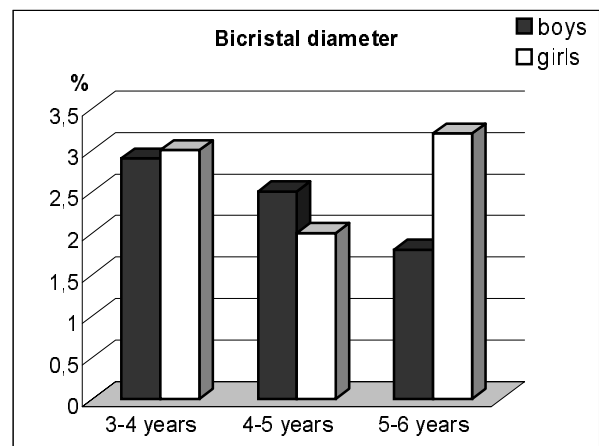


Fig. 11 Growth velocity

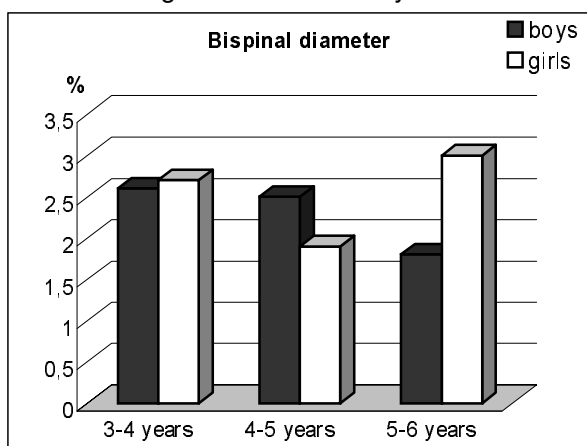


Fig. 12 Growth velocity

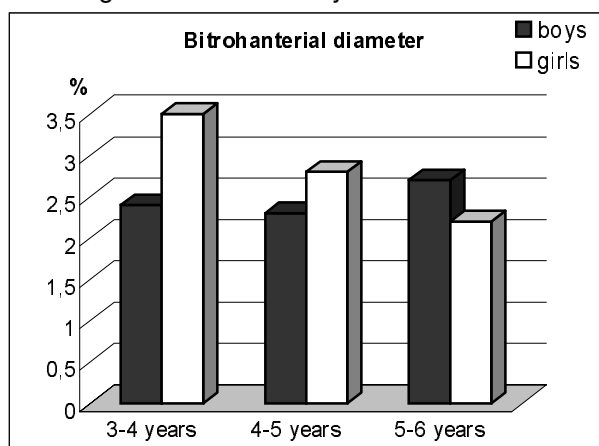


Fig.13 ISD-data - biacromial, transversal, sagittal diameters

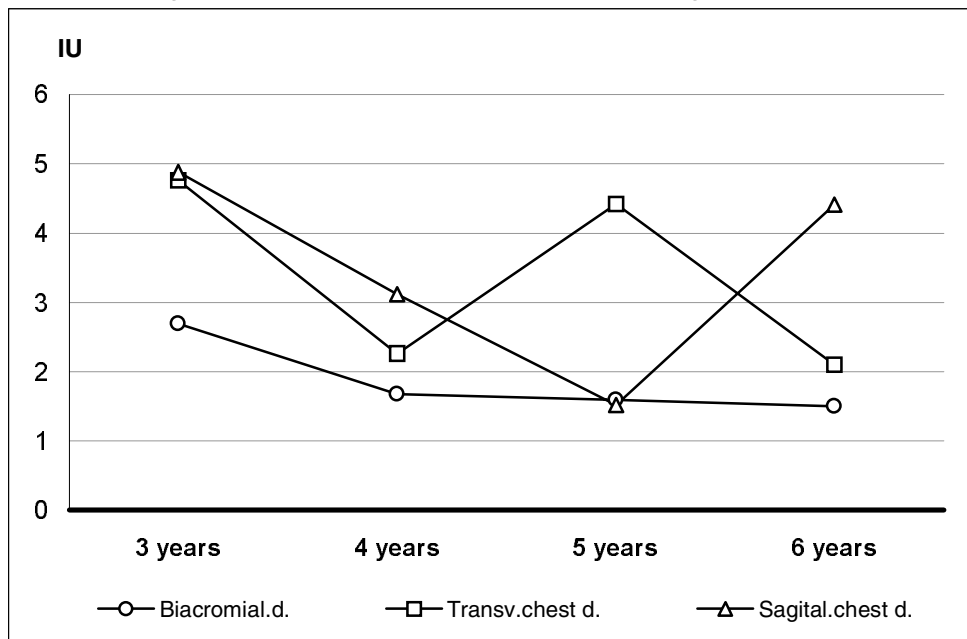
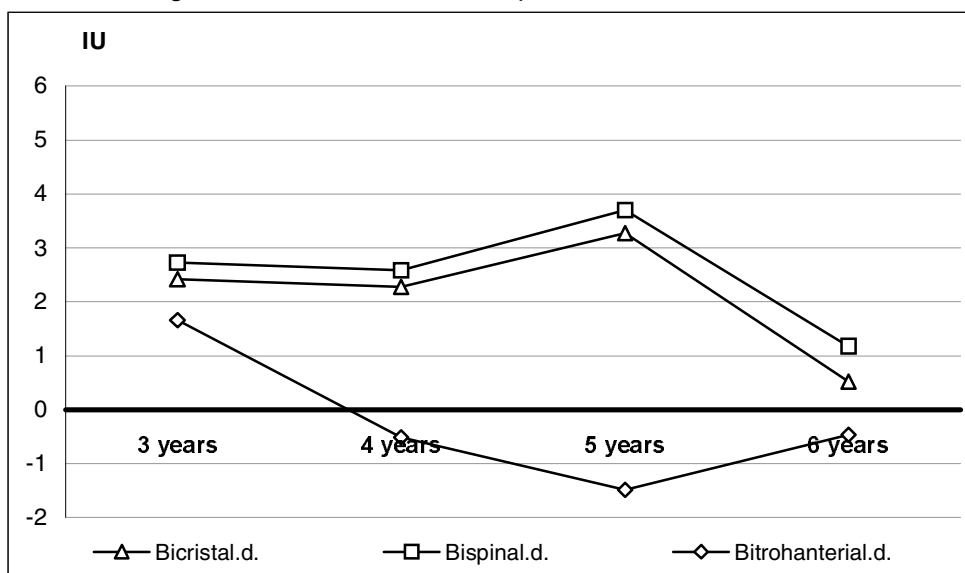


Fig. 14 ISD-data - bicristal, bispinal, bitrohanterial diameters





**Table 1.** Statistical data about the investigated diameters – boys

Age, years	BOYS												
	n	Biacromial diameter		Transversal chest diameter		Sagital chest diameter		Bicristal diameter		Bispinal diameter		Bitrochanterial diameter	
		x	SD	x	SD	x	SD	x	SD	x	SD	x	SD
3	44	22,6*	1,4	17,2*	0,9	12,6*	0,7	16,7	1,0	14,9*	1,0	18,2	1,2
4	62	24,0	1,3	17,9*	1,4	13,0*	1,0	17,7	1,6	15,7*	1,3	19,1	1,6
5	59	25,3	1,5	18,5*	1,5	13,3	1,0	18,6	1,9	16,5*	1,4	20,0	1,8
6	45	26,8	1,4	19,2	1,1	13,9*	1,0	19,3	1,4	17,1	1,2	21,1	1,5

Statistically significant sexual differences  $p \leq 0,05$ **Table 2.** Statistical data about the investigated diameters – girls

Age, years	GIRLS												
	n	Biacromial diameter		Transversal chest diameter		Sagital chest diameter		Bicristal diameter		Bispinal diameter		Bitrochanterial diameter	
		x	SD	x	SD	x	SD	x	SD	x	SD	x	SD
3	48	22,0*	1,0	16,4*	0,8	12,0*	0,7	16,3	1,0	14,5*	0,7	17,9	1,0
4	69	23,6	1,4	17,5*	1,1	12,6*	0,8	17,3	1,3	15,3*	0,9	19,2	1,6
5	70	24,9	1,2	17,7*	1,0	13,1	1,2	18,0	1,2	15,9*	1,0	20,3	1,5
6	43	26,4	1,3	18,8	1,5	13,3*	1,2	19,2	1,8	16,9	1,4	21,2	1,6

Statistically significant sexual differences  $p \leq 0,05$ **Table 3.** Year's increment (cm)

Age	Biacromial diameter		Transversal chest diameter		Sagital chest diameter		Bicristal diameter		Bispinal diameter		Bitrochanterial diameter	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
3	-	-	-	-	-	-	-	-	-	-	-	-
4	1,4	1,6	0,7	1,1	0,4	0,6	1,0	1,0	0,8	0,8	0,9	1,3
5	1,3	1,3	0,6	0,2	0,3	0,5	0,9	0,7	0,8	0,6	0,9	1,1
6	1,5	1,5	0,7	1,1	0,6	0,2	0,7	1,2	0,6	1,0	1,1	0,9

**Table 4.** Growth velocity (%)

Age	Biacromial diameter		Transversal chest diameter		Sagital chest diameter		Bicristal diameter		Bispinal diameter		Bitrochanterial diameter	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
3	-	-	-	-	-	-	-	-	-	-	-	-
4	3,0	3,5	2,0	3,2	1,6	2,4	2,9	3,0	2,6	2,7	2,4	3,5
5	2,6	2,7	1,6	0,6	1,1	1,9	2,5	2,0	2,5	1,9	2,3	2,8
6	2,9	2,9	1,8	3,0	2,2	0,8	1,8	3,2	1,8	3,0	2,7	2,2

**Table 5.** Sexual differences according to the ISD data

Age	Biacromial diameter	Transversal chest diameter	Sagital chest diameter	Bicristal diameter	Bispinal diameter	Bitrochanterial diameter
3	2,69	4,76	4,88	2,42	2,72	1,66
4	1,68	2,26	3,12	2,28	2,58	-0,52
5	1,59	4,42	1,52	3,28	3,70	-1,49
6	1,50	2,10	4,41	0,52	1,18	-0,47