

Physical Development of Adolescents from the City of Sofia and Town of Smolyan in 1980s

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The physical development of Sofia and Smolyan boys and girls aged 9 to 17 in the mid 1980s has been studied and the development differences of the adolescents from the capital and the smaller town have been traced.

Key words: adolescent period, physical development, social differences, socialistic period, Bulgaria

Introduction

From the beginning of the 20th century until now the physical development and growth of the adolescents (boys and girls in and around the puberty) has been a subject of many studies in Bulgaria, analysing either general or more particular aspects [1, 5]. Most of the researches are on the adolescents in the city of Sofia. However, they lack data for the period after 1980. Data about the physical growth of the adolescents in Smolyan have not been registered.

The aim of the present paper is to examine some basic measurements and indices of the physical development of the adolescents in Sofia and Smolyan in the mid 1980s. It is an attempt to trace the differences in physical growth of the adolescents from the most urbanized social environment in Bulgaria and those from a medium town, which in many socio-demographic parameters is closer to the small towns and villages [4] in the end of the specific "socialistic" period.

Material and Methods

In 1984-1987 in course of transversal investigations of the sexual maturation in Sofia and Smolyan, data for the physical development of 447 boys and 465 girls from Sofia and 169 boys and 192 girls from Smolyan, aged 9 to 17 in their last birthday have been collected. The data include the following absolute measures of physical development: height, weight, length of the lower limb, sitting height, biacromial diameter, transversal and sagittal chest diameters, circumferences of the chest, the hip and the

upper arm, sums of four skinfolds on the upper arm (on the triceps, on the biceps and two lateral) and the thigh (on the front, on the back side and two lateral). Based on these measurements the following indices have been calculated: body mass index, relative (compared to the height) lower limb length, sitting height, biacromial, chest and pelvic diameters and chest, hip and upper arm circumferences. The muscle circumference of the upper arm has been calculated too, by the formula:

$$C_{\text{mua}} = C_{\text{ua}} - (3.14 / 4) \times S_{\text{fua}},$$

C_{ua} is upper arm circumference; C_{mua} — muscle upper arm circumference;

S_{fua} — sum of four upper arm skinfolds.

In the analysis of the collected material the adolescents aged 17 have been excluded because they are not enough in number. The numbers of the boys aged 9 to 11 and the girls aged 9 and 10 in Smolyan are also small. For that reason they have been united in two joint samples of average ages of 10.5 and 10 years respectively. Despite that the number of the boys and girls in these ages in Sofia is sufficient, they have been united in two joint samples too for the sake of comparability between the development of the adolescents from the both localities. Thus data of 438 boys and 462 girls from Sofia and 168 boys and 188 girls from Smolyan have been included in the analysis. Because the specificity of the investigation, for particular traits and age groups the number is something less.

Results

The results of the study are collected in a short form in Table 1. They show that the adolescents in Smolyan are less tall than these ones in Sofia. This phenomenon can be related to their retarded sexual maturation by 0.6-0.7 years against the sexual maturation in Sofia [2]. In fact there is a comparison of individuals in different biological age. The analysis of the physical development in connection with the sexual maturation stage can be a subject of an other study. However, the differences in the height imposed to draw more attention at the comparison of the relative indicators of physical development (the proportions) between the adolescents from Sofia and Smolyan.

The adolescents from Smolyan show higher body mass index in all ages. This robustness can be due to more developed subcutaneous fat tissue or to more developed osteo-muscle system. The sums of the skinfolds on the upper arm and the thigh speak about more developed subcutaneous fat in Smolyan girls than in Sofia ones. Contrariwise, in Smolyan boys in all ages the skinfold sums are lower than in Sofia boys. However, in them higher relative muscle upper arm circumferences can be observed in all ages. This is an indication of the realisation of the second possibility - more developed osteo-muscle system. Since the body mass index, the development of the subcutaneous fat tissue and the osteo-muscle system have been discussed in a paper dedicated to the constitution of the adolescents in Sofia and Smolyan [3], we should draw more attention at the other parameters of physical development.

Smolyan girls are absolutely and relatively more short-legged and with higher sitting height than Sofia ones whereas Smolyan boys are more long-legged than Sofia ones (especially until 14). The biacromial, the transversal chest, the bicristal and especially the bitrochanterial diameters in Smolyan girls are higher. In the boys this can be observed until the age of 14 but at 15 this tendency reverses.

The sagittal chest diameter in Smolyan boys is also higher until the age of 14, than in Sofia boys. Contrariwise, more flat chests are characteristic in Smolyan girls of all ages. Their chest circumference is lower whereas in Smolyan boys it is higher

(until 16 years, when it equalizes). Contrariwise, the lower hip and upper arm circumferences in Smolyan girls until 16 at 16 hunt down and overpass these in Sofia ones. In the upper arm circumference this phenomenon is clearly due to the development of the subcutaneous fat tissue, because the relative upper arm muscle circumference remains lower. Once more at 16 in Smolyan girls the weight and the body mass index sharply increase (therefore the differences between them and Sofia ones). At last it has to be noted that at 15-16 the supremacy of Smolyan boys over Sofia ones in the absolute and the relative muscle upper arm circumferences decreases.

The short review of the separate parameters of physical growth show that the city-town differences concern different traits in the boys than in the girls. There is also some decrease of the city-town differences in the boys in the end of puberty (aged 15-16), where in the girls the differences rise. This decrease (respectively rise) of the differences concerns especially the traits in which the adolescents of the two localities differ strongly as early as the beginning of the age period under study, the traits which are connected with the mesomorphism in the boys and the endomorphism in the girls. A possible reason can be a more active participation in sports in Sofia adolescents than the Smolyan in this period.

Conclusion

The results of the study show significant differences in the physical development of the adolescents from the capital city and the town of Smolyan in the mid 1980s. They can be due to the different social environment, which impacts the physical development through the way of nutrition, the participation in the household and farm work and in sports etc. The decrease of the differences in the end of the adolescence in the boys and contrariwise, their increase in the girls, support the necessity the traits of the physical growth and development to be compared not only according to the chronological but also according to the biological age (the stage of the sexual maturation). Filling the shortage of data on the adolescent growth and development in Bulgaria in 1980s the results can be used for comparison with new investigations in the present social conditions.

Table 1. Basic measures and indices of physical development in adolescents in Sofia and Smolyan (mean values, standard deviations and significance of differences)

Age years	Sex	Number		Height, cm		Weight, kg		BMI, kg/m ² .m.	
		<i>boys</i>	<i>Sofia</i>	<i>Smolyan</i>	<i>Sofia</i>	<i>Smolyan</i>	<i>Sofia</i>	<i>Smolyan</i>	<i>Sofia</i>
9-11		155-172	23	145.3	143.1	37.8	38.7	17.8	*18.9
				8.0	8.2	8.4	7.0	2.8	1.9
12		65-72	46	154.8	*151.3	45.2	47.9	18.8	**20.6
				8.5	7.0	9.7	12.1	3.2	3.5
13		69	33-34	161.9	*158.0	50.5	50.2	19.1	19.9
				7.0	8.9	9.4	11.3	2.6	3.0
14		60	26	169.2	165.8	58.8	60.1	20.5	21.7
				7.7	9.4	10.0	15.3	2.7	4.6
15		36	23	172.2	*168.6	63.5	62.1	21.4	21.7
				6.5	6.5	9.6	13.1	3.2	3.6
16		29	15-16	172.8	171.7	66.6	*72.4	22.3	22.4
				6.8	5.1	8.8	8.5	2.5	2.3

Table 1 – Continued

Age years	Sex	Number		Height, cm		Weight, kg		BMI, kg/m ² .m.	
		girls	Sofia	Smolyan	Sofia	Smolyan	Sofia	Smolyan	Sofia
9-10		99-100	15	142.1	136.9	35.6	35.7	17.6	*19.0
				6.2	6.7	6.8	5.3	2.6	2.3
11		65	22	149.3	147.2	41.3	40.5	18.4	18.6
				6.9	6.8	8.1	6.8	2.5	1.8
12		58	37	154.6	151.8	46.1	45.1	19.2	19.4
				8.5	6.5	10.0	8.1	3.2	2.5
13		86	19–20	158.7	157.6	51.1	50.7	20.2	20.5
				7.0	5.8	10.1	8.6	3.5	3.8
14		49	26	160.8	158.2	54.4	55.3	21.0	22.0
				7.7	7.1	9.0	10.6	2.9	3.5
15		63	35	162.9	***159.8	56.8	55.4	21.4	21.7
				6.5	3.8	9.0	6.5	3.5	2.3
16		41	33	162.2	160.7	55.3	***63.4	21.0	***24.6
				6.8	5.3	9.5	8.3	3.1	3.5

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

The higher values are printed bold.

Age years	Sex	Lower limb length cm		Relative lower limb length,		Sitting height, cm		Rel. Sitting height, %	
		boys	Sofia	Smolyan	Sofia	Smolyan	Sofia	Smolyan	Sofia
9-11		83.0	83.4	57.1	***58.6	75.1	74.2	51.7	51.9
		5.4	5.8	2.0	1.5	4.2	4.7	1.6	1.3
12		87.6	89.1	56.6	58.9	79.1	78.0	51.1	51.6
		5.2	4.7	1.3	1.6	4.6	4.1	1.5	1.6
13		91.6	92.3	56.6	58.6	83.1	81.0	51.3	51.2
		4.2	5.7	1.7	1.7	3.8	6.2	1.4	1.9
14		95.9	96.0	56.7	**57.9	86.2	84.5	50.9	51.0
		4.6	5.7	1.8	2.0	4.3	5.7	1.6	1.6
15		96.8	95.8	56.2	56.8	88.6	87.0	51.4	51.4
		4.4	4.0	1.9	2.0	4.0	5.2	1.5	1.9
16		96.7	97.1	56.0	56.5	89.2	87.7	51.7	51.1
		5.3	2.6	1.7	1.8	4.2	4.2	1.7	1.5
9-10		81.5	***75.8	57.4	***55.3	73.0	74.7	51.4	***54.1
		4.6	5.7	2.0	1.8	2.8	4.1	1.8	1.7
11		84.4	82.7	56.5	56.3	77.1	78.0	51.6	**53.1
		4.2	4.3	1.7	1.0	4.6	4.3	1.5	2.2
12		86.6	85.6	56.0	56.5	80.6	79.9	52.2	52.6
		4.9	5.0	1.6	1.3	4.2	4.5	1.6	1.5
13		89.4	*87.4	56.4	**55.4	82.1	83.6	51.8	**53.1
		4.5	3.7	1.9	1.0	3.8	4.0	1.8	1.6
14		89.9	**86.9	55.9	55.2	84.4	84.6	52.5	*53.5
		4.1	4.6	1.7	1.9	3.7	4.4	1.7	1.7
15		91.1	***87.6	55.9	**54.8	85.5	86.4	52.5	***54.1
		4.6	3.5	1.9	1.6	2.8	2.6	1.5	1.3
16		90.1	*87.5	55.6	**54.4	85.7	86.9	52.8	***54.1
		4.8	4.0	1.9	1.4	3.8	2.7	1.5	1.5

* $p < 0.05$ ** $p < 0.01$ 55.6 *** $p < 0.001$ 52.8

The higher values are printed bold.

Table 1 — Continued

Age years	Sex	Biacromial diameter (cm)		Rel. Shoulder diameter (cm)		Transversal diameter (cm)		Rel. Transv diameter (cm)	
		boys	Sofia	Smolyan	Sofia	Smolyan	Sofia	Smolyan	Sofia
9-11	2.1	30.7	31.1	21.2	* 21.7	21.8	* 22.4	15.0	*** 15.7
		1.8	0.9	1.0	1.8	1.4	1.1	0.8	
12		32.4	33.1	20.9	*** 21.9	23.2	* 23.9	15.0	15.8
		2.2	2.4	1.1	0.9	2.1	1.8	1.3	1.0
13		33.9	34.3	21.0	** 21.7	24.5	24.4	15.1	15.4
		2.4	2.9	1.1	1.2	2.1	2.3	1.0	0.9
14		36.2	35.8	21.4	21.6	26.0	26.3	15.4	15.9
		2.1	2.2	0.9	1.1	1.8	2.5	0.9	1.4
15		37.6	36.6	21.8	21.7	27.4	26.7	15.8	15.8
		2.1	2.7	1.1	1.4	2.4	2.4	1.0	1.0
16		38.9	37.9	22.5	22.1	28.4	27.3	16.5	15.9
		1.9	2.6	1.1	1.1	2.0	2.4	1.2	1.2
9-10	girls	29.8	29.5	21.0	** 21.6	20.6	20.8	14.5	** 15.2
		1.9	1.7	1.1	0.7	1.8	1.1	1.1	0.7
11		31.2	*** 32.7	20.9	*** 22.2	21.6	* 22.5	14.5	*** 15.3
		1.7	1.7	0.7	0.8	1.7	1.5	0.9	0.9
12		31.8	*** 33.6	20.5	*** 22.1	22.3	* 23.2	14.4	*** 15.3
		2.2	2.6	0.9	1.0	2.2	1.9	1.2	1.0
13		33.5	34.1	21.1	* 21.7	23.8	23.7	15.0	15.1
		1.8	1.6	1.0	1.1	1.8	1.3	1.1	1.0
14		34.5	34.8	21.5	22.0	24.1	24.8	15.0	* 15.7
		1.4	1.9	0.8	1.3	1.7	1.7	1.1	1.2
15		34.9	34.9	21.4	21.9	24.8	24.5	15.2	15.3
		1.7	1.8	1.2	1.0	1.8	1.3	1.2	0.8
16		34.5	*** 36.8	21.3	*** 22.9	24.6	*** 26.2	15.2	*** 16.3
		1.6	1.4	0.9	1.1	1.8	1.6	1.2	1.1

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

The higher values are printed bold.

Age years	Sex	Sagittal diameter cm		Rel. sagittal diameter, %		Chest circumference cm		Rel. Chest circumf, %	
		boys	Sofia	Smolyan	Sofia	Smolyan	Sofia	Smolyan	Sofia
9-11		15.7	* 16.4	10.8	*** 11.5	72.4	73.2	49.9	51.2
		1.7	1.3	1.0	0.8	6.6	6.6	3.8	3.7
12		16.7	* 17.4	10.8	*** 11.5	76.2	** 80.3	49.3	*** 52.9
		1.9	1.9	1.1	1.0	7.2	8.3	4.5	3.8
13		17.7	17.5	10.9	11.1	79.3	81.8	48.9	*** 51.7
		1.7	1.6	0.9	0.9	7.0	8.0	3.4	3.6
14		18.7	19.0	11.1	11.5	84.7	87.3	50.1	* 52.6
		1.7	2.7	0.9	1.4	6.2	10.7	3.3	5.8
15		19.2	18.7	11.2	11.1	89.6	90.4	52.1	53.5
		1.8	2.6	1.1	1.4	6.4	7.7	4.0	3.5
16		20.3	19.9	11.7	11.6	93.6	92.9	54.2	54.1
		2.2	1.5	1.1	0.9	5.5	7.1	3.3	3.8
9-10	girls	15.1	*** 13.8	10.6	** 10.1	69.7	67.6	49.1	49.4
		1.5	1.1	0.9	0.6	6.4	4.0	4.0	2.8
11		15.7	** 14.7	10.5	10.0	74.4	*** 69.9	49.9	*** 47.5
		1.5	1.3	0.9	1.0	6.9	3.8	3.6	2.2

Table 1 — Continued

12	16.4	***15.0	10.6	***9.9	77.4	***71.5	50.0	***47.1
	1.7	1.6	1.0	0.9	8.3	4.1	4.6	2.1
13	17.1	**16.0	10.8	*10.2	83.2	***74.8	52.4	***47.5
	1.9	1.6	1.2	1.1	7.7	4.9	4.6	3.8
14	17.5	**16.3	10.9	*10.3	85.7	***76.9	53.3	***48.7
	1.2	1.8	0.7	1.0	5.6	5.8	3.3	4.2
15	18.2	***16.2	11.2	***10.1	88.0	***78.4	54.1	***49.1
	1.9	1.4	1.2	0.8	7.3	5.4	4.9	3.3
16	17.7	**16.5	10.9	*10.3	87.0	***81.3	53.7	**50.6
	1.7	1.7	1.0	1.1	6.0	6.9	3.8	4.6

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

The higher values are printed bold.

Age years	Sex	Biacromial diameter (cm)		Rel. Bicristal diameter (cm)		Bitrochanterial diameter (cm)		Rel. bitroch. diameter (cm)	
		boys	Sofia	Smolyan	Sofia	Smolyan	Sofia	Smolyan	Sofia
9-11		20.5	***22.3	14.2	***15.6	25.1	25.2	17.3	17.6
		2.6	1.5	1.5	0.8	2.3	2.0	1.1	0.8
12		21.9	***23.6	14.2	***15.6	26.9	27.5	17.4	***18.2
		2.6	2.6	1.6	1.3	2.5	2.4	1.3	1.1
13		23.0	*24.0	14.2	***15.2	28.7	28.2	17.7	17.8
		2.5	2.4	1.4	1.2	2.0	2.8	1.0	1.1
14		24.4	*25.8	14.5	**15.5	30.6	30.6	18.1	18.4
		2.5	3.0	1.5	1.5	2.1	3.3	1.0	1.4
15		25.2	25.8	14.6	15.3	31.5	30.8	18.3	18.2
		2.2	2.6	1.3	1.2	1.6	2.7	0.9	1.2
16		26.6	26.0	15.4	15.2	32.4	*31.2	18.8	*18.2
		1.6	1.2	0.8	0.7	1.4	1.6	0.9	0.8
9-10	girls	20.0	**21.8	14.1	***15.9	24.4	24.8	17.2	**18.1
		2.6	1.9	1.7	1.1	1.9	1.9	1.1	1.2
11		20.0	***23.3	13.4	***15.8	25.6	**26.8	17.1	***18.2
		2.6	1.5	1.2	0.6	2.2	1.7	1.0	0.6
12		20.6	***24.9	13.3	***16.4	27.2	*28.4	17.6	***18.7
		2.5	2.2	1.3	1.1	2.7	2.0	1.4	1.1
13		22.6	***25.1	14.3	***16.0	29.6	29.6	18.7	18.8
		3.3	1.6	2.1	1.2	2.3	1.3	1.3	0.9
14		22.1	***26.9	13.8	***17.0	30.2	*31.6	18.8	***20.0
		2.4	2.4	1.4	1.6	1.9	2.7	1.2	1.2
15		24.0	***26.3	14.7	***16.5	31.5	31.1	19.4	19.5
		2.3	1.7	1.5	1.0	2.1	1.9	1.4	1.1
16		23.6	***28.2	14.6	***17.5	31.0	***33.3	19.1	***20.7
		2.5	2.3	1.6	1.5	2.0	2.0	1.1	1.4

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

The higher values are printed bold.

Age years	Sex	Hip circumference, cm		Rel. hip circumf., %		Upper arm circumf., cm		Rel. upper arm circumf., %	
		boys	Sofia	Smolyan	Sofia	Smolyan	Sofia	Smolyan	Sofia
9-11		77.3	*74.5	53.4	*52.1	21.9	22.5	15.1	*15.7
		7.6	5.6	4.0	2.3	2.7	2.2	1.6	1.3
12		83.7	82.2	54.1	54.3	23.2	24.3	15.0	*16.0
		7.8	8.7	4.6	4.1	3.0	3.4	1.0	1.8
13		86.3	83.2	53.3	52.6	24.5	24.6	15.1	15.6
		7.0	8.2	3.5	3.6	3.2	3.2	1.8	1.7

Table 1 — Continued

Age years	Sex	Hip circumfe- rence, cm		Rel. hip circumf., %		Upper arm circumf., cm		Rel. upper arm circumf., %	
		boys	Sofia	Smolyan	Sofia	Smolyan	Sofia	Smolyan	Sofia
14		90.7	89.0	53.6	53.7	26.2	27.0	15.5	16.3
		7.0	11.0	3.6	5.8	2.8	4.0	1.6	2.2
15		93.4	**89.4	54.3	52.5	28.7	27.8	16.6	16.4
		6.4	8.2	3.9	3.8	3.0	3.5	1.7	1.8
16		94.8	**91.0	54.9	53.0	30.3	29.4	17.5	17.1
		6.2	5.7	4.0	3.0	2.4	2.6	1.3	1.5
9-10	girls	76.8	*72.9	54.1	53.3	21.3	21.3	15.0	15.6
		6.8	5.8	4.0	4.7	2.4	2.4	1.5	1.4
11		81.9	***76.3	54.9	***51.8	21.9	21.8	14.7	14.8
		6.6	6.0	3.0	2.7	2.2	1.8	1.3	1.2
12		86.4	**81.0	55.8	**53.3	22.6	22.3	14.6	14.7
		8.7	7.0	4.4	4.1	2.4	2.6	1.4	1.5
13		91.7	***82.3	57.8	***52.3	24.0	24.0	15.1	15.2
		7.5	7.2	4.5	4.9	2.7	3.2	1.7	2.3
14		94.5	**88.3	58.8	*55.9	24.9	24.8	15.5	15.7
		7.2	8.0	4.1	5.2	2.0	2.8	1.3	1.6
15		97.3	***88.4	59.8	***55.3	25.0	25.3	15.4	15.8
		6.9	6.1	4.6	3.8	2.3	2.1	1.6	1.3
16		95.9	95.3	59.2	59.4	25.2	***27.3	15.6	***17.0
		6.3	7.6	3.7	5.0	2.2	2.6	1.4	1.8

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$
The higher values are printed bold.

Age years	Sex	Upper arm muscle circ., cm		Rel. upper arm muscle circ., %		Sum of 4 upper arm skinf., mm		Sum of 4 thigh skinfolds., mm	
		boys	Sofia	Smolyan	Sofia	Smolyan	Sofia	Smolyan	Sofia
9-11		18.3	**19.7	12.6	***13.9	45.3	***35.1	79.4	***63.1
		2.3	1.9	1.5	1.1	18.4	9.0	29.6	15.7
12		19.1	***20.7	12.3	***13.7	54.7	*46.1	98.4	**79.7
		2.5	2.4	1.5	1.2	25.7	19.3	44.6	27.3
13		20.2	*21.6	12.5	***13.6	53.9	***38.7	93.2	***66.1
		2.8	2.7	1.6	1.3	18.6	18.2	28.7	24.1
14		22.3	*23.9	13.2	**14.4	49.3	39.1	82.7	78.3
		2.9	2.9	1.7	1.5	22.5	22.7	28.6	36.3
15		24.1	25.0	14.0	14.8	58.1	**35.2	92.9	**67.7
		3.5	2.8	1.9	1.4	35.7	16.8	45.4	25.0
16		26.1	26.9	15.1	15.7	53.2	**31.7	84.6	**57.2
		4.0	2.5	2.1	1.4	35.4	31.7	49.0	17.0
9-10	girls	17.0	16.5	12.1	12.1	52.2	61.1	98.4	*111.5
		2.2	1.6	1.3	0.8	16.7	21.4	27.7	19.3
11		17.7	16.8	11.8	11.6	54.4	**63.6	103.7	112.2
		2.3	1.6	1.3	1.4	16.2	11.7	31.0	17.6
12		18.7	17.2	12.1	***11.3	50.1	***65.5	98.1	***121.9
		1.8	1.5	1.1	0.9	18.8	22.3	37.5	22.3
13		19.2	19.0	12.1	12.1	60.1	60.8	108.2	110.4
		1.9	2.3	1.2	1.7	18.9	17.3	23.9	24.0
14		19.4	19.3	12.1	12.2	69.5	70.2	127.0	138.8
		1.7	2.1	1.1	1.3	23.5	17.2	33.7	20.6
15		19.5	19.6	12.0	12.3	70.2	72.0	135.3	126.7
		2.2	1.9	1.5	1.1	19.1	20.1	38.7	17.4
16		20.2	19.8	12.5	12.3	63.9	***95.4	129.5	***148.1
		1.6	1.9	1.0	1.3	16.4	18.6	29.4	17.7

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$
The higher values are printed bold.

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