RECENT SECULAR GROWTH CHANGES IN MOSCOW SCHOOLCHILDREN

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Abstract: *Studies of secular changes in different body systems remain among major subjects of auxological investigations. To show the latest trends of such changes in Moscow schoolchildren, data of numerous examinations from successive decades have been used. Results of several cross-sectional anthropometric surveys of Moscow schoolchildren (about 10,000 individuals of both sexes from 8 to 17 years examined in 1960's, 1970's, 1980's, 1990's and 1998–2002) and two longitudinal series of 8–17-year-olds (1st: 1960–1969, 292 boys and girls; 2nd: 1982–1991, 246 boys and girls) are presented in this study. A large number of anthropometric measurements were taken on each individual, such as height, weight, arm, leg and trunk lengths (estimated), body diameters and circumferences, skinfold thickness, head and face dimensions. Stages of secondary sex characteristics were evaluated; data on menarcheal age were collected by status-quo, retrospective and prospective methods. For both sexes and for each age class there are significant differences in such variables, as stature, between 1990's and 1970's – 1960's, 1980's and 1970's – 1960's, while the differences between 1990's and 1980's are statistically non-significant. The differences in weight are significant only for boys, and differences in chest circumference in certain age groups reveal reverse pattern – negative changes – in the latest series. There are noticeable changes in head and face measurements, expressed in more elongated head and face forms, i.e. the head becomes longer and narrower and the face – narrower and higher. Secular changes in head and facial morphology may be considered as part of the general trend.*

Keywords: *Secular changes; Cross-sectional growth studies; Moscow schoolchildren.*

Introduction

This can be easily explained. Though the number of studies dealing with secular changes is enormous, there appear still new regional surveys showing that secular changes may be going in different directions and with different intensity, which will depend on the local environmental conditions, mainly of socio-economic origin.

Materials and Methods

The analysis is based on data collected by the Institute and Museum of Anthropology, Moscow State University, and the Institute of Hygiene and Health Protection of Children and Adolescents, Russian Academy of Medical Science, for more than 40 years. It includes observations on about 15,000 Moscow children and adolescents from 8 to 17.

There were two longitudinal surveys – from 1960 to 1969, and from 1982 to 1991, as well as several cross-sectional surveys – in 1960's, 1970's, 1980's, 1990's and 1998–2002.

A large number of anthropometric measurements were taken on each individual, such as height, weight, arm, leg and trunk lengths (estimated), body diameters and circumferences, skinfold thickness, head and face dimensions. Stages of secondary sex characteristics were evaluated; data on menarcheal age were collected by status-quo, retrospective and prospective methods.

Children were measured during or immediately after school-hours; an age group consisted of children whose age falls within the interval ± 6 months of the whole year (e.g., 7-year olds: from 6.5 to 7.5, etc.). All anthropometric measurements were taken according to standard techniques (Bounak 1941; Weiner and Lourie 1981). Subjects were measured bare-feet, wearing only underwear.

Statistical analysis was performed on PC-Pentium 4 with the standard software package Statistica 5.0.

Results and Discussion

Statistical parameters of main body dimensions (body height, weight and chest circumference) for two series of longitudinal data are presented in Tables 1–3. Changes in body diameters (chest width and length, pelvic breadth) are demonstrated in Figures 1–6.

As can be seen from the presented data, Moscow children at the beginning of the century are becoming much narrower (more *leptosomic*) than their counterparts of the previous decade.

This can be also demonstrated with cross-sectional data. On Figure 7 the changes in main body dimension for 15-year-old Moscow girls are shown. It is clear that present-day teenagers have significantly smaller body weight (p<0.05) and chest circumference (p<0,01) than their counterparts of 10–20 and even 40 years ago.

What is also shown here is the direction and intensity of secular changes in Russia for almost half a century. In the 1960's and 1970's there were strong positive changes in height, weight and chest circumference. Starting with the 1980's, growth in length has practically stopped and average values for weight and chest circumference are becoming smaller.

Stabilization of secular trend in the 1980's has been stated by many authors in different European countries (Roede and van Wierengen 1985, Vercautern and Susanne 1985, Richter 1985, 1986, Wellens et al. 1990, Boldsen et al. 1993, Tryggvadottir et al. 1994, Liestoel and Rosenberg 1995, Larsen and Kragstrup 1997, Bodzsár 2000, Helm and Groenlund 1998, see also Bodzsár and Susanne 1998). But in Moscow population the halt in length growth is accompanied by decrease in weight and growth in width. This can be seen in the cross-sectional data from the latest decade both for girls and boys (Figure 8).

Table 1. Height changes in Moscow schoolchildren from 8 to 17 in two different decades (longitudinal studies).

Age (years)	Year of invest.	Boys M±m (cm)	SD±m (cm)	V±m (%)	Girls M±m (cm)	SD±m (cm)	V±m (%)
8	1960	126.5±0.4	5.0±0.3	4.0±0.2	125.7±0.4	5.4±0.3	4.3±0.2
	1982	127.7±0.5	5.8±0.4	4.6±0.3	127.8±0.5	5.7±0.4	4.5±0.3
9	1961	131.2±0.4	5.0±0.3	3.8±0.2	130.6±0.5	5.8±0.3	4.5±0.3
	1983	132.6±0.6	6.0±0.4	4.6±0.3	132.8±0.6	6.1±0.4	4.6±0.3
10	1962	136.2±0.4	5.3±0.3	3.9±0.2	136.5±0.5	6.5±0.4	4.7±0.3
	1984	137.1±0.6	6.3±0.4	4.6±0.3	137.6±0.6	6.4±0.4	4.6±0.3
11	1963	141.1±0.4	5.5±0.3	3.9±0.2	142.9±0.6	7.1±0.4	5.0±0.3
	1985	142.1±0.6	6.6±0.4	4.6±0.3	144.1±0.5	7.2±0.5	5.0±0.3
12	1964	146.0±0.5	6.0±0.3	4.1±0.2	147.2±0.6	7.2±0.4	4.8±0.3
	1986	147.4±0.7	7.3±0.5	5.0±0.3	150.2±0.6	7.5±0.5	5.0±0.3
13	1965	152.8±0.6	7.0±0.4	4.6±0.3	154.8±0.5	6.5±0.4	4.2±0.2
	1987	154.5±0.8	8.4±0.5	5.5±0.3	156.4±0.6	6.8±0.4	4.3±0.3
14	1966	160.0±0.6	7.4±0.4	4.6±0.3	158.0±0.5	6.1±0.3	3.8±0.2
	1988	162.3±0.8	8.8±0.6	5.4±0.4	160.0±0.5	5.9±0.4	3.7±0.2
15	1967	166.7±0.6	6.6±0.4	4.0±0.2	159.7±0.5	5.7±0.3	3.6±0.2
	1989	168.3±0.8	8.6±0.6	5.1±0.3	162.0±0.5	5.7±0.4	3.5±0.2
16	1968	171.2±0.5	5.9±0.4	3.5±0.2	160.2±0.5	5.8±0.3	3.6±0.2
	1990	173.1±0.7	7.9±0.5	4.6±0.3	163.1±0.5	5.7±0.4	3.5±0.2
17	1969	173.2±0.4	5.2±0.3	3.0±0.2	160.8±0.5	5.7±0.3	3.5±0.2
	1991	174.9±0.7	7.6±0.5	4.4±0.3	163.4±0.5	5.7±0.4	3.5±0.2

Table 2. Chest circumference changes in Moscow schoolchildren from 8 to 17 in two different decades (longitudinal studies).

Age (years)	Year of invest.	Boys M±m (cm)	SD±m (cm)	V±m (%)	Girls M±m (cm)	SD±m (cm)	V±m (%)
8	1960	26.3±0.3	4.1±0.2	15.9±0.9	60.5±0.3	3.8±0.2	6.2±0.4
	1982	26.3±0.4	4.4±0.3	16.8±1.1	58.4±0.3	3.8±0.2	6.5±0.4
9	1961	29.1±0.3	4.2±0.2	14.4±0.8	62.7±0.3	4.4±0.2	7.1±0.4
	1983	29.4±0.5	5.0±0.3	17.0±1.1	61.5±0.3	3.8±0.2	6.2±0.4
10	1962	32.2±0.4	5.4±0.3	16.9±1.0	64.3±0.4	4.9±0.3	7.7±0.4
	1984	32.3±0.5	5.7±0.4	17.6±1.2	63.4±0.4	4.2±0.3	6.6±0.4
11	1963	35.5±0.5	6.0±0.3	16.8±1.0	67.8±0.4	5.1±0.3	7.6±0.4
	1985	35.9±0.6	6.5±0.4	18.1±1.2	64.6±0.5	5.3±0.3	8.2±0.5
12	1964	38.9±0.5	6.3±0.4	16.3±0.9	70.8±0.4	5.1±0.3	7.3±0.4
	1986	39.8±0.7	7.6±0.5	19.2±1.3	68.8±0.5	5.4±0.3	7.8±0.5
13	1965	44.5±0.6	7.8±0.5	17.7±1.0	75.0±0.4	5.0±0.3	6.0±0.3
	1987	44.8±0.8	8.9±0.6	19.8±1.3	73.7±0.5	5.7±0.4	7.7±0.5
14	1966	49.9±0.7	8.5±0.5	17.0±1.0	76.7±0.4	4.4±0.3	5.8±0.3
	1988	52.4±0.9	9.6±0.6	18.3±1.2	76.4±0.5	5.6±0.3	7.4±0.5
15	1967	56.3±0.7	8.6±0.5	15.2±0.9	78.4±0.3	4.1±0.3	5.2±0.3
	1989	58.7±0.9	10.4±0.7	17.7±1.2	79.2±0.5	5.1±0.3	6.5±0.4
16	1968	61.1±0.6	7.3±0.4	12.0±0.7	79.5±0.4	4.4±0.3	5.5±0.3
	1990	64.0±1.0	11.0±0.7	17.1±1.1	80.0±0.4	4.8±0.3	6.0±0.4
17	1969	64.4±0.4	6.9±0.4	10.7±0.6	80.8±0.3	3.9±0.2	4.8±0.3
	1991	66.7±1.0	10.6±0.7	15.9±1.0	81.0±0.5	5.2±0.3	6.4±0.4

| Age (years)	Year of invest.	Boys			Girls		
		M±m (kg)	SD±m (kg)	V±m (%)	M±m (kg)	SD±m (kg)	V±m (%)
8	1960	26.3±0.3	4.1±0.2	15.9±0.9	25.5±0.3	4.2±0.2	16.7±0.1
	1982	26.3±0.4	4.4±0.3	16.8±1.1	26.2±0.4	4.6±090	17.7±1.2
9	1961	29.1±0.3	4.2±0.2	14.4±0.8	29.2±0.4	5.0±0.3	17.0±1.0
	1983	29.4±0.5	5.0±0.3	17.0±1.1	29.5±0.5	5.3±0.3	18.1±1.2
10	1962	32.2±0.4	5.4±0.3	16.9±1.0	32.6±0.5	6.1±0.4	18.7±1.1
	1984	32.3±0.5	5.7±0.4	17.6±1.2	32.5±0.6	6.3±0.4	19.4±2.3
11	1963	35.5±0.5	6.0±0.3	16.8±1.0	36.4±0.6	6.9±0.4	19.0±1.1
	1985	35.9±0.6	6.5±0.4	18.1±1.2	36.7±0.6	7.3±0.5	19.9±1.3
12	1964	38.9±0.5	6.3±0.4	16.3±0.9	41.3±0.6	7.2±0.4	17.5±1.0
	1986	39.8±0.7	7.6±0.5	19.2±1.3	41.9±0.7	8.2±0.5	19.6±1.3
13	1965	44.5±0.6	7.8±0.5	17.7±1.0	46.8±0.7	8.0±0.5	17.0±1.0
	1987	44.8±0.8	8.9±0.6	19.8±1.3	47.2±0.8	8.6±0.5	18.3±1.2
14	1966	49.9±0.7	8.5±0.5	17.0±1.0	50.6±0.6	7.4±0.4	14.7±0.8
	1988	52.4±0.9	9.6±0.6	18.3±1.2	52.2±0.8	8.7±0.5	16.7±1.1
15	1967	56.3±0.7	8.6±0.5	15.2±0.9	54.1±0.6	7.2±0.4	13.3±0.8
	1989	58.7±0.9	10.4±0.7	17.7±1.2	54.8±0.8	8.4±0.5	15.3±1.0
16	1968	61.1±0.6	7.3±0.4	12.0±0.7	56.3±0.6	7.5±0.4	13.3±0.8
	1990	64.0±1.0	11.0±0.7	17.1±1.1	56.9±0.7	7.9±0.5	14.0±0.9
17	1969	64.4±0.4	6.9±0.4	10.7±0.6	58.1±0.6	7.4±0.4	12.7±0.7
	1991	66.7±1.0	10.6±0.7	15.9±1.0	57.6±0.7	8.2±0.5	14.3±0.9
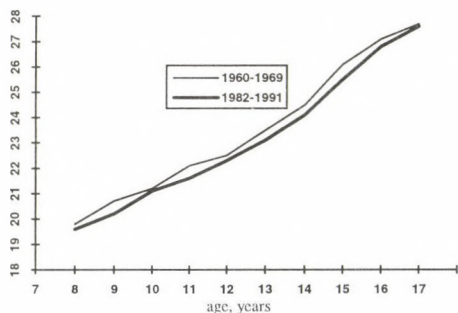
Figure 1: Growth curves of chest width (cm) in
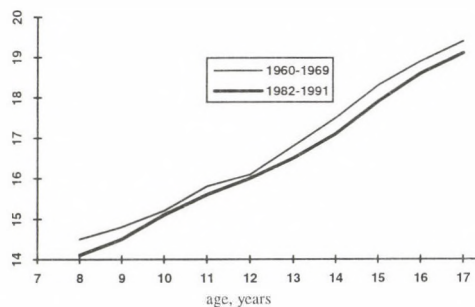Moscow boys in two different decades
(longitudinal data).

Figure 2: Growth curves of chest length (cm) in
Moscow boys in two different decades
(longitudinal data).

Besides the above-described changes, it was shown that for the last several decades some changes in the head and face morphology of Moscow schoolchildren had occurred: i.e., their heads and faces became longer and narrower (Table 4).
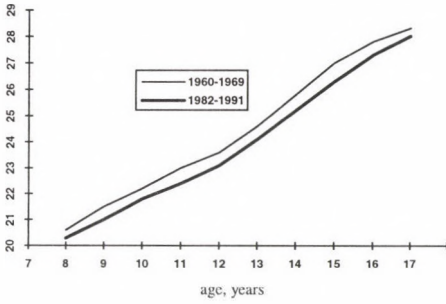
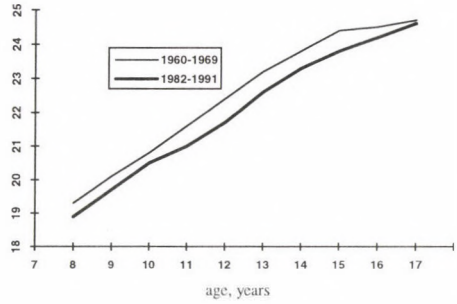*Figure 3:* Growth curves of pelvic breadth (cm) in Moscow boys in two different decades (longitudinal data).

Figure 4: Growth curves of chest width (cm) in Moscow girls in two different decades (longitudinal data).
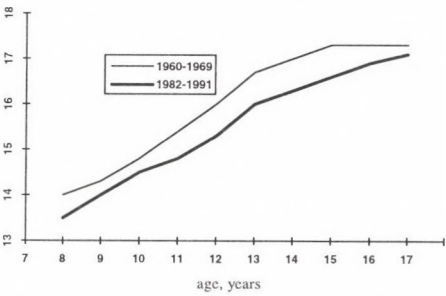

Figure 5: Growth curves of chest length (cm) in Moscow girls in two different decades (longitudinal data).
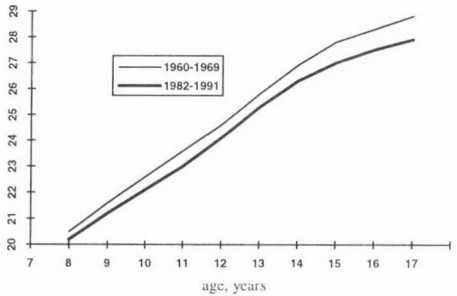

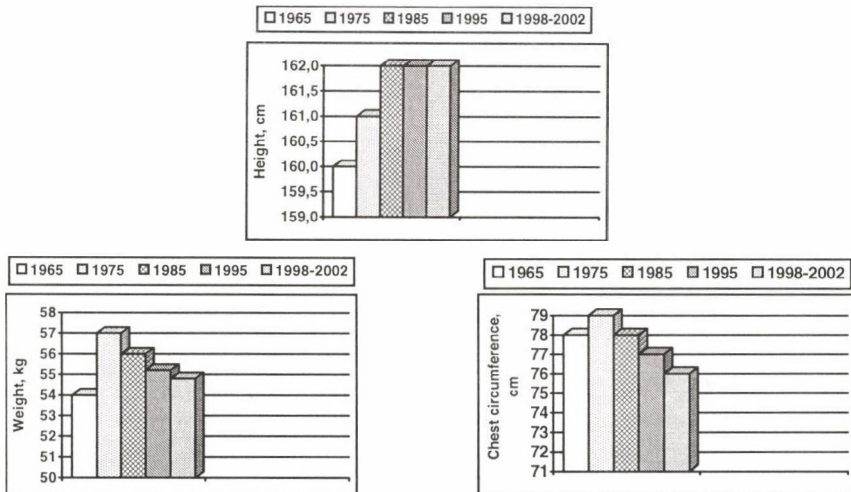*Figure 6:* Growth curves of pelvic breadth (cm) in Moscow girls in two different decades (longitudinal data).

Figure 7: Secular changes in some body dimensions in 15-year old Moscow girls for the last 40 years (cross-sectional data).

Table 4. Secular changes of cephalic and facial indices in Moscow schoolchildren.

Age years	Cephalic index						Facial index			
	Boys			Girls			Boys		Girls	
	1940's	1960's	1990's	1940's	1960's	1990's	1960's	1990's	1960's	1990's
8	83.3	84.1	80.7	82.8	84.4	79.9	77.8	70.8	78.4	70.3
9	84.0	83.0	80.9	83.1	84.7	80.0	78.4	70.0	77.9	70.3
10	82.5	84.0	81.3	83.3	83.7	80.7	77.6	70.9	78.1	70.7
11	82.6	83.5	80.1	83.0	83.8	80.9	77.0	72.1	77.6	71.6
12	82.3	84.0	80.9	83.1	83.0	81.0	77.3	72.1	77.5	72.8
13	82.7	83.7	80.0	82.0	83.4	79.6	76.8	72.3	77.4	72.7
14	83.6	82.2	80.3	82.5	83.1	80.2	75.8	72.9	76.7	73.4
15	83.1	82.6	80.0	82.9	83.8	80.7	75.4	73.3	77.1	73.7
16	82.9	82.7	79.2	82.5	83.4	79.6	75.8	73.3	77.1	74.6
17	82.2	81.9	80.0	82.9	83.1	81.8	75.5	73.7	77.3	74.8

This trend towards *debrachicephalization* could be explained, to our opinion, as part of the general trend of growth in length when head length, face height and some other measurements had increased significantly (p<0.05). At the same time decrease in some breadth measurements (head breadth, bizygomatic breadth) was also stated (Khomyakova et al. 1998).

To conclude this brief overview of recent secular changes in Moscow children and adolescents let us analyze characteristics of the process of sexual maturation, with the best marker as the age of menarche. On Figure 8 archival data from Moscow Maternity Hospitals, as well as our own cross-sectional data, starting from the 1950's, are presented.
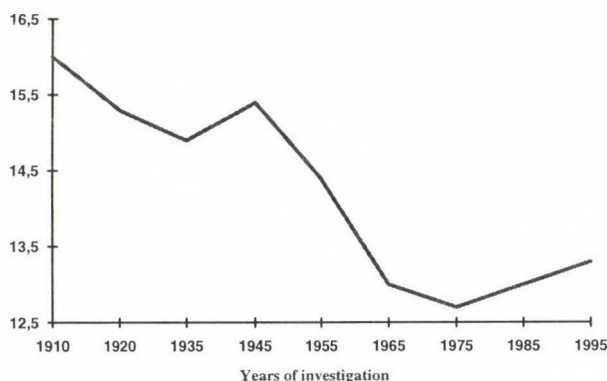

Figure 8: Changes in the age of menarche of Moscow girls in the 20th century.

As can be seen from the figure, the trend towards early ages was typical in the course of the 20th century (apart from Second World War years) till 1980's. The lowest age of menarche was stated in the 1970's and equaled 12.7 years. In the 1980's and 1990's a trend towards later ages is revealed: 13.0 and 13.2, respectively.

Summarizing our results, we can conclude that secular changes of Moscow children in the last decades of the 20th century show tendency towards linearity, stabilization of growth in length, and later ages of sexual maturation.

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