THE HUNGARIAN NATIONAL GROWTH STANDARDS

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Abstract: The authors, prompted by sociologic claims, organized and managed a nation-wide cross-sectional growth study in Hungary in the early 1980's. Their aim was to elaborate the Hungarian national growth standards as well as to help the foundation of the government's „youth policy" by scientific findings on the biological development of the youth.

Their sample (N = 39.035) contains 1.5 percent of the 3–18 year old healthy boys and girls, and it is nation-wide representative for the demographic, geographic and socio-economic stratification of the population. A detailed anthropometric programme was carried out and data of sexual maturation as well as data on socio-economic background of the children's family were collected.

The field-work of the research project was completed, however, the elaboration of the data is still in process. The authors present the new (and first!) Hungarian National Growth Standards of height, weight and weight-for-height.

Key words: National Growth Standards, Hungary, Height, Weight, Weight-for-height.

Introduction

There has been sporadic attempts to provide local cross-sectional growth standards in Hungary since the 1870s (Kézmárszky 1873, Weisz-Földes 1875, Scheiber 1881, – see Eiben 1977, 1982a, 1982b). There are, in fact, several hundred regional studies, however, no comprehensive sampling of the entire population has previously been attempted as has been done as, for example, in the Netherlands (Roede – van Wieringen 1985).

The need for such a study is based both on scientific and practical concerns. A comprehensive sampling „provides reference data for individual medical care and contributes to the description of the health situation of the population by the study of the secular changes. The data are also of use in the construction of *'the'* living environment and may supply a biological basis for governmental policies concerning young people" (Roede – van Wieringen 1985).

Reference data presented as growth diagrams have direct application in medical practice to assess growth status and monitor change with various modalities. They are used as clinical tools in pediatrics, endocrinology and in various institutions concerned with optimal growth and development of normal and handicapped children and youth.

According Rhoede – van Wieringen (1985) „physical growth is a sensitive indicator of a child's overall condition. A deviation of a child's growth pattern may manifest itself before there are symptoms of the underlying disease and/or mental stress. Consequently, every unexpected deviation should alert the physician to detect its cause. On the other hand, pursuing 'normal' growth over a period of time may be one of the reasons for the physician to reassure the parents concerning the status of health of their child."

Typically, normative data on height and weight are presented as attained values for a given age. More informative, however, is presented in the display of age standards showing weight values for incremental measures of height. This information can be

augmented by norms for age of menarche and age of oigarche which provides some insight into the individual maturational rates. The norms also serve as a frame for supplementary radiographic methods to assess skeletal age and for making judgements about the secular trend for earlier maturation.

The First Hungarian National Growth Study

Starting in from the fact established scientifically that growth and development of youth monitors the biological value of the whole population (Tanner 1978), the authors organized and carried out a nation-wide representative cross-sectional growth study in Hungary. They intended to analyze growth and development of the Hungarian children and youth, taking into consideration all the ecological factors existing in Hungary in the 1980s, especially the social structure and the social regrouping of the population, the urbanization, the urban and rural mode of life. These are nowadays, namely, the most important social-environmental factors influencing growth process (Eiben–Pantó 1981, Pantó–Eiben 1984a, 1984b).

Planned in 1981, the first Hungarian National Growth Study was designed to meet two important needs: (1) To provide normative standards to assess and monitor individual growth and (2) to establish a baseline for successive sampling studies to study change in the Hungarian population. Field studies commenced in January 1982 and were completed by March 1985.

Material and Methods

Sampling

Endorsed by the Hungarian Government, the national sampling was based on the 1980 national census (Népszámlálás, 1980). The sample was regionally stratified and involved over 40.000 healthy boys and girls with cohort sizes ranging from 830 to 1730 over the age range 3–18 years. Those suffering from serious anomalies or congenital defects were excluded. Children with incomplete data-set were also excluded. The sampling investigated 39.035 boys and girls as shown in Table 1, and this sum represents 1.5 percent of the Hungarian youth in question.

Stratification of the sample was made according to size of settlements as follows: (1) 20 percent of the sample was collected in Budapest, (2) 10 percent in large towns, with a population in excess of 100.000, (3) 20 percent in small towns (10.000–100.000 inhabitants), (4) 40 percent in large villages (1.000–10.000 inhabitants), and (5) 10 percent in small villages where the number of inhabitants does not exceed 1.000 (Fig. 1).

All geographical regions, all the 19 counties of Hungary were visited in order to gain a proportional representation of the geographical regions as well as duly-proportioned representation for each. The industrial and/or agricultural character of the county was taken into consideration; data on subjects/individuals collected in different settlements monitor both the urban and rural differences, and the rate of industrial and agricultural employment of the whole population.

Groups of national minorities in Hungary amount to some 5–6 percent. It was not projected to look especially for villages inhabited partially by such minority groups, but neither were these groups omitted. Thus, these minority groups of nationalities are presented in the sample in proportion to their presence in the Hungarian population as a whole.

The actual selection of the settlements and its institutions and schools was made by random selection from a national list. For practical purposes the field study team restricted their data assembly to a single class for each of the age-categories for each

Table 1. Distribution of the sampling investigated

Age (year)	Boys	Girls	Together
3	240	268	508
4	837	834	1671
5	1007	1006	2013
6	1204	1257	2461
7	1319	1158	2477
8	1357	1338	2695
9	1412	1356	2768
10	1419	1286	2705
11	1401	1355	2756
12	1351	1374	2725
13	1398	1373	2771
14	1483	1325	2808
15	1730	1563	3293
16	1659	1377	3036
17	1470	1238	2708
18	862	778	1640
Sum total	20149	18886	39.035

■ Budapest (2.060.000)

□ Large towns (> 100.000)

■ Small towns (10.000−100.000)

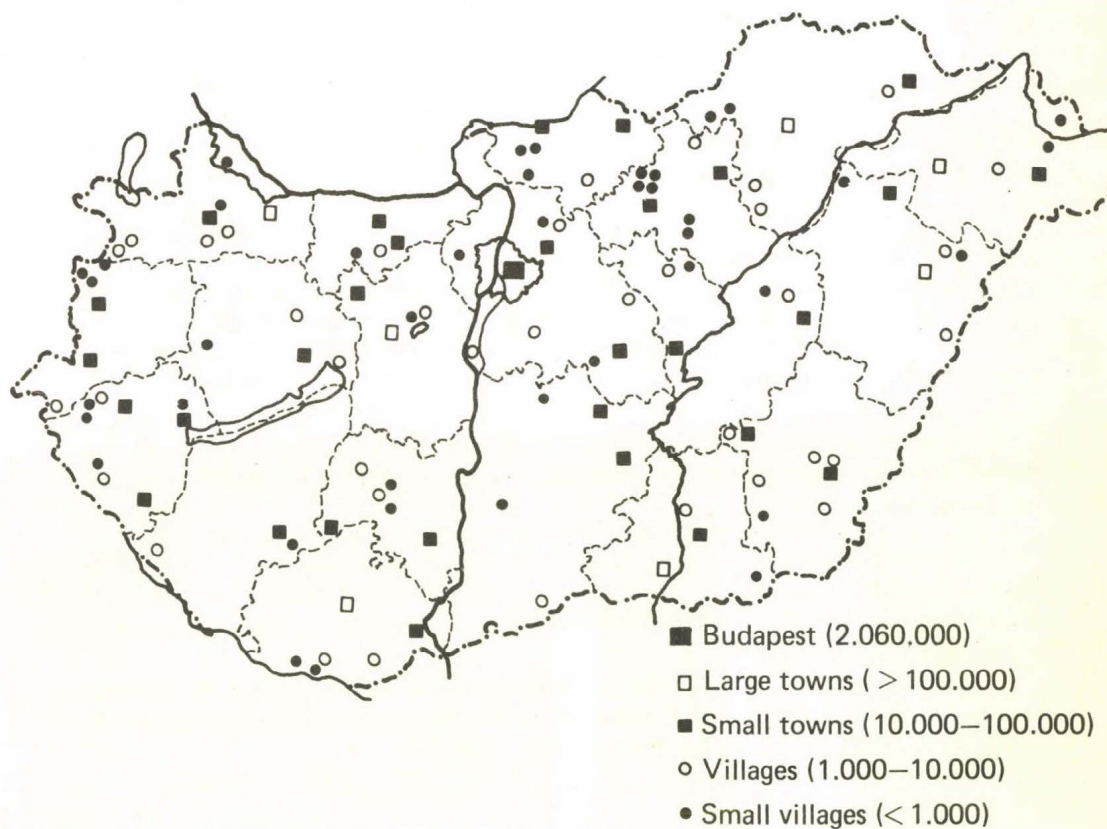o Villages (1.000−10.000)

• Small villages (< 1.000)

Fig. 1: Overview of the settlements investigated

designated institution or school. In total, about forty thousand boys and girls from 350 pre-schools and schools from 113 communities were included in the sample.

Because of the random selection of sites, the sample reflected the basic organisational plan for schools in Hungary: The „general" or primary schools for pupils age 6–14; and the subsequent streaming of about 93 percent of the pupils: (1) grammar schools (20.3%), (2) specialized schools (26.2%), and (3) vocational training schools (46.4%). The latter two categories are designed to provide learning opportunities to qualify youth for different trades and occupations. The sampling represents this proportional streaming.

Thus, for the first line, an attempt was made to provide for the construction of growth standards and the definition of the Hungarian population of children and youth age 3 to 18 years based on a nation-wide geographically stratified random sampling plan.

Programme of investigation

The methods used were both human biological and sociological. The anthropometric programme produces information about (1) children's growth status and age differences, (2) proportional changes, (3) changes in body composition, (4) changes in physique (somatotype components), and (5) maturation status, both age at oigarche and menarche, and, partly, skeletal age.

The basic anthropometric list contains 18 body measurements. The instruments used for these investigations were the standard tools (GPM and Harpenden anthropometer, Holtain bicondylar vernier caliper, Lange skinfold caliper, steel tape measure, portable weighing machine). Investigatory methods and techniques were in accordance with internationally-accepted standards, described by Martin and Saller (1957) and Tanner et al. (1969).

In about 16 percent of the sample, about 6500 boys and girls with complete anthropometric data were also assessed by a hand and wrist radiograph according to the TW2 method specified by Tanner et al. (1975). This investigation was obtained through the cooperation of medical practitioners by radiographic technicians in hospitals and polyclinics.

Except for the radiological procedures all the data assembly took place in classrooms of nursery and other schools in the morning. In addition to the anthropometric techniques, the field study team obtained data on the socio-economic background of the children's family, birth order, number of siblings and other members in the household, education and occupation of the parents, type of schools the children had attended, and, some estimate of the opportunities and availability of facilities for physical activity.

The field study team

The field study team consisted of the two authors and two trained assistants who made all the measurements. They were assisted by others, usually invited resident teachers, who served as recorders.

All the measurements were obtained by highly-experienced investigators. Moreover, replicated measurements were made initially and regularly throughout the investigation. These data provide reassurance that the measurements were precise and that there were no systematic differences among the investigators.

Elaboration of the data

A three year plan for the full elaboration of the data is underway. An initial analysis of data from seven counties with Hungary's largest cities (outside of Budapest) serves to pilot the final analysis which will involve all the 19 counties.

Preliminary findings

Based on the initial subsample of 13.000 boys and girls, a number of preliminary conclusions appear warranted (Eiben—Pantó 1985).

(1)   There has been a secular trend for increased size, with stature increase greater than that of weight, with no apparent increase in lateral measurements of widths and girths. The trend is toward increased tallness and linearity.

(2)   Family background and socio-economic status determine children's growth and development and maturation more than their family-genetic endowments. Paternal/maternal age, the child's place in the sibling-sequence, number of brothers and sisters — in this increasing effects's order — influence growth process of children, but the differences in height according to these pointviews are small. The education level of the parents and their profession, i.e. cultural level and mode of life of the family, however, show significant differences also in biological development.

(3)   Urban children tend to grow faster and mature earlier than their rural counterparts.

This is noted in urban-rural differences in age at menarche 12.99 ± 0.23 vs 13.13 ± 0.08 year, and age of oigarche 13.86 ± 0.10 vs 14.37 ± 0.11 years. The difference between urban and rural girls is about two months, and between urban and rural boys about six months (Eiben—Pantó 1984, Pantó—Eiben 1984c).

(4)   The initial analysis also revealed a persistent trend for boys and girls of grammar schools to be significantly taller than their counterparts in the specialized schools, and these latter taller than boys and girls in the vocational training schools (Eiben—Pantó 1986).

The differences between urban and rural children and youth and between those of higher and lower socio-economic and educational levels appears manifest in the Hungarian population.

These initial findings are thought-provoking and confirm the need for the stratified-random sampling plan and the auxiliary questions relating to socio-economic conditions. They also provide a basis for inference, hypothesis formation and further assessment of the apparently dynamic status of the Hungarian population of children and youth.

The Hungarian Growth Standards

Although the balance of the data on the total sample of 39.035 boys and girls is still under investigation, normative values for height, weight, and weight for increment of height have been produced as shown in Figures 2, 3, 4 and 5. The numerical data of means, SD-s and percentile values of height, weight, and weight-for-height are also given in Tables 2, 3, 4, 5, 6, and 7. In this case, in the interest of a detailed information, half a year age groups were formed.

Figures 2 and 3, and Tables 2 and 3 show *height* for age standards for boys and girls with divisions at percentiles 3, 10, 25, 50, 75, 90 and 97. Figures 2 and 3, and Tables 4 and 5 show *weight* for age for boys and girls scaled similarly. These charts provide a simple method for ascribing height or weight status for an individual boy or girl with respect to the Hungarian norms. The normative data also provide a basis for group and sub-sample comparisons.

Figures 4 and 5, and the data of Tables 6 and 7 are not age related. They show *weight for incremental values of height*. Constructed from the weight distribution for every two centimeters increase in height these figures answer the question "irrespective of age, how heavy is a particular individual for his or her height?".
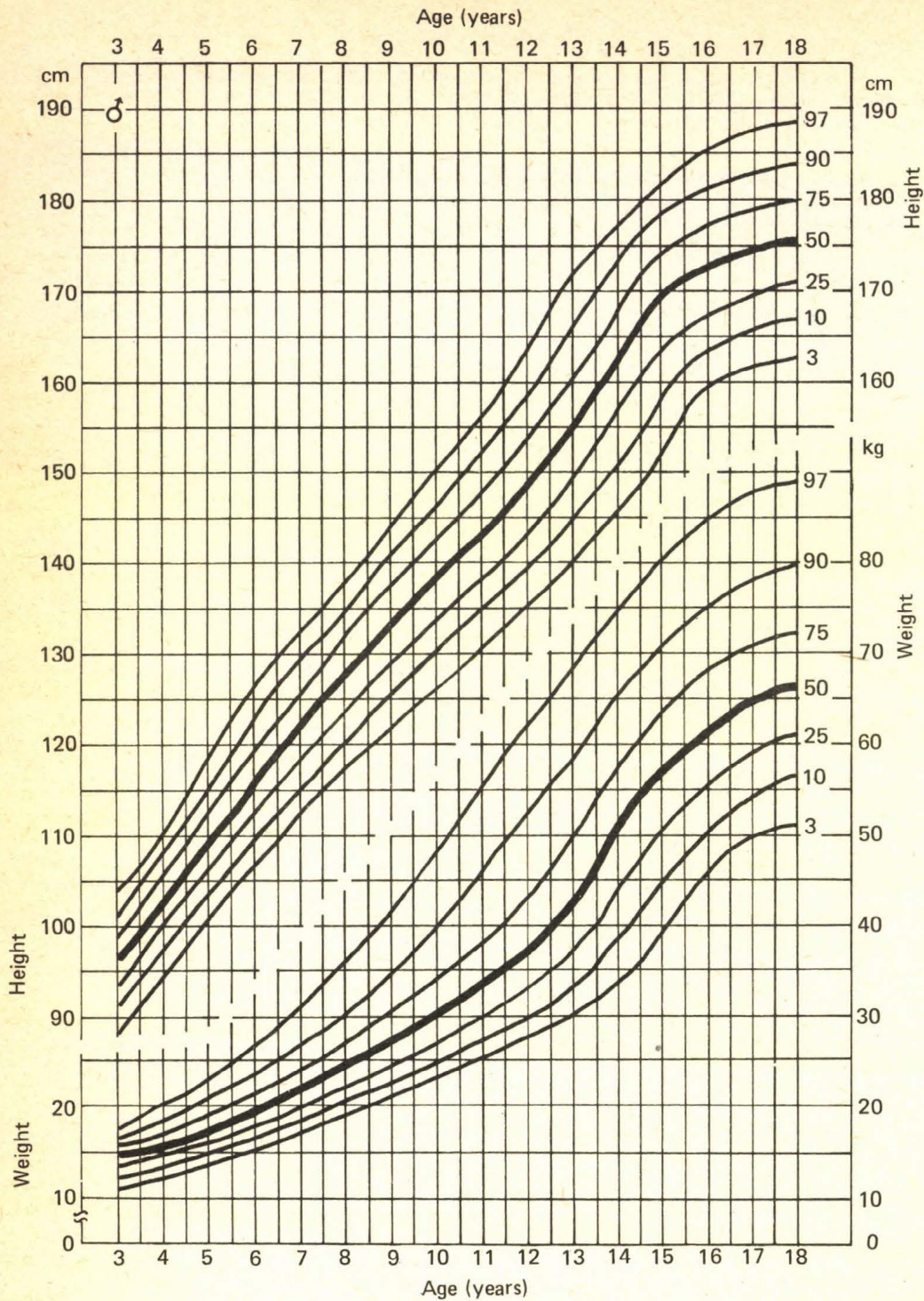
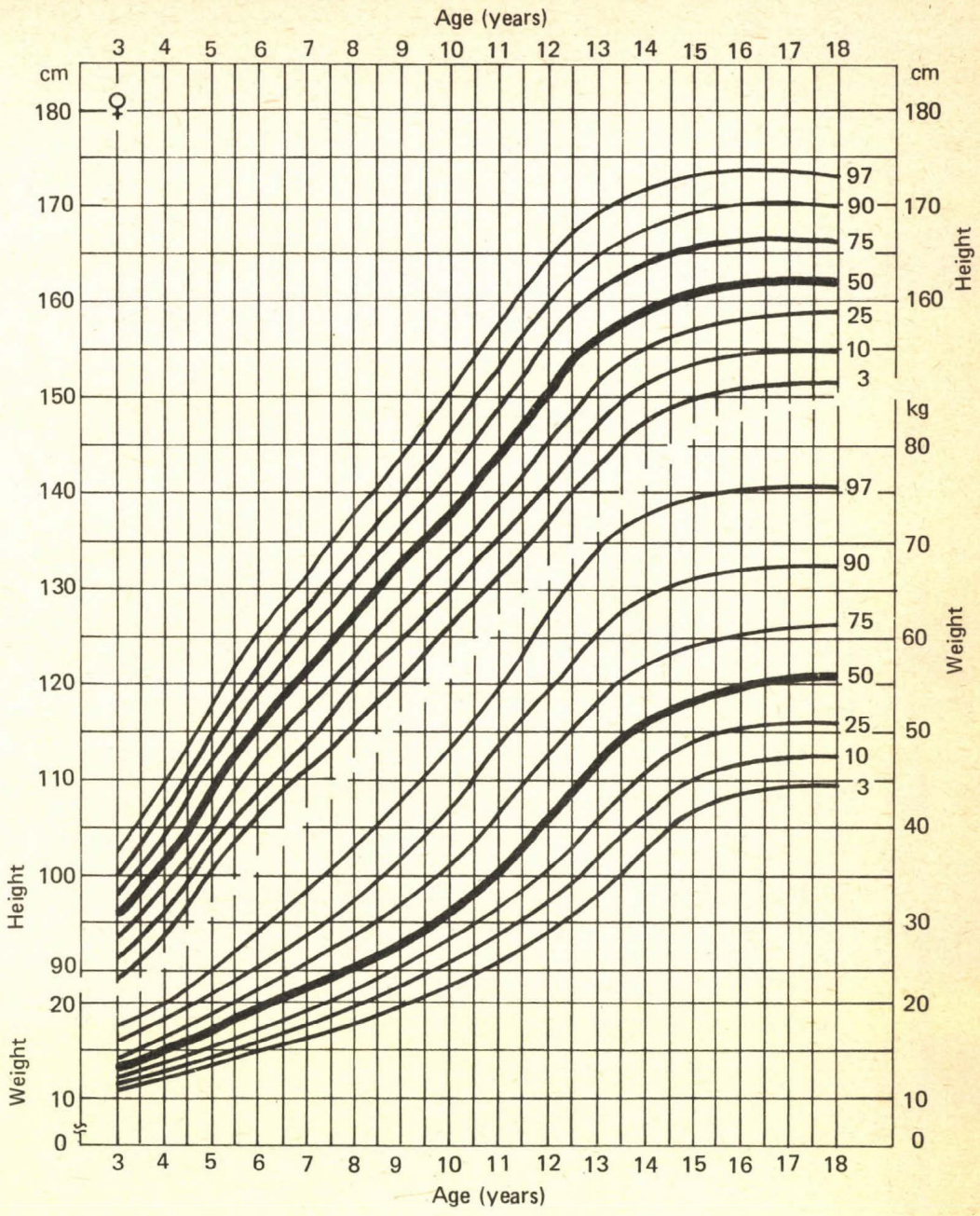*Fig. 2:* Percentiles of the height and weight – boys

Fig. 3: Percentiles of the height and weight – girls

Table 2. Means, SD-s and percentile values of height in Hungarian boys (cm)

Age (years)	N	Mean	SD	Percentiles						
				3	10	25	50	75	90	97
3	98	96.24	3.97	88.5	89.9	93.4	96.4	98.5	101.2	105.0
3.5	310	99.39	4.20	91.8	94.0	96.7	99.5	102.1	104.6	107.2
4	394	102.80	4.36	94.5	97.3	99.9	102.6	105.5	108.5	110.5
4.5	518	106.14	4.43	97.9	100.7	103.2	105.9	109.1	111.8	114.8
5	492	109.01	4.84	100.7	102.9	105.9	108.7	111.7	115.2	118.3
5.5	543	112.71	4.88	103.9	106.5	109.2	112.8	115.9	118.8	122.3
6	615	116.34	5.30	107.0	109.8	112.9	116.1	119.6	123.2	126.6
6.5	599	119.07	5.51	109.1	111.8	115.5	118.6	122.4	126.3	129.5
7	688	122.21	5.34	112.2	115.3	118.5	122.3	125.7	129.2	131.8
7.5	717	125.00	5.49	114.8	117.7	121.2	125.2	128.4	131.9	135.6
8	658	127.56	5.37	117.7	120.5	123.8	127.4	131.5	134.4	137.7
8.5	693	130.62	5.69	119.8	123.3	126.8	130.7	134.2	138.2	141.2
9	695	133.24	6.21	122.1	125.2	128.7	133.0	137.5	141.1	144.8
9.5	719	136.03	6.42	124.2	128.0	131.8	136.0	140.3	143.9	147.6
10	713	139.06	6.32	126.7	131.1	134.9	138.8	142.9	146.7	150.7
10.5	693	140.39	6.25	128.3	132.7	136.2	140.4	144.8	148.7	152.7
11	718	143.30	6.75	130.6	135.1	138.7	142.8	148.0	152.0	156.9
11.5	658	146.18	7.12	133.5	138.2	140.9	145.7	150.8	156.0	159.4
12	666	148.95	7.11	136.0	140.3	143.6	148.4	153.6	158.3	163.2
12.5	700	152.34	8.23	137.6	142.0	146.6	152.2	157.2	163.5	168.4
13	711	155.67	8.26	140.9	144.9	149.9	155.3	161.3	165.9	171.3
13.5	706	158.87	8.53	142.7	147.6	153.0	158.8	164.8	170.5	174.0
14	747	162.60	8.38	146.3	151.2	156.7	163.1	168.4	173.5	177.4
14.5	774	166.16	8.43	149.1	154.6	160.8	166.8	172.0	176.7	180.2
15	889	168.72	7.90	152.5	158.2	163.7	169.0	174.1	178.5	182.1
15.5	847	171.40	7.38	157.5	162.3	166.2	171.2	176.3	180.2	184.3
16	852	172.19	6.76	159.3	163.4	167.8	172.3	176.8	180.9	185.0
16.5	796	173.41	6.66	161.3	164.8	168.8	173.4	177.8	181.8	186.9
17	758	174.41	7.10	161.6	165.3	169.6	174.1	179.1	183.0	187.9
17.5	596	174.88	6.58	162.0	166.7	170.3	174.6	179.2	183.3	188.1
18	436	175.58	6.87	162.5	166.9	171.2	175.6	179.7	184.3	188.4
18.5	244	172.10	15.35							

Table 3. Means, SD-s and percentile values of height in Hungarian girls (cm)

Age (years)	N	Mean	SD	Percentiles						
				3	10	25	50	75	90	97
3	118	95.99	3.67	89.7	91.7	93.6	95.7	98.2	100.3	103.0
3.5	317	98.95	3.93	91.2	93.9	96.5	99.1	101.5	103.5	106.2
4	441	101.76	4.46	93.9	96.2	98.8	101.7	104.9	107.3	110.1
4.5	469	105.53	4.58	96.9	99.7	102.4	105.7	108.6	110.9	114.0
5	497	109.18	4.82	100.6	103.1	105.8	109.1	112.4	115.5	118.2
5.5	565	112.67	4.82	103.8	106.7	109.3	112.5	115.9	118.8	122.3
6	629	115.97	5.25	106.2	109.1	112.5	116.0	119.5	122.6	125.2
6.5	626	118.72	5.30	109.4	111.9	115.0	118.3	122.3	125.9	129.0
7	579	121.63	5.15	112.0	114.9	118.0	121.6	125.2	128.1	121.0
7.5	624	124.16	5.71	113.5	116.5	120.6	124.0	127.8	131.2	135.5
8	648	127.32	5.72	116.0	120.1	123.6	127.3	131.1	134.4	138.3
8.5	715	129.65	5.84	118.7	122.6	125.8	129.5	133.4	136.9	140.5
9	680	132.67	6.28	120.7	125.1	128.6	132.7	136.7	140.5	143.9
9.5	642	135.24	6.15	123.3	127.8	131.1	134.9	139.0	143.3	147.7
10	622	138.13	6.60	126.4	130.2	133.9	137.8	142.2	146.4	151.4
10.5	663	141.58	6.83	129.4	133.0	136.7	141.2	146.0	150.6	155.8
11	693	144.72	7.17	131.6	135.6	140.0	144.3	149.6	153.9	158.1
11.5	674	147.49	6.98	134.8	138.8	142.7	147.2	152.3	156.7	161.2
12	680	150.81	7.62	137.1	141.0	145.6	151.0	156.4	160.2	164.7
12.5	710	153.89	6.99	140.8	144.5	148.8	154.0	158.9	162.3	166.2
13	685	155.89	6.95	143.1	146.9	151.7	155.8	160.2	164.6	169.2
13.5	665	157.97	6.60	145.4	149.5	153.7	158.0	162.4	166.3	170.8
14	655	159.23	6.26	147.7	151.2	155.2	159.2	163.2	167.3	172.1
14.5	750	160.60	6.35	148.7	152.5	156.4	160.5	164.6	168.9	172.4
15	789	161.28	6.37	149.3	153.3	157.2	161.0	165.4	169.5	173.3
15.5	662	161.84	6.24	150.5	154.1	157.6	161.5	165.7	169.6	173.5
16	723	161.88	5.99	150.6	154.3	157.9	161.6	165.8	169.7	173.6
16.5	683	161.95	5.78	151.2	154.8	158.3	161.7	165.9	169.8	173.7
17	630	162.28	5.98	151.2	154.9	158.4	161.8	166.1	170.2	173.8
17.5	508	161.95	6.03	151.4	154.9	158.5	162.1	166.2	170.2	173.9
18	427	162.45	5.93	151.5	154.9	158.6	162.2	166.6	170.3	174.4
18.5	199	160.12	13.23							

Table 4. Means, SD-s and percentile values of weight in Hungarian boys (kg)

Age (years)	N	Mean	SD	Percentiles						
				3	10	25	50	75	90	97
3	98	14.57	1.70	10.8	12.2	13.6	14.5	15.4	16.5	17.5
3.5	310	15.40	2.02	11.7	12.8	14.0	15.1	16.3	17.8	19.4
4	394	16.10	1.93	12.7	13.6	14.6	15.7	17.1	18.6	20.0
4.5	518	17.00	2.19	13.1	14.2	15.3	16.6	18.2	19.7	21.4
5	492	17.89	2.53	13.7	14.9	16.1	17.3	19.0	21.0	23.3
5.5	543	19.13	2.86	14.8	15.6	17.0	18.8	20.4	22.3	24.4
6	615	20.54	3.26	15.8	16.9	17.8	19.9	21.8	24.2	27.4
6.5	599	21.53	3.52	16.3	17.5	19.0	20.8	23.1	25.7	29.2
7	688	22.63	3.64	17.4	18.6	20.0	21.9	24.3	26.9	30.7
7.5	717	24.11	4.05	18.2	19.5	21.1	23.5	25.8	28.9	33.9
8	658	25.40	4.40	19.4	20.8	22.3	24.5	27.3	30.4	36.3
8.5	693	27.31	5.18	20.2	21.9	23.7	26.3	29.4	33.3	39.4
9	695	28.49	5.64	20.7	22.1	24.6	27.6	30.8	34.9	41.2
9.5	719	30.46	6.48	21.5	23.9	25.9	29.3	33.0	38.5	45.4
10	713	32.51	6.83	23.0	25.4	27.8	30.7	34.8	41.1	48.2
10.5	693	33.13	6.41	24.6	26.6	28.8	31.5	36.1	42.5	49.7
11	718	35.44	7.57	25.4	27.7	29.8	33.6	38.7	45.1	53.7
11.5	658	37.35	8.51	26.8	28.9	31.4	35.3	41.2	48.0	59.1
12	666	39.59	8.98	28.0	30.1	32.6	37.3	43.3	52.4	61.8
12.5	700	42.15	9.89	28.9	31.2	34.9	40.2	47.0	55.7	65.8
13	711	44.53	10.01	30.4	33.0	37.1	42.8	49.9	58.6	67.5
13.5	706	47.61	10.17	31.8	35.2	40.1	45.9	54.1	60.7	70.4
14	747	50.97	10.54	34.7	39.0	44.4	50.1	56.4	64.1	74.9
14.5	774	55.27	11.50	36.8	41.7	47.3	54.3	61.1	69.7	79.7
15	889	57.72	10.69	39.3	45.0	50.7	56.6	63.8	71.1	80.5
15.5	847	60.56	10.28	43.2	48.7	53.6	59.6	65.9	73.4	83.2
16	852	62.33	10.69	45.5	50.0	55.1	61.2	67.3	75.6	86.0
16.5	796	64.34	10.04	48.5	52.1	57.6	63.0	69.9	76.8	86.3
17	758	65.46	9.57	49.5	54.0	59.1	64.7	70.5	77.5	87.6
17.5	596	66.65	9.93	50.5	55.6	60.3	65.2	71.1	78.8	89.0
18	436	67.56	9.77	50.5	56.7	60.7	66.9	73.4	80.1	89.0
18.5	244	65.05	13.71							

Table 5. Means, SD-s and percentile values of weight in Hungarian girls (kg)

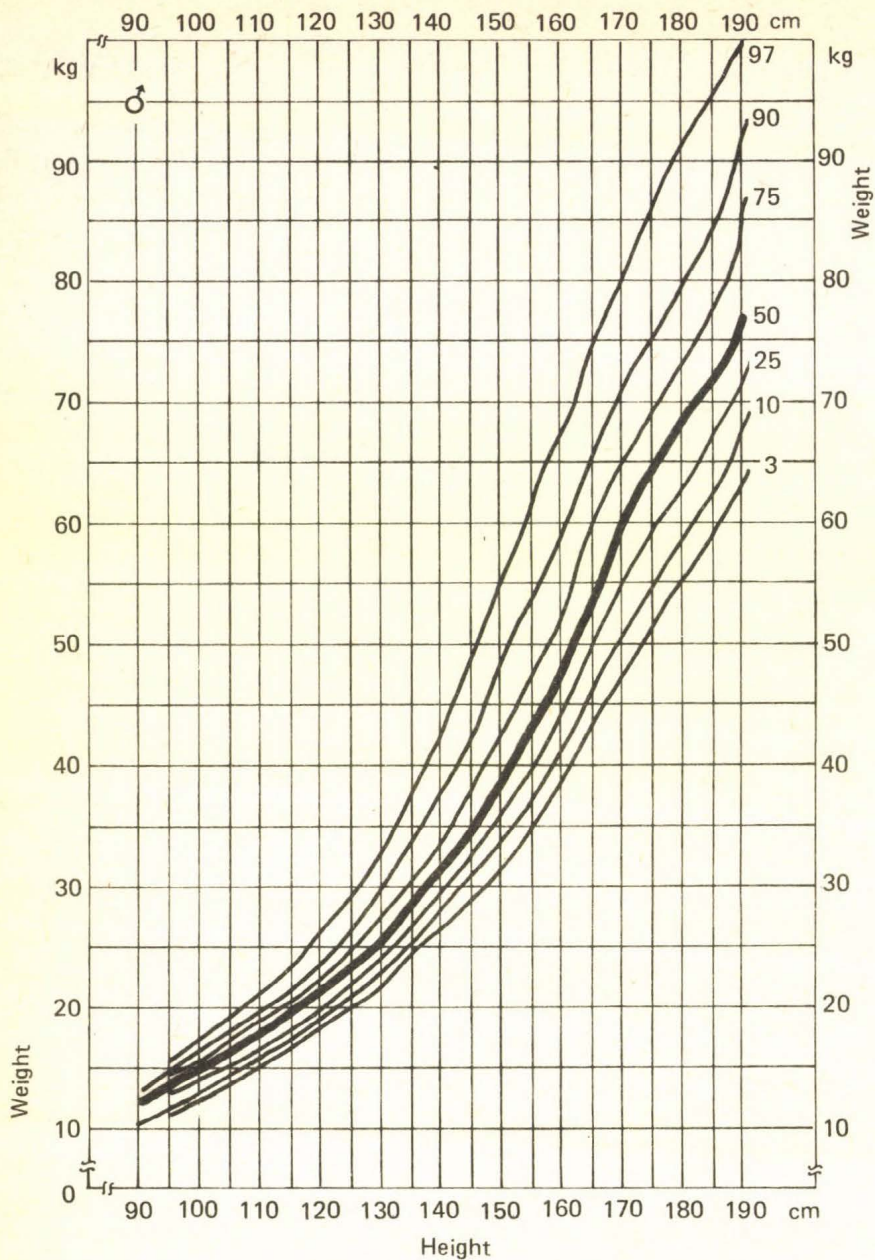| Age (years)	N	Mean	SD	Percentiles						
				3	10	25	50	75	90	97
3	118	14.06	1.73	11.0	11.8	12.7	13.7	14.7	16.3	18.0
3.5	317	14.90	1.92	11.5	12.3	13.5	14.6	16.0	17.2	18.4
4	441	15.54	2.13	11.8	12.8	13.9	15.2	16.6	18.3	20.0
4.5	469	16.60	2.25	12.6	13.8	15.0	16.2	17.7	19.4	21.3
5	497	17.96	2.52	13.9	14.8	15.9	17.5	19.2	21.3	23.5
5.5	565	19.30	3.01	14.7	15.8	17.1	18.8	20.5	23.1	26.2
6	629	20.44	3.59	15.2	16.4	17.9	19.8	22.0	24.2	28.4
6.5	626	21.27	3.63	15.8	17.1	18.7	20.5	22.8	25.4	29.8
7	579	22.56	3.87	17.0	18.3	19.7	21.5	24.1	27.4	32.3
7.5	624	23.60	4.49	17.3	18.8	20.5	22.5	25.1	29.1	34.0
8	648	25.02	4.44	18.3	19.9	21.7	24.2	27.2	30.5	36.1
8.5	715	26.42	5.05	19.0	20.8	22.8	25.3	28.6	32.5	39.6
9	680	28.52	5.67	20.1	22.1	24.5	27.0	30.7	35.7	41.6
9.5	642	29.88	6.44	21.2	23.3	25.3	28.3	32.0	38.5	45.3
10	622	31.29	6.32	22.8	24.5	26.9	29.8	34.3	39.8	46.2
10.5	663	33.84	7.57	23.2	26.4	28.3	32.0	37.4	43.3	51.5
11	693	36.40	8.05	24.7	27.5	30.5	34.8	40.6	46.5	53.8
11.5	674	37.73	7.98	26.2	28.7	31.8	36.1	42.7	48.3	56.3
12	680	41.03	9.41	27.5	30.3	34.2	39.7	45.7	52.8	61.8
12.5	710	43.81	9.30	29.6	33.0	36.7	42.3	49.3	54.9	63.8
13	685	47.03	9.74	31.8	36.1	39.6	45.3	51.7	58.6	67.8
13.5	665	48.23	9.57	33.3	37.6	41.5	46.9	53.0	60.1	69.9
14	655	50.10	9.07	35.9	39.7	43.4	49.1	54.8	61.9	70.0
14.5	750	51.33	8.39	37.9	41.7	45.3	50.2	55.9	62.1	71.2
15	789	53.25	8.85	39.7	43.2	47.0	51.7	57.8	64.3	72.5
15.5	662	54.07	8.74	40.5	44.2	48.0	52.5	58.0	64.4	73.0
16	723	54.23	8.13	40.9	44.9	48.7	52.9	58.2	64.6	73.3
16.5	683	55.00	8.30	41.6	45.0	48.8	53.2	58.8	64.7	73.7
17	630	54.77	8.97	42.2	45.1	48.9	53.3	58.9	64.8	73.7
17.5	508	54.61	7.89	42.3	45.2	49.0	53.5	59.3	65.1	73.8
18	427	55.70	9.25	42.5	45.6	49.6	54.6	60.0	66.6	73.8
18.5	199	52.92	10.79							

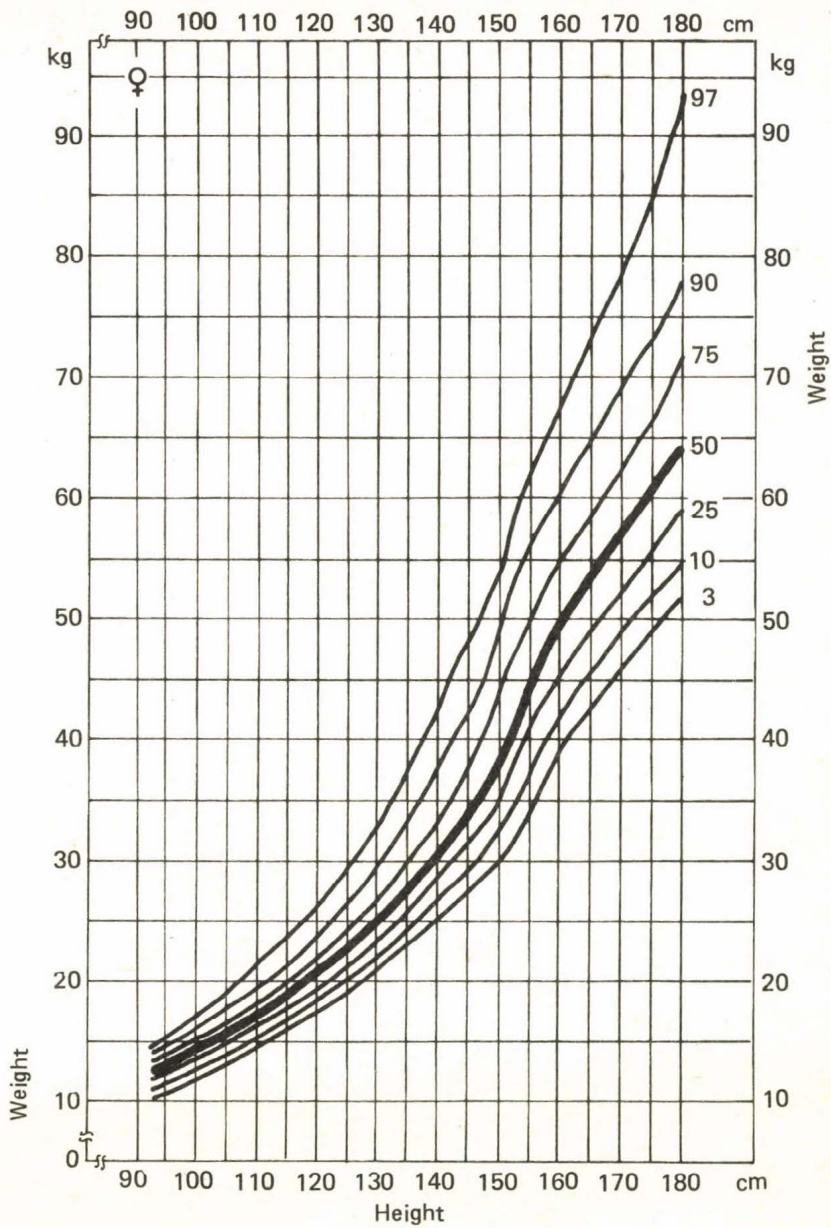*Fig. 4:* Percentiles of weight-for-height – boys

Fig. 5: Percentiles of weight-for-height – girls

Table 6. Means, SD-s and percentile values of weight-for-height in Hungarian boys

Height (cm)	N	Mean	SD	Percentiles						
				3	10	25	50	75	90	97
89.5	8	12.75	1.25		10.8		12.3		13.0	
91.5	13	12.27	1.36		11.0		12.4		13.4	
93.5	42	13.35	1.20		11.3		13.0		14.7	
95.5	62	13.85	1.30	11.4	11.9	12.7	13.8	14.6	15.3	15.9
97.5	100	14.42	1.27	11.8	12.6	13.5	13.9	14.9	15.6	16.8
99.5	143	14.77	1.08	12.4	13.2	13.8	14.6	15.1	15.8	16.8
101.5	188	15.31	1.37	12.6	13.5	14.1	14.9	15.5	16.8	17.8
103.5	267	15.99	1.59	12.9	14.2	14.8	15.6	16.0	17.6	19.0
105.5	265	16.43	1.39	13.9	14.6	15.1	16.0	17.0	18.0	19.3
107.5	305	16.90	1.31	14.5	15.0	15.7	16.6	17.6	18.4	19.5
109.5	306	17.67	1.53	14.9	15.6	16.5	17.3	18.3	19.3	20.8
111.5	321	18.33	1.68	15.6	16.1	16.9	17.8	19.1	20.2	21.7
113.5	326	18.95	1.62	16.0	16.8	17.6	18.7	19.6	20.8	22.1
115.5	356	19.44	1.79	16.5	17.1	18.0	19.0	20.0	21,2	23.2
117.5	399	20.33	1.76	17.3	18.0	18.9	19.9	21.0	22.0	23.9
119.5	414	20.99	1.87	17.8	18.7	19.5	20.6	21.7	23.2	24.9
121.5	387	21.92	2.24	18.6	19.4	20.2	21.5	22.6	24.1	27.0
123.5	454	22.75	2.54	18.9	19.8	20.9	22.0	23.7	24.9	28.3
125.5	504	23.64	2.56	19.7	20.7	21.8	22.9	24.6	26.2	28.9
127.5	490	24.60	2.77	20.5	21.5	22.6	23.9	25.6	27.6	30.8
129.5	519	25.71	2.91	20.9	22.0	23.7	25.0	26.7	28.9	31.9
131.5	507	26.76	3.19	21.9	23.1	24.6	25.9	27.9	30.0	33.9
133.5	519	27.92	3.54	22.9	24.3	25.4	26.9	29.0	31.6	35.8
135.5	507	29.16	3.36	24.0	25.4	26.7	28.5	30.0	33.6	37.0
137.5	541	30.60	4.03	25.5	26.5	27.7	29.6	31.7	35.5	39.9
139.5	541	31.65	4.04	25.9	27.3	28.7	30.7	33.1	36.7	41.5
141.5	581	33.12	4.83	26.8	28.3	29.8	31.7	34.6	38.8	43.8
143.5	566	33.85	4.22	27.8	29.1	30.8	32.8	35.2	39.8	44.9
145.5	545	35.55	5.01	28.7	29.9	31.9	34.3	37.7	42.0	47.0
147.5	474	37.58	5.62	29.9	31.6	33.4	36.3	39.9	44.6	51.1
149.5	441	38.81	6.05	30.5	32.6	34.6	37.3	40.9	46.4	53.9

Table 6. cont'd

Height (cm)	N	Mean	SD	Percentiles						
				3	10	25	50	75	90	97
151.5	439	40.70	6.70	31.6	33.8	36.1	39.4	43.1	49.7	56.8
153.5	428	42.68	6.83	33.0	35.3	38.2	41.0	45.7	51.6	58.4
155.5	432	43.84	6.89	34.6	36.7	39.1	42.2	46.8	53.2	60.1
157.5	412	45.96	7.07	36.6	38.7	40.6	44.2	49.3	56.0	63.7
159.5	372	47.56	7.33	37.4	39.8	42.7	45.8	50.6	57.9	66.1
161.5	423	49.84	7.37	38.8	41.5	44.7	48.8	53.2	58.8	67.7
163.5	513	52.77	7.56	41.1	43.9	47.3	51.6	56.3	61.5	70.0
165.5	582	54.67	8.44	42.9	45.3	49.0	53.4	58.7	64.6	74.5
167.5	607	57.15	8.37	45.2	48.0	51.2	55.5	61.2	67.5	76.3
169.5	719	59.22	8.42	46.4	49.9	53.3	58.2	63.2	69.7	78.3
171.5	737	60.96	8.57	48.2	51.3	55.4	59.7	64.8	71.5	81.5
173.5	749	63.03	8.62	49.4	53.2	57.4	62.0	67.6	73.0	83.0
175.5	688	64.43	8.47	51.3	54.8	59.0	63.3	68.3	74.8	85.3
177.5	592	66.23	9.07	53.1	56.5	60.3	64.9	69.7	76.6	88.9
179.5	522	67.78	9.46	53.8	57.2	61.5	66.2	72.2	79.2	91.0
181.5	328	70.97	9.62	56.5	60.3	63.9	68.6	74.2	81.7	91.1
183.5	222	70.57	7.83	57.8	61.4	64.9	69.5	75.2	81.8	91.6
185.5	164	71.36	8.50	58.0	61.7	65.5	70.6	76.4	82.9	92.5
187.5	100	72.92	10.02	59.6	62.6	66.9	71.8	78.8	84.8	97.1
189.5	62	77.38	9.87	61.4	66.1	70.8	74.9	82.9	90.9	97.8
191.5	30	81.93	13.27	64.4	69.0	73.6	77.0	86.9	93.0	120.6
193.5	31	78.18	19.94		69.6		81.5		(91.0)	

Table 7. Means, SD-s and percentile values of weight-for-height in Hungarian girls

Height (cm)	N	Mean	SD	Percentiles						
				3	10	25	50	75	90	97
87.5	8	12.56	1.27				12.5			
89.5	6	12.00	2.00				11.3			
91.5	19	12.84	0.82	10.8	11.0	11.8	12.8	13.3	13.9	14.4
93.5	40	12.94	1.07	11.0	11.3	11.9	12.9	13.5	14.0	14.9
95.5	89	13.32	1.26	11.5	11.8	12.4	13.3	13.9	15.0	15.4
97.5	138	13.76	1.21	11.8	11.9	12.9	13.8	14.3	15.3	16.4
99.5	164	14.63	1.23	12.4	13.0	13.8	14.4	15.3	16.0	16.9
101.5	233	15.23	1.41	12.5	13.4	14.0	14.9	15.9	16.9	17.9
103.5	232	15.67	1.55	13.3	13.9	14.8	15.4	16.4	17.0	18.0
105.5	240	16.38	1.86	13.3	14.3	15.3	16.0	17.0	18.0	19.3
107.5	278	16.83	1.39	14.4	15.0	15.8	16.4	17.1	18.8	20.2
109.5	318	17.67	1.79	14.8	15.4	16.3	17.4	18.5	19.8	21.8
111.5	319	18.18	1.79	15.3	15.9	16.9	18.0	19.0	20.4	22.3
113.5	335	18.91	2.09	15.8	26.4	17.3	18.5	19.9	21.4	23.6
115.5	373	19.57	2.03	16.4	17.0	17.9	19.3	20.4	21.9	24.2
117.5	438	20.20	2.31	16.7	17.5	18.6	19.7	20.9	22.5	25.0
119.5	397	21.22	2.56	17.5	18.2	19.5	20.7	22.0	23.8	26.7
121.5	415	21.85	2.55	17.9	19.0	20.5	21.2	22.7	24.7	27.7
123.5	463	22.80	2.87	18.5	19.8	20.8	22.0	23.7	25.9	29.2
125.5	432	23.45	2.64	19.5	20.4	21.4	22.8	24.5	26.2	29.8
127.5	466	24.51	2.94	20.1	21.1	22.3	23.8	25.7	27.9	31.0
129.5	490	25.55	3.45	20.5	21.7	23.0	24.7	26.8	29.6	33.1
131.5	480	26.78	3.31	21.9	23.0	24.3	25.8	28.0	30.6	34.3
133.5	481	28.02	4.06	22.4	23.6	25.3	27.0	29.2	32.7	36.9
135.5	487	28.97	4.03	23.5	24.5	25.8	28.0	30.6	33.8	38.3
137.5	457	30.32	4.31	24.2	25.6	27.1	29.4	32.2	35.7	39.9
139.5	462	31.94	5.11	25.2	26.7	28.2	30.5	33.9	38.2	43.4
141.5	409	33.05	5.24	26.3	27.7	29.1	31.8	34.9	39.8	45.4
143.5	429	34.34	5.43	26.9	28.3	30.4	32.8	36.6	40.8	47.4
145.5	452	36.01	5.58	27.7	29.7	31.8	34.6	39.2	43.6	49.2
147.5	451	38.06	6.42	28.6	30.6	33.0	36.8	41.2	46.1	51.8

Table 7. cont'd

Height (cm)	N	Mean	SD	Percentiles						
				3	10	25	50	75	90	97
149.5	489	39.68	6.64	30.1	32.0	34.7	38.5	43.0	48.3	53.2
151.5	544	42.71	7.02	31.7	34.6	37.5	41.1	46.2	51.6	57.3
153.5	636	44.29	7.19	32.1	35.6	39.1	43.3	48.0	53.3	60.5
155.5	826	47.17	7.73	34.8	38.2	41.7	46.0	51.1	56.4	63.8
157.5	903	48.86	7.58	37.1	40.3	43.6	47.6	52.2	58.2	66.0
159.5	1085	50.74	7.91	38.6	41.8	45.3	49.8	54.6	60.1	68.2
161.5	1097	52.35	7.88	40.1	43.6	46.9	51.0	56.1	61.5	70.5
163.5	935	53.61	7.72	41.4	44.6	48.0	52.3	57.7	63.2	71.2
165.5	788	55.20	7.64	43.4	46.5	50.0	53.9	58.4	64.8	73.1
167.5	605	56.60	8.01	44.2	47.3	51.1	55.2	60.1	67.0	75.9
169.5	406	58.16	9.36	45.5	48.5	51.7	56.3	62.2	69.8	78.5
171.5	315	60.12	8.78	47.3	50.4	53.8	58.5	64.0	70.6	81.2
173.5	158	60.67	7.88	48.4	51.2	54.9	59.6	65.4	71.2	83.7
175.5	95	61.84	7.63	49.2	52.7	56.6	61.3	67.3	72.6	86.8
177.5	41	66.24	12.70	50.6	53.0	58.1	62.9	70.0	75.5	96.2
179.5	44	64.59	15.91	51.5	54.1	59.0	63.7	71.5	77.9	98.0

Clinical interpretation

The Hungarian growth standards represented in Tables 2 to 7 and in Figures 2 to 5 involve only height and weight. They provide parents, teachers, clinicians with a general reference for child growth.

It is recognized that while all children follow a similar rhythm of growth from birth to adulthood, the tempo varies. Some children mature earlier or later than others. There may be some evidence of this from repeated measurement occasions and plots of obtained values on the growth charts. The causes of such variation in individual growth rates may be genetic in origin or as we have suggested may also be related to socio-economic and cultural factors.

Future research

The balance of the cross-sectional data on Hungarian children and youth will also be used in a series of studies designed to provide normative data on somatotype, proportionality, and estimation of body composition.

The present Hungarian National Growth Standards and the planned new models and approaches have both scientific and clinical relevance in school medical and governmental efforts to foster optimal growth and development of all the children of all the people. Having now the Hungarian reference growth data as an *etalon*, results of all the regional growth surveys are comparable, and so, they are more valuable.

The report to-date is not a final summary; it is an initial report in the ongoing difficult, complex and important task of providing quantitative methods in human biology.

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