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ANTHROPOLOGIAI KÖZLEMÉNYEK

A MAGYAR BIOLÓGIAI TÁRSASÁG
EMBERTANI SZAKOSZTÁLYÁNAK FOLYÓIRATA

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ANTHROPOLOGIAI KÖZLEMÉNYEK

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Felhívás a szerzőkhöz

Az Anthropologiai Közlemények a Magyar Biológiai Társaság Embertani Szakosztályának folyóirata, a Magyar Tudományos Akadémia Biológiai Tudományok Osztályának felügyeletével és támogatásával jelenik meg. Szerkeszti a szerkesztőbizottság.

A szerkesztőbizottság elfogad a fizikai antropológia, ill. az általános (nem klinikai) humángenetika témaköréből önálló vizsgálatokon alapuló tanulmányokat, továbbá olyan kritikai vagy szintézist tartalmazó közleményeket, amelyek az embertani tudomány előbbrevitelét szolgálják. A közlés alapfeltétele általában az, hogy a tanulmányt a szerző a MBT Embertani Szakosztályának szakülésén előadja.

Az előadásokat a szakosztály titkáránál lehet bejelenteni és azok műsorra tűzéséről a Szakosztály intézőbizottsága dönt.

Az Anthropologiai Közleményekhez közlésre benyújtott kéziratok tartalmi és formai követelményei a következők:

1. A tanulmányok világosan fogalmazott célkitűzésű, korszerű módszerekkel végzett vizsgálatok igazolt, bizonyított eredményeit tartalmazzák, tömör és érthető stílusban. A tanulmányok terjedelme mondanivalójuk mértékéhez igazodjon. A rendelkezésre álló évi 12 ív terjedelem korlátozza az egyes tanulmányok terjedelmét, ezért 2–2,5 szerzői ívet meghaladó terjedelmű kéziratokat nem áll módunkban elfogadni. A történeti antropológiai tanulmányoknál egyedi méreteket — őskori és honfoglalás kori szériák kivételével — általában nem közlünk.

2. A kéziratot A/4 alakú fehér papírra, kettős sorközzel, a papírlapnak csak az egyik oldalára kell gépelni, oldalanként 25 sor, soronként 55–60 betűhely lehet. Minden dolgozatot két teljes, nyomdakész kéziratpéldányban kell benyújtani, összefoglalással, táblázatokkal, ábrákkal együtt.

3. Az idegen nyelvű összefoglalást — amely a tanulmány terjedelmének mintegy 10 százaléka — az Anthropologiai Közlemények a kongresszusi nyelvek egyikén közli. Az idegen nyelvű összefoglalásnak tartalmaznia kell a probléma felvetését, az alkalmazott vizsgálati módszert, valamint a kutatás legfontosabb eredményeit.

A tanulmány címoldalán 150 szónál nem nagyobb terjedelmű, angol nyelvű *Abstract*-ot közlünk.

A fordításról — ha a szerzőnek nem áll módjában — a Kiadó gondoskodik.

4. A tanulmányhoz tartozó táblázatoknak, ábráknak az Anthropologiai Közleményeknél az utóbbi évfolyamokban kialakult egységes gyakorlatot kell követniük.

A táblázatokat a tudományos dokumentáció elveinek figyelembevételével kell megszerkeszteni. Az egyes tanulmányokhoz tartozó azonos típusú táblázatoknak egységeseknek kell lenniük. A folyóirat tükrébe be nem férő táblázatok több részre osztandók; több oldalas (behajtós) táblázatokat nyomdatechnikai okokból nem fogadunk el. Minden táblázatot külön lapra kell gépelni, sorszámmal és címmel kell ellátni.

5. Csak gondos kivitelű és klisézésre alkalmas minőségű ábrákat fogadunk el. A rajzon alkalmazott jelölések világosak, egyértelműek legyenek. Minden ábrát, függetlenül attól, hogy vonalas rajz vagy fotó, *ábra* jelöléssel, sorszámmal és aláírással kell ellátni. A műnyomó papírt igénylő fényképeket tábla formájában közli a lap; ezek összeállításánál a szerzőknek a tartalmi követelmények mellett az esztétikai szempontokat is figyelembe kell venniük.

The Anthropologiai Közlemények is indexed in Current Contents.

Folytatás a borító 3. oldalán

ANTHROPOLOGIAI KÖZLEMÉNYEK

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GROWTH STANDARDS

Fourth International Symposium of Human Biology

The Symposium was organized by the Departmant of Anthropology, Eötvös Loránd University and was held at Pécs between 23 and 26 June, 1986.

Anthrop. Közl. 30; 3–4. 1986.

GROWTH STANDARDS AS A TOOL IN PRIMARY HEALTH CARE

Opening Address
at the Fourth International Symposium of Human Biology
(Pécs, 23–26 June, 1986)

Ottó G. Eiben
Department of Anthropology, Eötvös Loránd University, Budapest, Hungary

It is my great pleasure and honourable task to have the occasion fourth time to welcome all of you to our Symposium. The series of our Symposiums of Human Biology have already a nice tradition, and without any immodesty we can state that our preceding symposiums were successful.

In 1976, in Balatonfüred, in connection with the "summing up" phase of the International Biological Programme, the main subjects of our First Symposium of Human Biology were *Growth and Development* of children as well as the variations of human *Physique*, themes which had been in the centre of interest long ago. Our intention was at that time to open the Hungarian physical anthropology's/human biology's windows wide at the world.

In 1979, in Visegrád the main subject of our Second Symposium was the *Functional Biotypology*, and the overwhelming majority of the presentations dealt with different aspects of the human physique. However, several lectures touched the problems of growth and development of children, and so, we intended to contribute to the success of the International Children's Year.

In 1981, in Bozsok, during our Third Symposium, we discussed the *Variations of Human Growth and Physique*, aspecially four aspects of them: the genetical, the clinical, the ecological, and the kinanthropometrical sides of this problem-circle.

The multidisciplinary character of our Symposiums was ensured.

This time (in 1986, in Pécs) as main topic of our Fourth Symposium we have chosen the *Growth Standards*, again a theme which was in the forefront of interest of as human biologists as well as pediatricians decades ago.

What does cause this great interest?

Simply two facts, I think. Firstly, a lot of us have a feeling of responsibility for the children's welfare, and secondly, growth and development data constitute a comprehensive and sensitive indicator specific to child health.

But, it seems to be worthy surveying some ambitions all over the world. Let us remember the International Conference on Primary Health Care organized in Alma-Ata in September 1978, and jointly sponsored by the World Health Organization and the United Nations Children's Found. This conference declared the basic principle *„Health for all by 2000!"*.

The Declaration of Alma-Ata strongly reaffirms that *"health*, which is a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity, is a fundamental human right and that the attainment of the highest possible level of health is a most important world-wide social goal whose realization requires the action of many other social and economic sectors in addition to the health sector".

The Declaration points out that "economic and social development is of basic importance to the fullest attainment of health for all and to the reduction of the gap between the health status of the developing and developed countries. The promotion and protection of the health of the people is essential to sustained economic and social development and contributes to a better quality of life and world peace.".

The Declaration emphasizes the governments' responsibility „for the health of their people which can be fulfilled only by the provision of adequate health and social measures. A main social target of governments, international organizations and the whole world community in the coming decades should be the attainment by all peoples of the world by the year 2000 of a level of health that will permit them to lead a socially and economically productive life. *Primary health care* is the key to attaining this target as part of development in the spirit of social justice". – "All governments should formulate national policies, strategies and plans of action to launch and sustain primary health care as part of a comprehensive national health system, and in coordination with other sectors". – "All countries should cooperate in a spirit of partnership and service..." – "An acceptable level of health for all the people of the world by the year 2000 can be attained through a fuller and better use of the world's resources..."

It is clear that growth and development data, first of all growth standards, are essential tools in hands of the primary health care, and they are indispensable in pediatric practice before and after birth and can be used as a positive indicator of outcome of pregnancy and of child health. In other words, data on growth and development can be considered "positive" and sensitive indicators specific to maternal and child health, and some relevant data can be monitored on the basis of simple measurements. Let be enough this time to mention the problems of fetal growth and birth weight, those of low birth weight, its etiology, preventions, and social implications, or in general, the childhood growth and development, including puberty. Today it is a proved statement that growth is the best indicator of nutritional status, i.e. it is more reliable than laboratory or clinical signs. But in general, we can state that children's growth process monitors also the public health status, and further also the biological value of the population.

We have many findings connected with remarkable effects as of the genetic endowments as well as of the environmental factors influencing growth and development process. We have many data on the most critical period of growth and development process, on the puberty. We know a lot about secular trend which also has important consequences for physical and mental health in childhood.

We can be sure that all these data are necessary for a well-organized primary health care system. In recent years, health workers (first of all social pediatricians) and scientists (first of all human biologists) have give more attention to systematizing the collection, the interpretation, and dissemination of data on growth and development, but much remained to be done in this field. We believe and profess that every child has his/her inalienable right to grow up healthy, and to realize his/her genetically given growth pattern wholly and completely. Consequently, we must take every opportunity to do something for the unceasing improve the environmental factors influencing growth and development of children. The youth of the early 2000s will born in the next years. We have a great responsibility for the children and youth of the next decades, for their better future. We must not forget: children grow up only once!

We are convinced that we worked in a good case as we intended to look over growth standards or reference data, and all possible findings near and far connected with growth process of children, since all these are valuable data also for the primary health care service. In this spirit we hope that our Symposium will be a useful contribution to the ambition of "Health for all by 2000!".

I wish all the best to all of you, I wish a successful Symposium!

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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

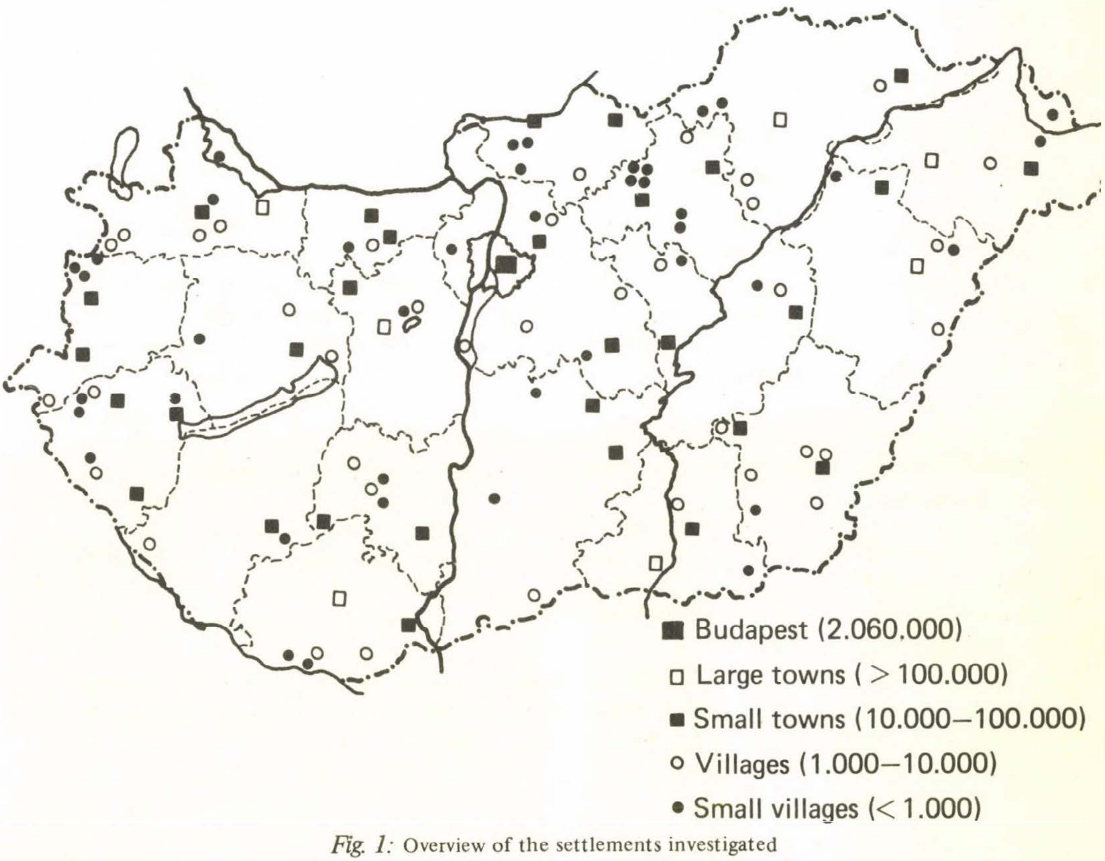

Fig. 1: Overview of the settlements investigated

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?".

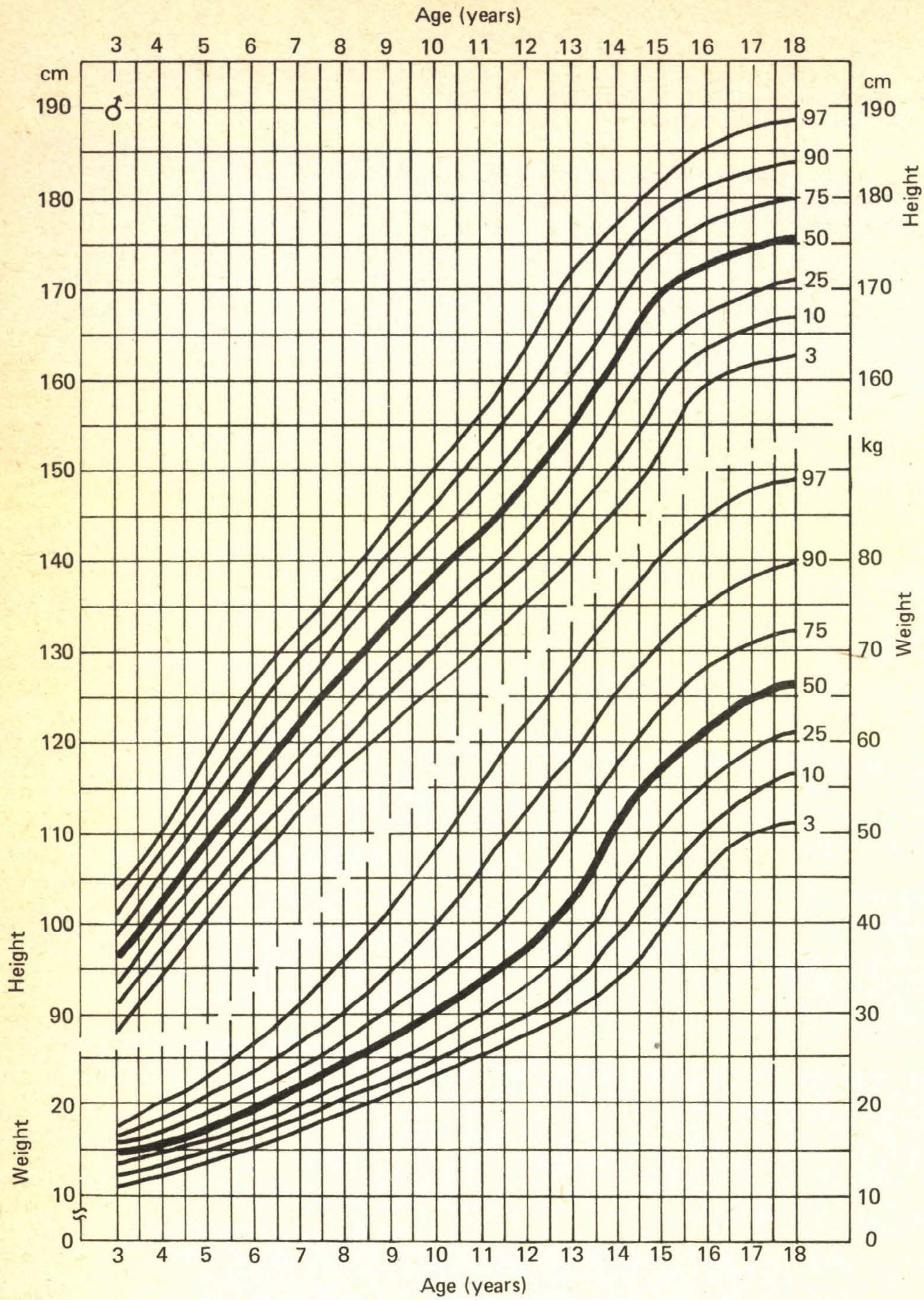

Fig. 2: Percentiles of the height and weight – boys

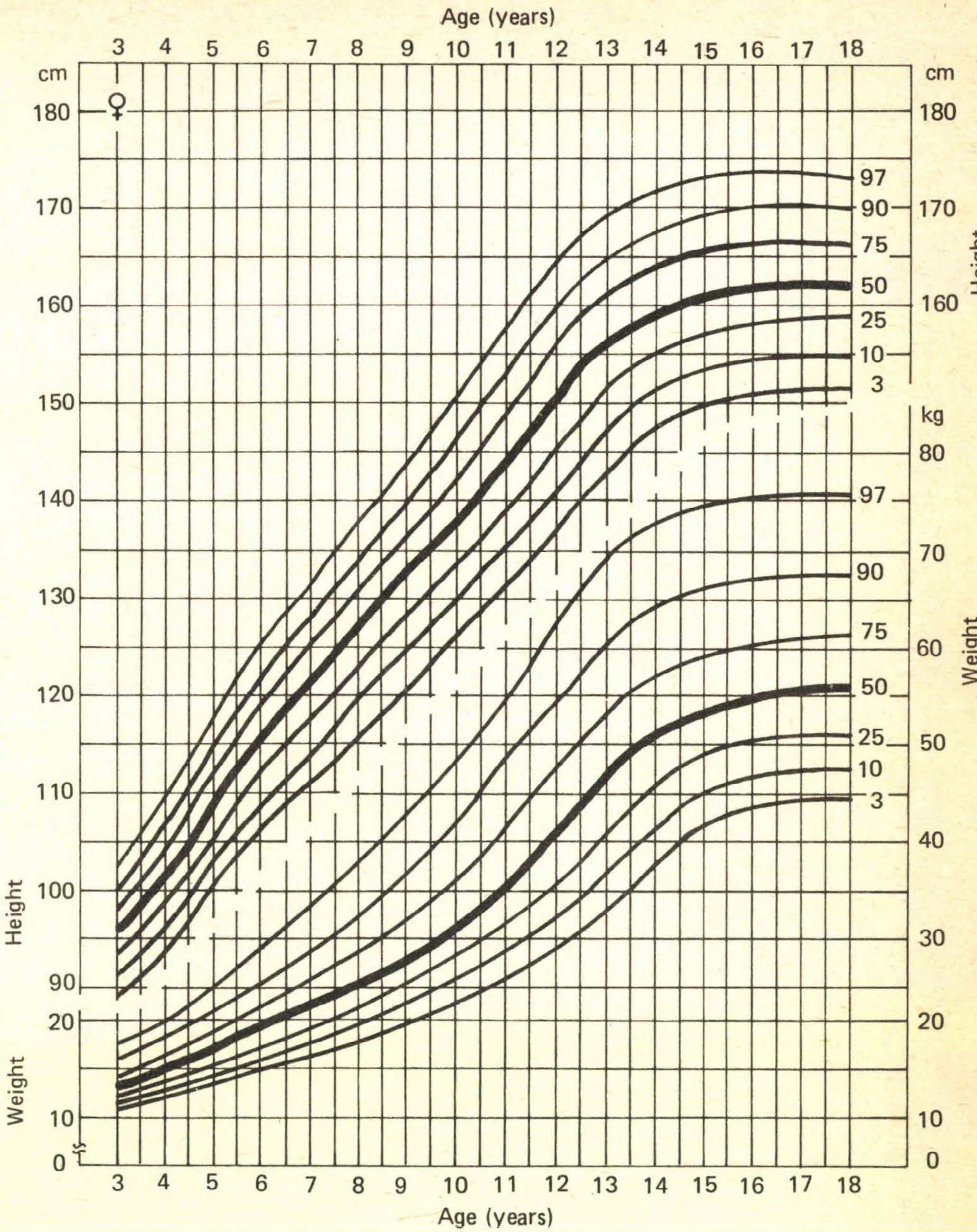

Fig. 3: Percentiles of the height and weight – girls

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	103.6	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							

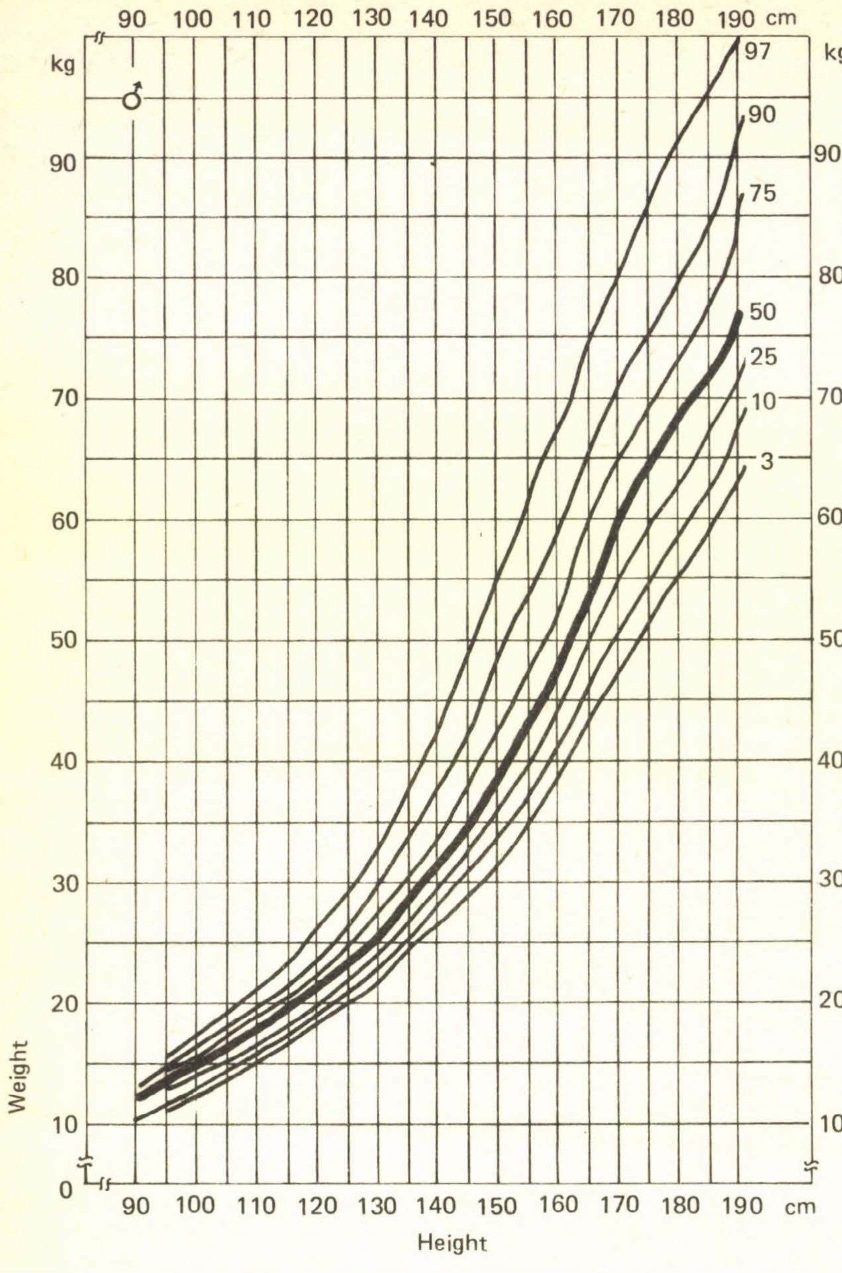

Fig. 4: Percentiles of weight-for-height – boys

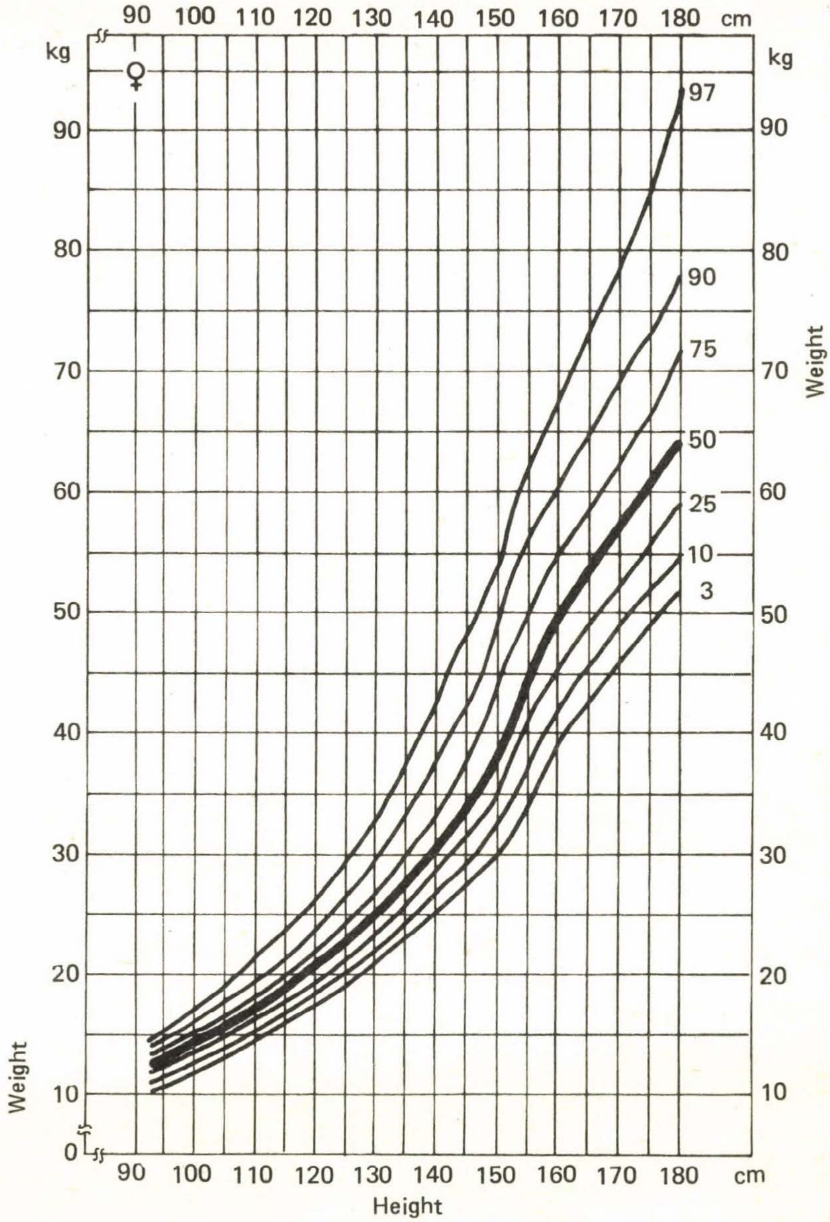

Fig. 5: Percentiles of weight-for-height – girls

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 socioeconomic 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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CHILD GROWTH NATIONAL STANDARDS IN CZECHOSLOVAKIA

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Abstract: The growth of children and adolescents in Czechoslovakia has been systematically investigated by nation-wide growth surveys, undertaken since 1951 at intervals of 10 years on a random sample of children between 0 and 18 years. Due to the secular trend demostrated by these surveys, the 1951 standards as used in the child health service, ceased to reflect reality as early as 1971. In that year the average height in the individual age groups of school children deviated from the 1951 standard by about 0.5 S.D. A new standard for assessing height and body proportions of boys and girls from 3 to 18 years of age has been established in the form of tables and charts based on the 1981 survey (for the Czech districts). Examples of how to use the charts in paediatrics (following the growth of an individual child) and in the public health service (following the distribution of height and body proportions and the state of nutrition in groups of children) are given. Data on height and weight of the Czech children and youth in 1981 from 0 to 18 years are given in the enclosed tables 1–4.
Key words: Growth standards, Paediatrics, Children's body proportions.

Introduction

It is well-known that even an experienced pediatrician cannot assess reliably a child's growth at a given age without appropriate growth standards (Tanner 1978). Despite the fact that Matiegka* (1927), with help of teachers, had accomplished an examination of about 100 000 Czech schoolchildren as early as in the year 1895, until the beginning of the second half ot the 20th century the growth of Czechoslovakian children was assessed according to foreign (American after Woodbury and Baldwin) and Austrian (after Pirquet) standards. An extensive investigation comprizing over 120 000 Czech children (a random sample of 4%) between 3 and 18 years of age was executed under the guidance of V. Fetter in the year 1951, when it was deemed necessary to obtain reliable national standards for the evaluation of the growth of children. Moreover the investigation was set up to elucidate the question whether or not the World War II had depressed the growth of children and adolescents. Consecutively to this investigation, three additional nation-wide growth suerveys have been executed to date. With intervals of 10 years, these were made comprising children from 0 to 18 years in the years 1961, 1971 and 1981, for the Czech and Slovakian regions separately. The results always demonstrated a progressive secular growth trend in the Czechoslovakian samples. As early as in 1971 it appeared that the 1951 growth standards, which were used in school health records, had ceased to correspond to reality (Prokopec et al., 1973, Prokopec 1985).

*Jindřich *Matiegka* (31.3.1862 – 4.8.1941) was the lst professor of anthropology and demography on the Charles' University in Prague and the founder of modern anthropology in Czechoslovakia. He also founded with paedagogists F. Čáda and J. Dolenský and with K. Herfort, a psychiatrist the Institute for the study of child and youth development in 1910 in Prague. Besides his extensive child growth survey in 1895 Matiegka introduced "dental age" into assessment of child development in early 1920th, stereophotogrammetry (with Prof. Pantoflíček) into physical anthropology as early as 1910 and has a World priority in developing the study of body composition "in vivo" by means of external measurements including skinfolds in 1921 (Am. J. Phys. Anthrop.).

Table 1. Czech National Standards – 1981. Boys' stature (M. Prokopec – S. Titlbachová)

Age (months/years)	N	M	S.D.
1 month	730	54.31	2.94
2	579	58.31	3.32
3	605	61.58	3.33
4	583	64.65	3.27
5	612	66.92	3.21
6	574	69.39	3.37
7	597	70.70	3.18
8	612	72.15	3.17
9	555	73.46	3.23
10	578	74.46	3.06
11	545	75.85	3.23
1 year	1661	76.97	3.56
1.25	1844	80.02	3.60
1.5	1784	82.96	3.60
1.75	1688	85.75	3.78
2	2770	88.07	4.10
2.5	2531	92.85	4.10
3	2214	96.87	4.14
3.5	2441	100.67	4.34
4	3972	103.51	4.95
5	2885	110.97	5.22
6	2339	117.28	5.59
7	2349	123.30	5.46
8	2351	129.22	5.87
9	2341	134.56	6.24
10	2257	139.88	6.45
11	2225	144.97	6.89
12	2289	150.50	7.27
13	2435	157.17	8,57
14	2243	164.60	8.81
15	2301	171.28	7.93
16	2543	175.21	7.16
17	2413	177.20	6.71
18	2006	178.26	6.83

Table 2. Czech National Standards – 1981. Girls' stature (M. Prokopec – S. Titlbachová)

Age (months/years)	N	M	S.D.
1 month	724	53.14	2.63
2	563	56.73	3.21
3	624	59.85	3.15
4	567	62.70	3.14
5	600	65.46	3.15
6	609	67.40	3.17
7	567	69.13	3.18
8	616	70.30	3.20
9	531	71.72	3.35
10	600	73.12	3.23
11	575	74.13	3.49
1 year	1668	75.28	3.47
1.25	1811	78.52	3.44
1.5	1872	81.67	3.79
1.75	1712	84.26	3.86
2	2822	86.74	4.14
2.5	2523	91.79	4.39
3	2203	96.13	4.25
3.5	2451	99.76	4.37
4	3975	103.09	4.93
5	2876	110.44	5.36
6	2474	116.74	5.51
7	2266	122.78	5.45
8	2437	128.34	5.88
9	2341	133.91	6.20
10	2269	139.47	6.58
11	2280	145.71	7.43
12	2330	152.28	7.60
13	2485	158.03	6.96
14	2233	162.10	6.51
15	2486	164.13	5.87
16	2832	164.69	5.95
17	2884	165.07	5.78
18	2418	165.35	5.83

Table 3. Czech National Standards – 1981. Boys' weight (M. Prokopec – S. Titlbachová)

Age (months/years)	N	M	S.D.
1 month	730	4.14	0.64
2	579	5.19	0.76
3	605	6.14	0.86
4	583	6.98	0.82
5	612	7.66	0.88
6	574	8.22	0.92
7	597	8.72	0.91
8	612	9.05	1.00
9	555	9.52	1.09
10	578	9.84	1.06
11	545	10.16	1.17
1 year	1661	10.42	1.26
1.25	1844	11.11	1.22
1.5	1784	11.82	1.35
1.75	1688	12.34	1.41
2	2770	12.90	1.49
2.5	2531	14.02	1.60
3	2214	15.04	1.73
3.5	2441	16.14	1.89
4	3972	17.02	2.07
5	2885	19.21	2.45
6	2334	21.64	3.14
7	2349	24.09	3.64
8	2351	27.07	4.40
9	2341	30.23	5.36
10	2257	33.65	6.19
11	2225	37.23	7.13
12	2289	41.09	7.89
13	2435	46.79	9.57
14	2243	52.71	10.14
15	2301	58.96	9.59
16	2543	63.97	9.33
17	2413	67.29	8.98
18	2006	69.74	8.48

Table 4. Czech National Standards – 1981. Girls' weight (M. Prokopec – S. Titlbachová)

Age (months/years)	N	M	S.D.
1 month	724	3.84	0.54
2	563	4.73	0.64
3	624	5.59	0.70
4	567	6.40	0.77
5	600	7.11	0.85
6	609	7.60	0.85
7	567	8.08	0.87
8	616	8.47	0.97
9	531	8.83	1.08
10	600	9.23	1.05
11	575	9.39	1.11
1 year	1668	9.75	1.16
1.25	1811	10.48	1.19
1.5	1872	11.11	1.30
1.75	1712	11.72	1.36
2	2826	12.27	1.47
2.5	2523	13.47	1.61
3	2203	14.56	1.76
3.5	2451	15.58	1.90
4	3975	16.51	2.16
5	2876	18.77	2.78
6	2474	21.15	3.19
7	2266	23.70	3.81
8	2437	26.62	4.46
9	2341	29.85	5.46
10	2269	33.37	6.35
11	2280	37.61	7.71
12	2330	43.23	9.26
13	2485	48.25	9.21
14	2233	52.77	8.74
15	2486	55.87	8.16
16	2832	57.78	8.33
17	2884	58.87	7.71
18	2418	59.08	7.94

Therefore on the basis of the results of the 4th nation-wide anthropometrical research from the year 1981 (for the Czech districts) new tables were compiled to be used as a new growth standard (Table 1–4). On basis of these tables, new percentile charts, were developed at the Institute of Hygiene and Epidemiology in Prague by Prokopec and Roth (Figures 1 and 2).

Growth Standards

Description of the charts: The Assessment of Height

The charts were drawn separately for boys (Figure 1) and for girls (Figure 2). The principle of both charts is the same. The measured height of the child (from 3 to 18 years) is evaluated from the upper part of the chart in relation to age. The body proportions, i.e. measured weight for height are evaluated from the lower part of the chart. Age is registered on the horizontal scale at the top of the charts, height on the vertical one. The curves represent the boundaries of the bands as determined by selected percentiles. For example 3 per cent of the children in the given age category from the group which has been submitted for measurement are under the curve denoted by the third percentile. The drawn curves form three bands, which are divided in halves by the dashed curves. By plotting into them the individual values of height and age, the charts render it possible to classify the child in one of the five height categories: I= very tall, II = tall, III = of medium height, IV = small, V = very small.

A more accurate evaluation of the height can be obtained by estimating the deviation of the child's position in the grid from the median 50th percentile curve (thick dashed line – M) at given age expressed in fractions (decimals) of the band's width (B. W.) at that age. Band's width (the distance between the two thick curves at given age) equals approximately 1.2 S.D. of the mean height at given age. In case of extremely tall or extremely small child for its age whose height lies either in the area I or IV, we may estimate the distance of the child's position from the 50th percentile by extrapolation using the width of the band at given age as a measure (Table 5).

The heavily dotted line in the Figures 1 and 2 which is not a part of the chart represents the abandoned 1951 standard – a visual comparison with the 50th percentile dashed curve of the 1981 standard is possible in this way.

The Assessment of Body Proportions

In the lower part of the charts height is marked on the horizontal axis and weight on the vertical axis. The weight scale is logarithmic, to economize on space. In this way the curves become linear, and can be fitted into the charts. The curves divide the lower part of the charts into five categories denoted by letters A, B, C, D, E according to the body proportion of the child in question: A = fat or obese, B = robust, C = well-proportioned, D = thin, E = very thin.

For more accurate evaluation we use again fractions of the band width at given centimetre of height. The way of assessing the deviation of the child from the 50th percentile median curve is similar as it was when assessing height in the upper part of the grid (Table 6).

Again, the heavily dotted curve drawn in the lower portion of the chart (which is not a part of it) represents the 1951 mean height-weight ratio, showing the secular change in mean body proportions when compared with the 1981 fifty percent curve. Girls show a more distinct tendency towards thinning than boys (see Figures 1 and 2).

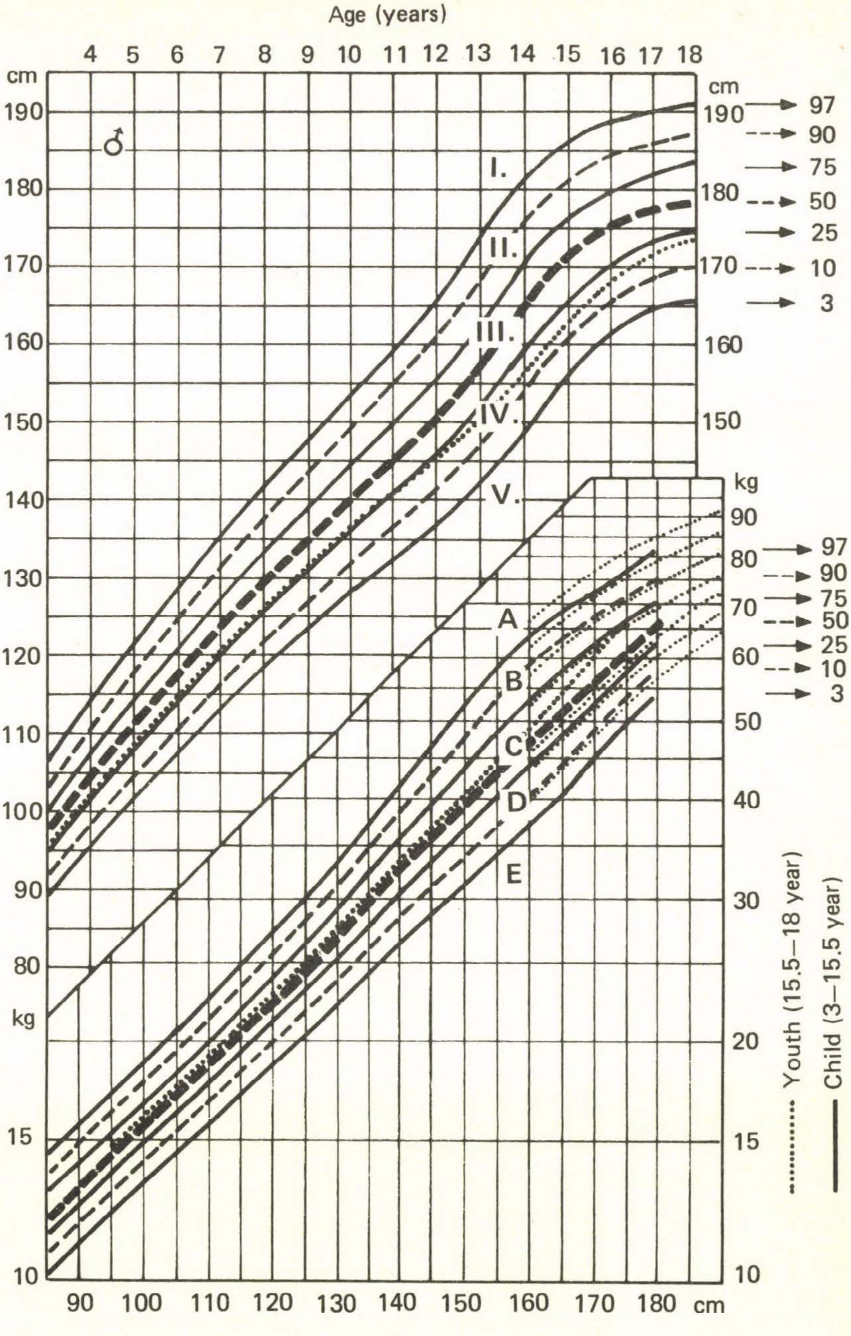

Fig. 1: Percentile chart for the assessment of height for age (upper part) and weight for height (body proportions; lower part) in boys. The heavily dotted lines represent the standards of 1951. For a further legend: see text

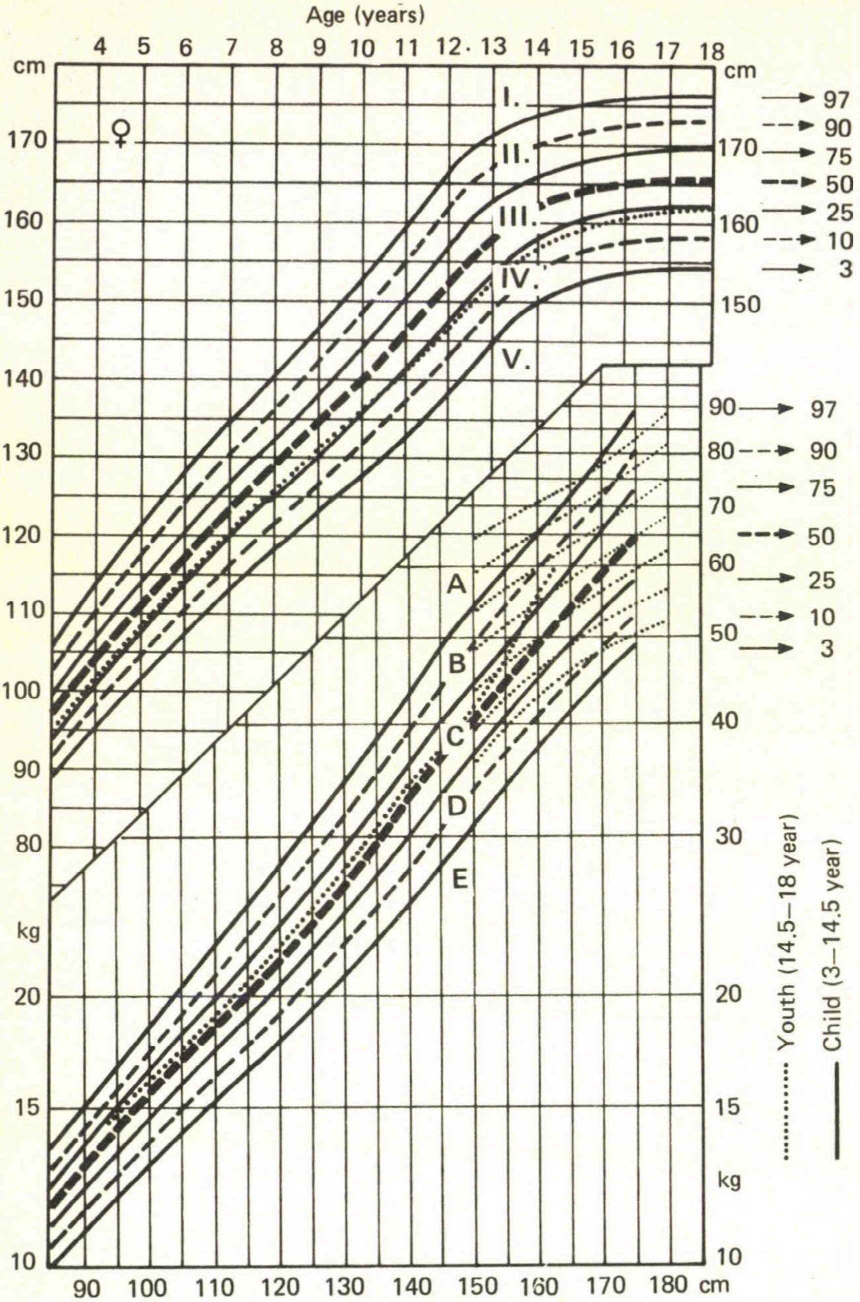

Fig. 2: Percentile chart for the assessment of height for age (upper part) and weight for height (body proportions; lower part) in girls. The heavily dotted lines represent the standards of 1951. For a further legend: see text

Table 5. Height categories

	Height category	Percentiles	Expected number of children in percent	Fractions of band width
I	Very tall	over 97th	3	M+1.6 and more
II	Tall	75th to 97th	22	M+0.6 to M+1.5
III	Of medium height	25th to 75th	50	M–0.5 to M+0.5
IV	Small	3rd to 25th	22	M–0.6 to M–1.5
V	Very small	below 3rd	3	M–1.6 and more

Table 6. Categories of Body Proportionality

	Category of Body Proportionality	Percentiles	Expected number of children in percent	Fractions of band width
A	Obese	over 97th	3	M+1.6 and more
B	Robust	75th to 97th	22	M+0.6 to M+1.5
C	Well-proportioned	25th to 75th	50	M–0.5 to M+0.5
D	Thin	3rd to 25th	22	M–0.6 to M–1.5
E	Very thin	below 3rd	3	M–1.6 and more

The use of the charts

Important data which are necessary to a child's assessment are: (1) its accurate age in years and months (or decimals of the year), (2) its height, determined by measuring the child without any footwear in a maximum erect posture with its heels together, the head positioned to look into far distance, i.e. with the position of the head on the Frankfurt plane, and (3) its weight by means of accurate scales (not using a spring system).

By plotting the height for age in the upper part of the appropriate chart, we are able to evaluate the child's height by means of the symbols I–V, according to the position of the point, representing the child in the proper band. The height may be more accurately defined by using the band widths.

After plotting the weight for height values into the lower part of the chart we are also able to read the body proportions. In compliance with the position of the point representing a given child in the bands of the chart we may evaluate his or her body proportions, designating it by one of the letters (A–E). If we want to express its proportions more accurately, we may use the auxilliary dashed curves and express the deviation of the child from the 50th percentile curve in fractions of band widths or by the corresponding percentiles.

Example: Ann is 10 years old. She is 145 cm tall. After plotting her height into the grid we find out that she is in the II category of body height. We may assess her more accurately as being M+0.6 B. W. above the 50th percentile curve. Supposing that she adds 10 cm to her height in the course of a year, she will remain at 11 years with her 155 cm in the II category. Her deviation from the median 50 th percentile curve will be + 1.1 B. W.

Ann's weight at 10 years was 43 kg. When plotted in the lower part of the grid jointly with her height she finds herself in the B category as "robust". She deviates from the 50th median percentile curve by M+0.8 B. W. At 11 with her 48 kg and 155 cm she moved to category C as "well-proportioned", her position in the grid being M+0.4 B. W.

Ann was assessed in symbols at 10 as II/B and at 11 as II/C.

The relation of weight to height changes with the child's age: Out of two children, equally tall, the older child tends to be heavier, starting after about the age of 12 in girls and 14 in boys. The curves characterising the group of older children: boys between 15 and 18 and girls between 14 and 18 years old are represented by a series of thin dotted lines at the upper and of the weight curves. Their course is different, especially in girls. The order of the bands remains and their use is the same. The fact that the percentiles were calculated from the age 3 to 14 years makes the grid slightly a less sensitive to very thin and very heavy (obese) children from younger age groups.

The information about the individual child, to be derived from the charts

The possibilities of practical use of the percentile evaluation charts are the following: (1) It is possible to evaluate each child within the framework of the bands. The child may be designated by a formula representing his or her height and body proportions, i.e. by a Roman numeral and a capital letter. Should we want to make its evaluation more accurate, we are obliged to determine its position within the appropriate band. The band is then considered as the evaluation unit, in the same way as was the standard deviation (S.D.) in the former charts (Kapalin and Prokopec 1957). A precise reading (calculation) of percentiles from the chart is uneasy, even not possible because there are different numbers of percentiles in the various bands. (2) If a boy or a girl has been measured regularly, the individual growth curve may demonstrate his or her longitudinal bodily development against the background of the total population of children. In this way we may evaluate the dynamics of the growth of an individual child. This is convenient for the clinical practice, the school health service, for the determination of the relative date of the onset of puberty, etc. The puberty period in the individual child has a shorter duration than is indicated by the accelerated slope of the growth curves on the chart, which represent the whole population of children. Therefore, the growth curve of an individual child most frequently deviates temporarily from the general course of the standard height curves and after about two to three years returns to the position in the band which it occupied before the growth spurt started. The diagnosis of an early or late maturer is possible by comparing the individual growth curve with the standard. This may serve for the selection of athletes, etc.

The information on specific groups within the children's population, to be derived from the charts

The percentile charts renders it possible to evaluate a collective of children (a school class, etc.), which is not homogeneous with regard to age or which even consists of both sexes together (group diagnosis). By calculating the percentages of children in the separate height or body proportion groups (bands) we may obtain, by means of a simple table (Fig. 3), an idea about the growth, variability or homogeneity of the given group and even to a certain extent about its level of nutrition and other factors. Expected (theoretical) relative numbers of children (percentages) in individual bands I–V for height and A–E for body proportionality are als follows: I/A = 3 per cent, II/B = 22 per cent, III/C = 50 per cent, IV/D = 22 per cent, V/E = 3 per cent. Any substantial deviation of this scheme found in a studied group of the Czech children should be a reason for being concerned and for a raised attention.

This practical use of the chart is demonstrated by an example of 4 girls and 4 boys. Figure 4 shows 4 selected girls: 1 = slender, 2 = well-proportioned, 3 = robust and 4 = of delayed growth. Their individual data are presented in Table 7. The girl No. 4 appears to be a well-proportioned child according to the lower part of the chart as well as by visual assessment. However, if we relate the value of her height to her calender age, she is very

Table 7. Height, weight and body proportions of four girls

Number of the girl	Age	Height	D1*	Weight	D2*	Assess-ment
1	13y. 1m	157.0 cm	– 0.2	39.0 kg	–1,0	III/D
2	12y. 1 m	153.0 cm	0	41.5 kg	–0.2	III/C
3	8y. 0 m	123.0 cm	–0.75	30.5 kg	+1.7	IV/A
4	11y. 6 m	126.0 cm	–2.4	23.2 kg	–0.4	V/C

*Deviation (distance) from the 5th percentile curve (M) in fractions of band width at given age for D1 and for given height for D2

small. The average girl of her age would be 149 cm tall according to the 50th percentile curve. Her biological (height) age is 7y, 6m. as shown by a cross-section of the girl's actual height with the 50th percentile curve.

The boys are depicted in Figure 5, and their data are presented in Table 8. The boy No. 4 shows an accelerated growth, in contrast to the delayed girl. He exceeds his peers of medium stature by 14cm, the mean stature for a boy of 12y, 5m. being 154 cm. The silhouettes of the children in Figures 4 and 5 were all made at the same scale, so that their heights and body proportions are mutually comparable.

	A	B	C	D	E	Σ	expected percent
I				● 4		1	3
II						-	22
III			● 2 ▲ 2	● 1 ▲ 1		4	50
IV	▲ 3	● 3				2	22
V			▲ 4			1	3
Σ	1	1	3	3	-	8	
expected percent	3	22	50	22	3		

▲ BOYS
● GIRLS

Fig. 3: Example of a group diagnosis after Kapalín and Prokopec (1957) of eight children assessed by the charts according to their stature and body proportions. The variation of both attributes in a collective of children may be expressed in percentages and the eventual deviation from the distribution in the total population of children may be tested by the χ^2 method. (Calculation of per cent frequencies in our case of eight children only is of course irrelevant.)

Table 8. Height, weight and body proportions of four boys

Number of the boy	Age	Height	D1*	Weight	D2*	Assess-ment
1	12y. 2m	153.3 cm	+0.1	38.0 kg	−0.6	III/D
2	12y. 9 m	153.8 cm	−0.25	40.0 kg	−0.4	III/C
3	12y. 6 m	148.0 cm	−0.6	47.5 kg	+1.25	IV/B
4	12y. 3 m	168.0 cm	+1.6	49.8 kg	−0.6	I/D

*Deviation (distance) from the 50th percentile curve (M) in fractions of band width at given age for D1 and for given height for D2

Final Remarks and Discussion

The evaluation percentile charts represent the output of the IVth nation-wide child growth survey (for the Czech districts). It has shown clearly that the standard applied in the health service since the year 1951 is no longer valid. The innovative aspects of these charts is the use of percentiles instead of standard deviations. An advantage of the evaluation by means of charts as compared to that of tables is the possibility of an optical control of the position of the child in the grid, an evaluation of the dynamics of the child's development, if it is measured regularly and the possibility to classify each child according to its accurate age. Figure 3 shows the way in which individually assessed children of different ages (and also of both sexes) may be evaluated as a group using their symbols of body height and body proportions. In this way V. Kapalín evaluated groups of children, which he used as a sensitive detectors of the quality of environmental, social and nutritional living conditions already in late sixtieth.

The validity of the newest Czech growth standards from 1981 may be longer than those from 1951, because the secular trend is expected to slower down in the near future with increased rapidity. The chart for assessing growth and physique, which has been just described represents the first draft; it undergoes testing in paediatric practice at present. It has still several weak points. One of them is the sharp transition from the lower to the higher age category at 15 years in boys and at 14 in girls. Other is a certain inaccuracy based on the use of the logarithmic scale in the lower grid. When assessing deviation of the child from the 50th percentile curve, one must keep in mind that in the plus direction it is in reality bigger than it visually seems to be and vice versa the deviation in the minus direction seems to be bigger than it actually is. No allowance for the log scale is taken when calculating the distance from the medium 50th percentile curve using the band widths.

Nevertheless, the system works and is already in its present state of development an invaluable aid in evaluating growth and physique in healthy and sick children to everybody who spends some time using it.

As soon as one makes himself familiar with the system of categories for height and body proportions and with the use of the symbols, one can easily visualize each child (its stature and physique) just when seeing its symbols. He learns to know the meaning of each particular pair of symbols (for height and for height-weight ratio), that i.e. I/A is a very tall and very heavy built child, III/C a child of a medium stature and of balanced proportions, III/D a child of a medium stature and thin, etc.

It is not a rare case in the school medical service that a mistake either in measuring or recording the data has been discovered on the basis of discrepancy between what the investigator had in mind when hearing or reading the symbols of particular child and what he saw.

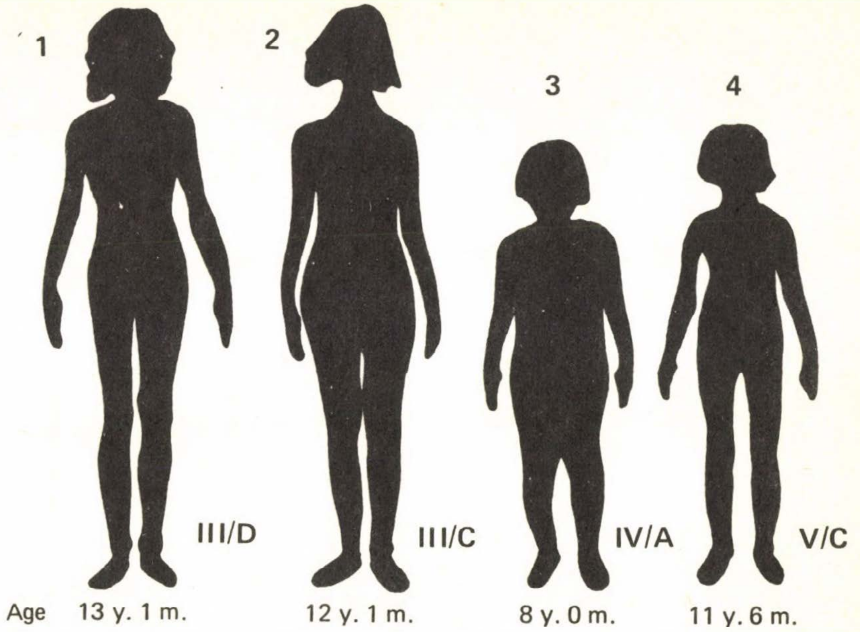

Fig. 4: Example of four girls assessed by the chart, with their symbols for height and body proportions. For details see text

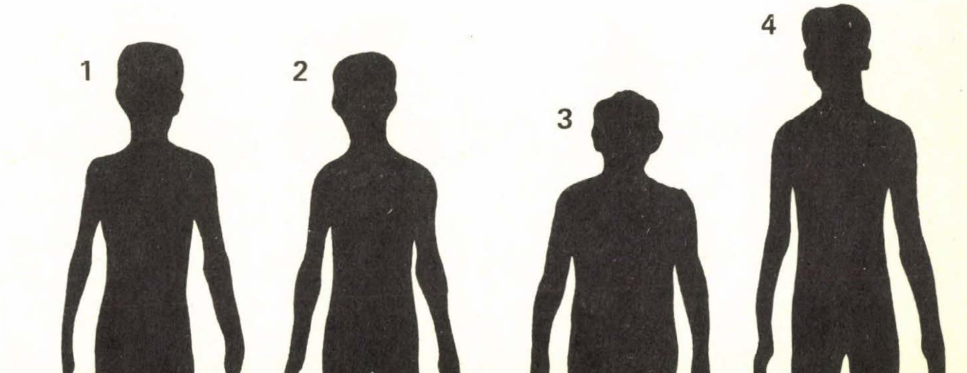

Fig. 5: Example of four boys assessed by the chart, with their symbols for height and body proportions. For details see text

Table 9. Computer Assessment

Growth level of the children according to age, height, weight and sex

EXAMPLE OF COMPUTER ASSESSMENT of the 4 girls in Fig. 4

1	2	3			4			5		6	7	8	9	10
JMENO	DATUM	MERENI			NAROZENI			VEK		VYSKA	ODCH.	HMOTN.	ODCH.	HM.RL.
	POHL	D	M	R	D	M	R	R	M	CM	SIGMA	KG	SIGMA	SIGMA
1	Z	0	0	0	0	0	0	13	1	157.0	−.20	39.00	−1.05	−2.32
2	Z	0	0	0	0	0	0	12	1	153.0	.03	41.50	−.23	−.27
3	Z	0	0	0	0	0	0	8	0	123.0	−.90	30.50	.87	2.25
4	Z	0	0	0	0	0	0	11	6	126.0	−3.07	23.20	−2.03	−.56
N = 4 (11) PRUMER:								11.17		139.7	−1.03	33.55	−.61	−.23
(12) SMERODATNA ODCHYLKA:								2.21		17.7	1.41	8.35	1.23	1.88
(13) STREDNI CHYBA PRUMERU:								1.11		8.9	.71	4.18	.61	.94

EXAMPLE OF COMPUTER ASSESSMENT of the 4 boys in Fig. 5

1	2	3			4			5		6	7	8	9	10
JMENO	DATUM MERENI				NAROZENI			VEK		VYSKA	ODCH.	HMOTN.	ODCH.	HH. RL.
	POHL	D	M	R	D	M	R	R	M	CM	SIGMA	KG	SIGMA	SIGMA
1	M	0	0	0	0	0	0	12	2	153.3	.22	38.00	−.49	−.86
2	M	0	0	0	0	0	0	12	9	153.8	−.22	40.00	−.59	−.55
3	M	0	0	0	0	0	0	12	6	148.0	−.77	47.50	.41	1.62
4	M	0	0	0	0	0	0	12	2	168.0	2.19	49.80	.95	−.83
N = 4 (11) PRUMER:								12.40		155.8	.35	43.83	.07	−.15
(12) SMERODATNA ODCHYLKA:								.28		8.6	1.29	5.71	.74	1.19
(13) STREDNI CHYBA PRUMERU:								.14		4.3	.65	2.85	.37	.60

1 – name, 2 – sex, 3 – date of measurement, 4 – date of birth, 5 – age in years and months, 6 – height, 7 – normalized deviation (Z-score) of height, 8 – weight, 9 – normalized deviation (Z-score), 10 – normalized deviation of the log body weight from its mean for given cm of height, which expresses the body proportionality, (11) – mean (M), (12) – S. D. of the mean, (13) – med.error of the mean (m).

Computer evaluation of body height and proportionality

A Computer programme has been developed (Z. Roth) for calculating individual deviation from the population means in terms of multiples of Standard Deviation (S.D.) This programme follows closely the graphical way of evaluation given above and besides the evaluation of individuals it provides also means and S.D. for a group of children not necessarily of the same age (and even of the same sex).

The S.D. for weight is presented in two modifications. The first being only the normalized deviation of the mean for a given age and sex, the second is the normalized deviation of the log body weight from its mean for a given height and expresses the height-weight ratio (body proportionality), see Table 9.

This programme is presented in FORTRAN IV and is available also in BASIC.

*

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GROWTH STANDARDS OF LJUBLJANA SCHOOL CHILDREN

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Abstract: In the years from 1974 to 1982 an anthropological longitudinal research of the physical development and the growth of stature and weight was performed in Ljubljana. Children were measured in one years intervals from the age of 7 to 14. For the final analysis 125 girls and 116 boys remained. The data were analysed with respect to sexual dimorphism, environmental factors and secular trend. Growth standards for height and weight were compiled.
Key words: Growth standards, Secular trend, Ljubljana children.

Introduction

Stature and weight are measurements which give us basic and most important data and information for evaluation of growth and development. They are the best indicators of health and nutrition state of individuals and of population in the research period (Tanner 1978, van Wieringen 1978, Rhoede-van Wieringen 1985).

As we wished to examine in detail the lows of changes in growth of both parameters we used the longitudinal method of work. We have worked out the growth standars and diagrams for the Ljubljana children. It is necessary to evaluate the growth of individuals in curative as well as in preventive medicine and also for anthropologists to study the changes in time and space. Physical growth is a sensitive indicator of a child overall condition. A deviation of a child's growth pattern may manifest itself before symptoms of the underlying desease or mental stress occur.

Growth standards composed at time intervals may reveal changes in growth. Such changes over period of time defined as secular shift or trend comprises changes in growth velocities, the age at which the adolescent spurt starts and stops, development of secondary sex characteristics.

The first longitudinal survey in the city of Ljubljana was carried out in the years 1954–1965 by the Health Protection Service for School Children and Youth at the Institute of Public Health (Skerget). Two cross-sectional survey were carried out in Ljubljana in the years 1939/40 by Institute of Biology (Škerlj) and in years 1969/70 by University Institute of Public Health (Dovecar).

The aim of our studies is to analyse dinamics of growth on the longitudinal data. We analysed individual differences in growth on the basis of centile values and also the data of height and weight according to socio-economic status and studie the secular trend in the city of Ljubljana.

Material and Methods

The measurements of height and weight of Ljubljana school children from the ages of 7 to 14 were taken by the Institute of Biology, University of Ljubljana in the period between 1974 and 1982. The programme was realised on 13 elementary schools in Ljubljana. There we selected out those children who reached their age of 7 between 15th September 1974 and 15th July 1975. The selected children were observed and measured at intervals of one year on their birthday with the tolerance of ±30 days. From the original number of 314 children (149 boys and 165 girls) we menaged to keep due to migration and moving to other schools only 241 (116 boys and 125 girls). We performed the measurement every two months. Children were measured barefoot and in light underwear.

Standing height was measured by Martin's anthropometer with the child's head in Frankfort plane and the heels together. The child was encoureged to strech itself actively. The step scale was used for the weighing and was checked before each session. Both parameters were measured all the time by the same person.

Basic statistics were calculated on DEC-SYSTEM–10 and results tested with HEWLETT PACKARD 9820 A.

As we already had the longitudinal data we wanted to study the diagram of personal growth and development. We calculated centile values: $C_3, C_{10}, C_{25}, C_{50}, C_{75}, C_{90}$ and C_{97}. To analyse the harmonical growth of both parameters in the same time, we draw 241 individual diagrams on the growth centile standards.

Children were grouped to three socio-economic groups according to occupational status of father. Variation in height and weight was tested for average values.

Results

We have calculated for stature and weight the centile values which are separately for boys and girls shown on the Table 1. The growth diagrams – centile standards are shown on the Fig. 1 for boys and Fig. 2 for girls.

Table 1. Standards values of height and weight of Ljubljana boys and girls

Age (years)	C_3	C_{10}	C_{25}	C_{50}	C_{75}	C_{90}	C_{97}
				Boys			
Height (cm)							
7	115.18	119.16	121.81	124.37	127.63	130.97	135.77
9	127.24	129.25	132.78	135.86	138.88	141.72	147.93
11	135.04	138.14	142.66	146.74	149.18	153.64	158.70
14	151.05	154.78	161.52	166.93	172.17	175.66	180.53
Weight (kg)							
7	19.89	21.79	23.55	25.06	27.42	31.24	35.72
9	24.85	26.82	28.59	30.99	33.94	39.96	47.31
11	28.59	31.62	33.33	37.09	41.88	50.37	58.64
14	38.29	43.07	49.57	55.84	61.54	70.26	82.01
				Girls			
Height (cm)							
7	113.96	118.69	121.35	123.90	127.86	131.11	134.34
9	125.33	129.72	133.02	135.98	139.92	144.21	147.34
11	137.66	140.48	144.29	148.09	153.26	126.52	161.00
14	152.19	156.46	160.12	164.14	166.93	171.12	174.34
Weight (kg)							
7	19.80	20.80	22.91	25.05	28.06	31.67	35.18
9	24.58	25.91	28.59	32.07	35.81	41.97	47.70
11	29.00	31.55	35.38	39.83	44.96	50.37	60.48
14	43.98	47.17	50.82	55.84	62.91	67.34	80.22

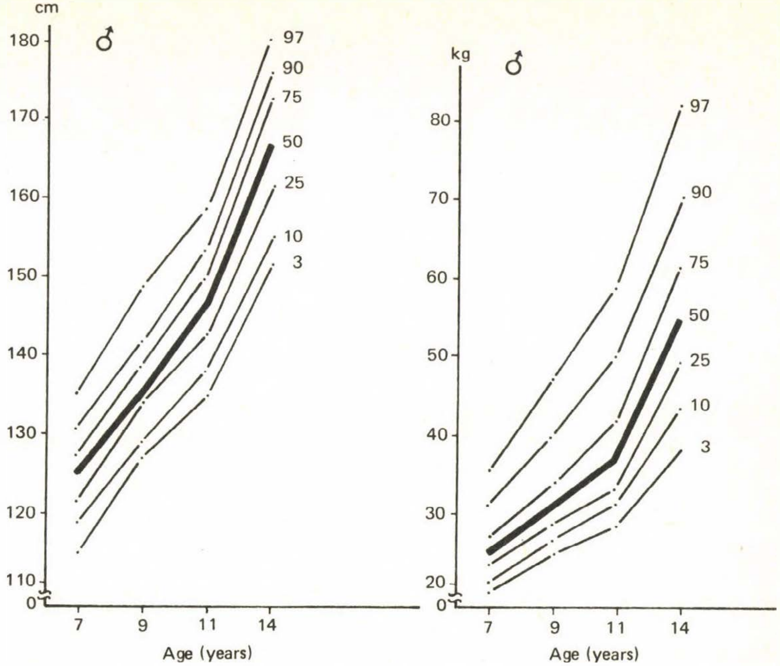


Fig. 1: Centile values of height and weight – Boys

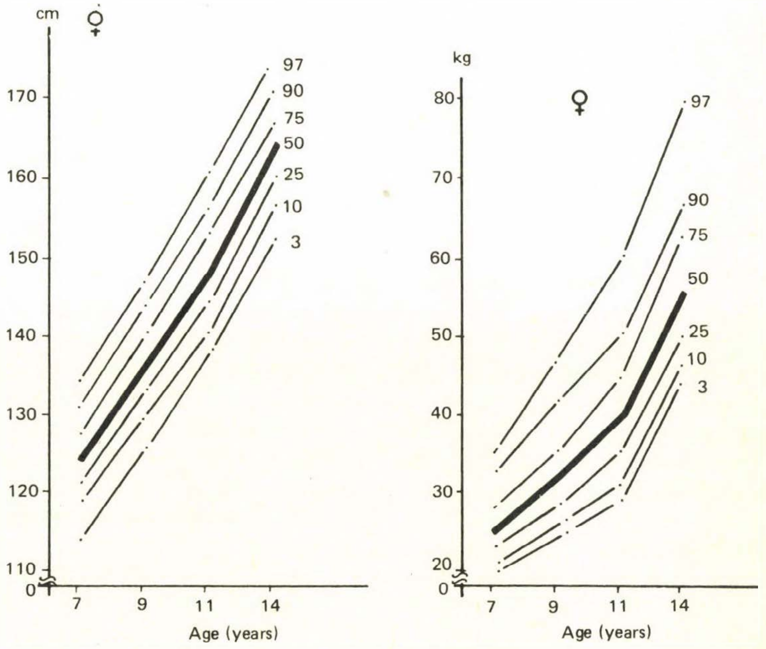


Fig. 2: Centile values of height and weight – Girls

With regard to advantage of our longitudinal data, we have drown all the 241 particular individual growth curves separately in the centile standards, regarding sex, both for stature and weight. We wanted to establish harmony in the growth of both measurements.

We have classified all the 241 sets of the individual development curves into two groups regarding the conditions at the age of 14:

Group A.: Both parameters have values-in the same centile ranges. This groups was devided into three subgroups with regard to the position of the stature and weight in the centile net as follows: (1) Stature and weight are in the centile range between C_{75} and C_{25}; (2) Stature and weight are in the centile range above C_{50}; (3) Stature and weight are in the centile range under C_{50}.

Group B: Stature and weight in different centile ranges. This group was devided into two subgroups: (1) Stature in the centile range above C_{50}, weight in the centile range under C_{50}; (2) Stature in the centile range under C_{50}, weight in the centile range above C_{50}.

The analysis of the distribution of children investigated (Table 2) has proved that Ljubljana boys and girls predominate a harmonious development. In one third of the cases their stature and weight are about the mean values, between C_{25} and C_{75} (boys 37.1%, girls 33.6%). Such a case in shown in Fig. 3. The stature and weight the boy No. 141 were very near to the limits of C_{50} during his primary school career, i.e. in the limits of the calculated mean values.

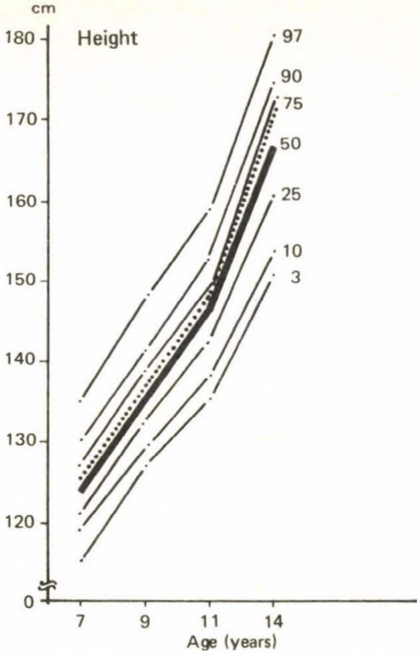
Table 2. Position of individual height (H) and weight (W) in centile standards

Position	Boys		Girls	
	N	%	N	%
Group A				
1. H and W from C_{25} to C_{75}	43	37.1	42	33.6
2. H and W over C_{50}	31	26.7	32	25.6
3. H and W below C_{50}	33	28.4	31	24.8
Group B				
1. H over C_{50}, W below C_{50}	5	4.3	9	7.2
2. H below C_{50}, W over C_{50}	4	3.5	11	8.8
Total	116	100.0	125	100.0

There were 26.7% of taller and at the same time heavier boys and 24.8% of girls. Such a case was boy No. 181 (Fig 4). His stature was at about C_{90} during the period investigated. His weight was above C_{97} at 7, 9 and 11, but at 14 little under this centile.

In the group of children with low values of stature and weight there were 28.7% boys and 24.8% girls. The boy No. 147 (Fig. 5) had his stature at 7, 9 and 11 between C_{25} and C_{10} and at 14 even under C_3. His weight moved at 7, 9 and 11 between C_{25} and C_{10}, and at 14 it was on the same way as his stature, reached C_3.

Unharmonious development and different position of stature and weight was established only with small number of children. There were 4.3% of tall and proportionaly light boys and 7.2% those of girls. The girl No. 20 (Fig. 6) was tall and light during her measuring period. Her stature was all the time between C_{75} and C_{97} but her weight between C_{10} and C_{50}. At 14 this girl was 174 cm tall ($\bar{x}$ = 163.7 cm) and weighted only 49.0 kg ($\bar{x}$ = 57.1 kg).



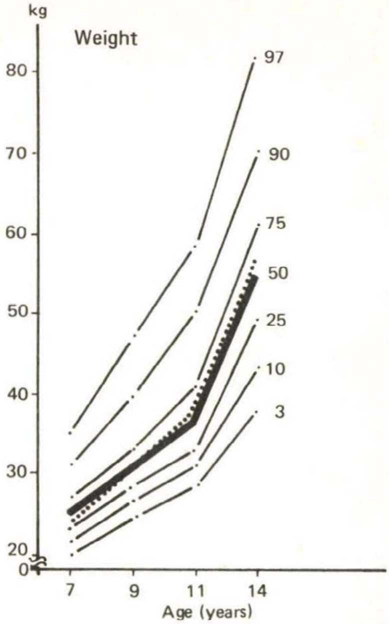
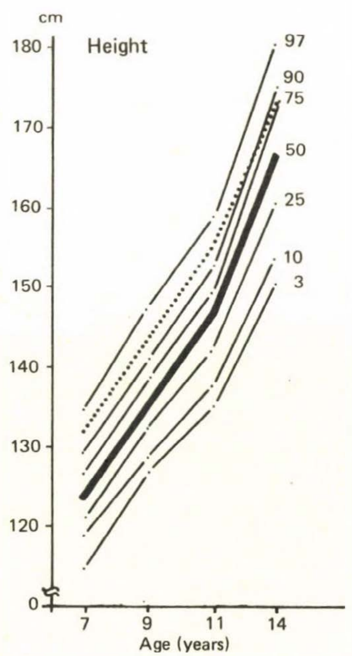


Fig. 3: Growth in height and weight of Boy No 141



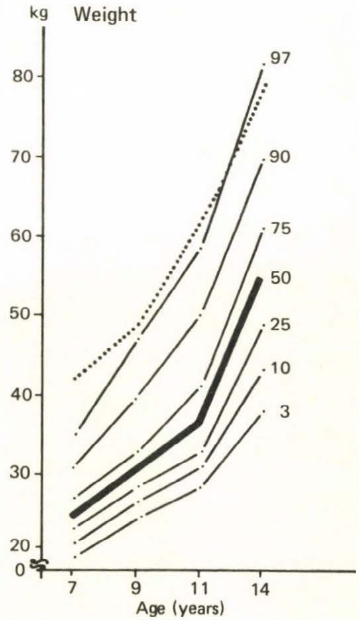


Fig. 4: Growth in height and weight of Boy No 181

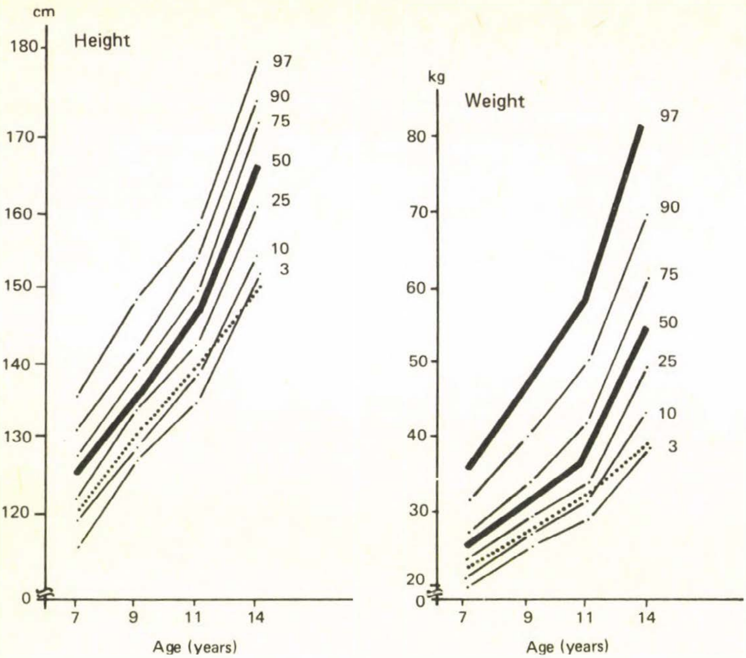


Fig. 5: Growth in height and weight of Boy No 147

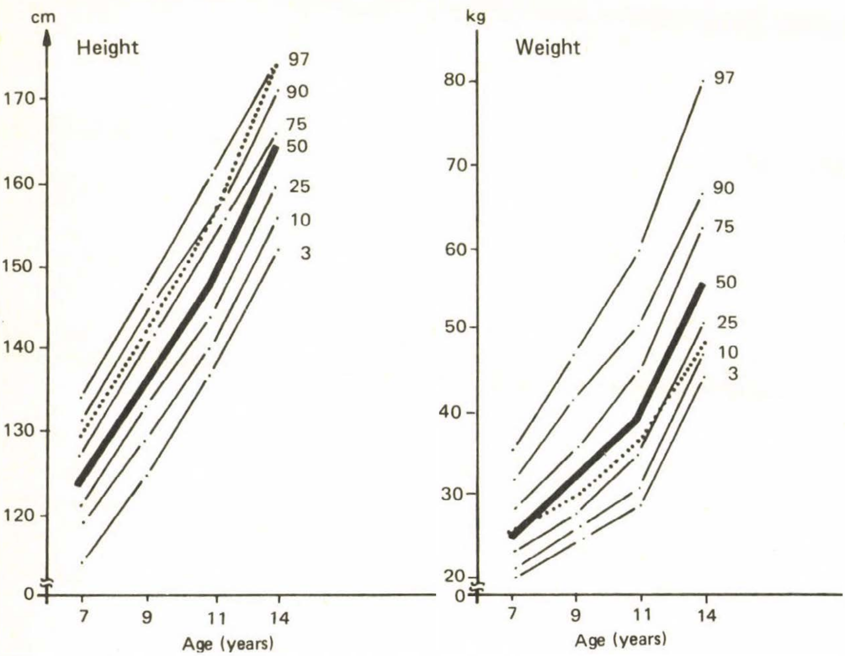


Fig. 6: Growth in height and weight of Girl No 20

Lower stature and higher weight was found in 3.5% of boys and in 8.8% of girls. The girl no. 90 (Fig. 7) from 7 till 14 had her stature on C_{25} and her weight was at these ages above C_{90}. At 14, this girl was 161.7 cm high ($\bar{x}$ + 163.7 cm) and weighed 73.0 kg ($\bar{x}$ = 57.1 kg).

There were more girls than boys in the groups with different stature and weight. It is possible that the girls in both studied parameters were more variable than boys.

Discussion

We evaluated our longitudinal study in the frame of comparative studies made also in Ljubljana and carried out with the same methods. Series which suited our need were: longitudinal series made in Ljubljana in the years 1954 to 1965 (Skerget 1965) and cross-sectious series from the years 1939/40 (Škerlj 1950) and 1969/70 (Dovečar 1973). The comparison of mean values is shown in the Table 3.

Table 3. Mean height and weight of Ljubljana school children

Age (year)	sex	1939/40 N	1939/40 $\bar{x}$	1954/65 N	1954/65 $\bar{x}$	1969/70 N	1969/70 $\bar{x}$	1974/82 N	1974/82 $\bar{x}$
Height									
7	♂	–	–	46	124.9	103	123.7	115	124.6
	♀	–	–	43	125.0	110	133.6	125	124.6
9	♂	–	–	55	135.9	101	134.6	116	136.0
	♀	–	–	58	135.0	104	133.3	125	136.6
11	♂	75	139.6	48	146.4	103	144.8	111	146.1
	♀	94	141.3	52	147.9	104	147.1	117	148.5
14	♂	147	154.5	38	164.7	127	161.0	116	166.5
	♀	260	154.8	46	162.3	108	161.4	125	163.7
Weight									
7	♂	–	–	45	25.3	103	25.1	115	25.9
	♀	–	–	43	24.0	110	24.6	112	25.8
9	♂	–	–	54	30.5	101	30.6	116	32.1
	♀	–	–	59	29.9	104	29.4	125	32.6
11	♂	75	32.5	47	38.3	103	37.7	111	38.8
	♀	94	33.1	53	39.1	104	39.1	117	40.7
14	♂	147	43.7	37	52.9	127	51.7	116	56.3
	♀	260	45.9	46	55.3	108	53.6	125	57.1

Comparing of all the four series, we certainly have to take into account the difference in years of research. During these years changes in quality of life occurred and, of course, essential raising of living standard. From the previous studies we already knew the changes of stature and weight during the last decades, established and acknowledged the secular trend (Brodar 1974, Dovečar–Arko 1975, Dovečar 1978, Tomazo-Ravnik 1981). This phenomenon of quicker development in physical and psychical aspect is observed in most countries all over the world in all categories of inhabitants (Wolański 1973, Tanner 1978, van Wieringen 1978, Rhoede–van Wieringen 1985).

The results of the longitudinal study in the years 1954–1965 in comparison with our series, show, there are no statistically significant differences between the average values of the stature in girls. Boys are significantly higher only at 14 when the difference is 1.8 cm (P = 0.05). In weight the differences are significant on the level P = 0.05 in 14 year-old boys and in girls at 7 and 9. In spite of all mentioned differences these are in contrary to our expectation quite small. The reason for this is first of all the small number (between 20 and 50) of children measured in the old serie.

We were interested also in time and age, respectively, when in girls overtake boys in physical development. In the old series this overtaking in stature occurred at age of 11. The sex difference to the advantage of girls in 1.5 cm. In our series girls overtake the boys in stature already at 9. The difference at 11 is 2.5 cm. In weight the girls of our series overtake the boys at the age of 9, in the old series comes to crossing of the curves at the age of 10.

The comparison of our data to the results of the series of children measured in the years 1939/40 is possible only at the age of 11 and 14 years. As we expected, the difference between the average values of stature as well as of weight at both ages are high and statistically significant. The rise of stature after the 1940s in 14 year-old boys is 12.0 cm and in 14 year-old girls 8.9 cm. The high increase of average values is probably conditioned by a better state of health and a better quality of food. The weight followed these increases, too. In case of 14 year-old children during 40 years the average weight increased by 12.6 kg in boys and 11.2 kg in girls, respectively.

The changed nutrition is one of the essential reasons for acceleration or retardation of growth. The data show that the acceleration highly declined due to shortage in the first and the second world wars. Where the condition due to shortage vere very bad and nutrition troubles very long lasting, it came to interruption of acceleration or even to retardation. During the war time the acceleration was not interrupted only because of bad nutrition but also have to take into account psychical factors like stress, fear, etc. Between the two world wars and especially after the second world war the acceleration attended again very much (van Wieringen 1978, Brodar 1974).

The second cross-section series of Ljubljana's children were measured in the years 1969/70. Compared our data to this series of measurements – which are older for about 10 years than ours – we can see that the average values in our series are higher. The differences in boys are significantly higher only at the age of 14. They are 5.5 cm in stature and 4.6 kg in weight. Our girls are significantly higher than the girls of the older series. The difference at 9 year of age is 3.2 cm and at 14 year of age it is 2.3 cm. While significant differences in boys' weight occur only at 14, the girls of our series are significantly heavier than their counterparts before 10 years. The differences were at 7 year of age 1.2 kg, at 9 3.2 kg and at 14 3.5 kg. The girls of 1969/70 series overtake the boys in stature at 11 year of age when they were higher by 2.3 cm and in weight as well as at 11 when they were heavier by 1.9 kg (Figures 8 and 9).

Similar results about secular trend has achieved also Prebeg when comparing the series of children and youth of Zagreb (Prebeg 1978, 1984). Series of children and youth from the years 1951, 1964, 1973 and 1982 were compared. The increase of average values of stature and weight during the last decades in Jugoslavia was described also by Ivanović (1985) for the area of Titograd and by Gavrilovič et al. (1983) for the area of Vršac.

In our future research we would therefore wish to study these problems in such a way that we would take into account more information on the way of life, on the income of a family members, nutrition, education and similar factors influencing growth and development.

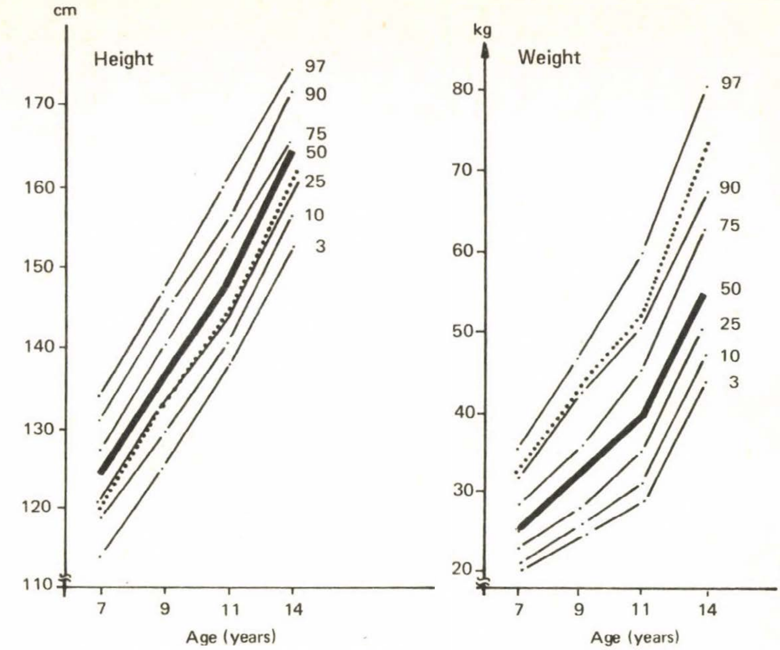


Fig. 7: Growth in height and weight of Girl No 90

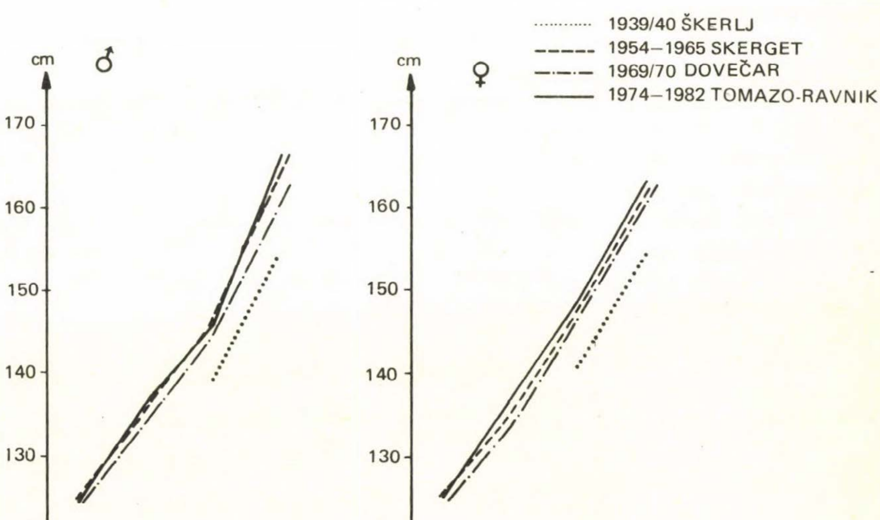


Fig. 8: Comparison of mean height values of Ljubljana series

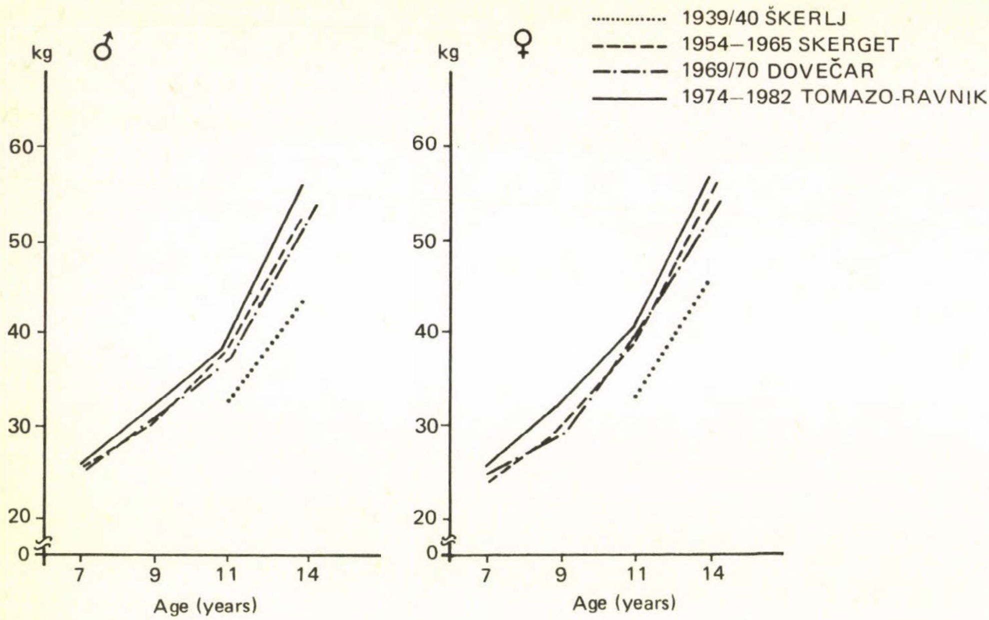


Fig. 9: Comparison of mean weight values of Ljubjana series

Summary

Based on longitudinal growth data of stature and weight of Ljubljana primary school-children in the age of 7–14, we elaborated centile standards. The work was done in the years 1974–1982.

The analysis of individual data drown in centile standards shows that in our series owerwhelming majority of children shows a convenient growth of stature and weight (92.2% of boys and 84.0% of girls). There are more cases of inconsistent development of both parameters with girls.

We established the secular changes between our series and the series of Ljubljana's children measured in the years 1939/40, 1954–1965, and 1969/70. Socio-economic differences in primary school population in the period 1974/82 have not essentially influence the values of stature and weight.

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NATIONAL AND DISTRICT LONGITUDINAL GROWTH PROFILES FROM 7 TO 17 YEARS IN PORTUGAL

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Abstract: This work represents a co-ordinated effort lasting 11 years and carried out by a diversified team in 18 towns involving dozens of people. We made these studies always with the same observers, the same measuring instruments and the same young people observed. Our study is based on the measurements (weight and height) taken in 9022 boys and 9135 girls, in a total of 31913 and 33500 observations, respectively. All the young people studied were born in 1964. They were investigated from their age of 7 to 14 which initially allowed us to draw up national and district mixed longitudinal profiles. By a selection of young people observed at least ten times (164 boys and 275 girls), it was possible to obtain national pure longitudinal profile which is also shown in percentiles.

Key-words: Growth standards, Longitudinal growth profiles, School children, Heights and Weights

Introduction

Our growth study vas started in 1971 in 18 towns of Portugal (Fig. 1). The number of boys and girls investigated yearly is given in Table 1. The number of observations was diminishing progressively since 1978, because pupils moved from school to school or from school to work.

Table 1. Number of yearly investigated boys and girls

Year of investigation	Boys investigated	Girls investigated
1971	1571	1365
1972	2696	2713
1973	3373	3718
1974	3337	3314
1975	3523	3543
1976	3187	3664
1977	3856	3142
1978	3404	3299
1979	2729	3170
1980	2450	3117
1981	1787	2455
Total	31913	33500

It was 1970/71 when we realized the National Tables of Height and Weight, a controlled cross-sectional growth study carried out in all over the country, including also Tables for Districts.

The basic idea of our work was the complexity of the child (mode of life, with physical, ethical, pedagogical, social, etc. values) which passes through our study. We did not really consider to be important whether he or she was tall or heavy, but to be healthy, and to have an equilibrium as the aim what we have to attain.

Fig. 1: Map of Portugal with district where the growth study was carried out

Methodology

Our project was accomplished by the School Health Service, with the collaboration of Pedagogical Authorities and Health Authorities. We had (1) in each town a doctor and a health visitor or nurse and in each school a teacher (of physical education); (2) for the country a team, circulating from town to town: two health visitors and a driver. When the country team arrived in the town, the doctor of that town was responsible for the work there.

Centrally, we were outlining sequences, liaisons; coordinating the peripheral and central work; cathering data; obtaining the statistical approach; maintaining the sequential rhythm, that is to say, from town to town, over five weeks, without breaks, the work was going on. Over 11 years the work was always accomplished.

Locally, we were searching young people to be observed (find in the schools the requested boys and girls), all of them were born in 1964; centralising activities, one or two places in each town (or session); adapting transports and liaisons; putting files in order, filling up maps of registration.

The fact of putting the girls and the boys in groups, according to the trimester they were born, gives to the work statistical accuracy. To be acquainted with the environment, as well as with the local possibilities, is also essential. We must underline this idea, all the work was done without prejudicing school life.

The accuracy of the task depends on these purposes. Obviously the pupils were not always the same. But all of them were born in 1964. The percentage was different from town to town. We have only one town where 50% of the pupils were observed 6 times, but in most towns the percentage was about 20%. Therefore we concider our whole sample as a *mixed longitudinal* one. We have, however a lot of young people (164 boys and 275 girls) whom we could investigate at least ten times, over these eleven year period. With them we could obtain the *pure longitudinal* profiles.

The basic conditions described were present in the mind of the observers: Minimal clothes: in boys underpants or shorts or training-suit, in girls panties or training-suit or bathing-suit; time: in the morning after a light breakfast; previous urination; the same period of the year (April–May). We considered the estimated weight of the clothes to be discounted.

Observers were acquainted with the criteria established by the W.H.O. to obtain the accuracy we needed. The previous training was essential. We can have a look of these criteria: barefoot; joined heals; buttocks, shoulders and head contacting with the vertical surface; interior orbital border and the auditive external canal in the same horisontal line; upper surface of the scale touching the crown of the head.

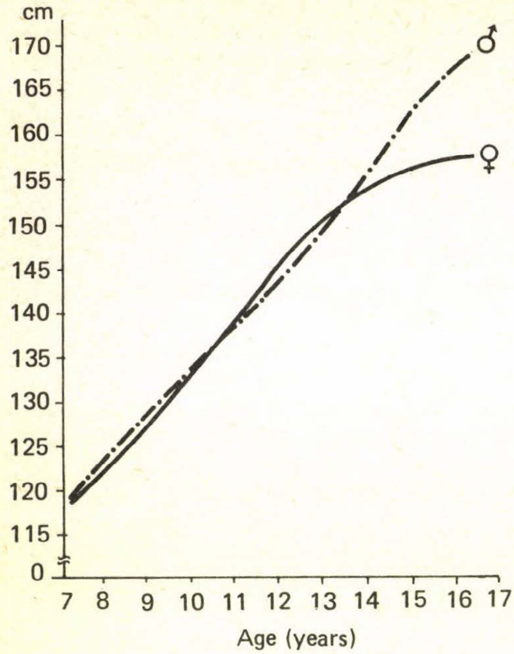
The same automatic balance and the same graduated scale were used which were 50 gramms fractions and measuring every 0.5 cm, respectively.

In this work we have the same observers with the same criteria and same training, the same measuring instruments, balance and scale, the same pupils to be investigated (when possible).

Results

Based on our whole sample (mixed longitudinal) means of height and weight in Portuguese boys and girls are shown in Fig. 2. The curves of boys and girls show the well-known phenomenon: during puberty girls are taller and heavier than their male-counterparts, however, at the age og 17 year („final" production of our study) boys are taller and heavier. We compared these mixed growth profiles to our pure longitudinal profiles as shown in Fig. 3. The differences between means of the whole and selected (i.e. mixed longitudinal and pure longitudinal, resp.) samples can be observed in Table 2.

To study secular trend, we made a comparison between the data of the 1970/71 Portuguese cross-sectional growth study and our present study. The well-known phenomenon of secular trend is observable well. The 17 year-old boys and girls in 1971, i.e. ten years before, had a smaller size than boys and girls at the same age in 1981. The evidence of secular trend is demonstrated by the following differences. Height in boys in 1971 was 168.3 cm, and in 1981 it was 171.1 cm, the difference is +2.8 cm. The same values in girls were 155.6 cm, and 158.5 cm, resp., the difference is +2.9 cm. We can also see an increase of weight which in boys in 1971 was 58.7 kg, in 1981 it was 60.8 kg, the difference is +2.1 kg; in girls 52.1 kg and 52.8 kg, resp., and the difference is +0.7 kg. – We add to these that the adolescent growth spurt comes obviously later, especially in boys. Consequently, in the male, the whole body has a longer period of growth, causing a generally greater size.



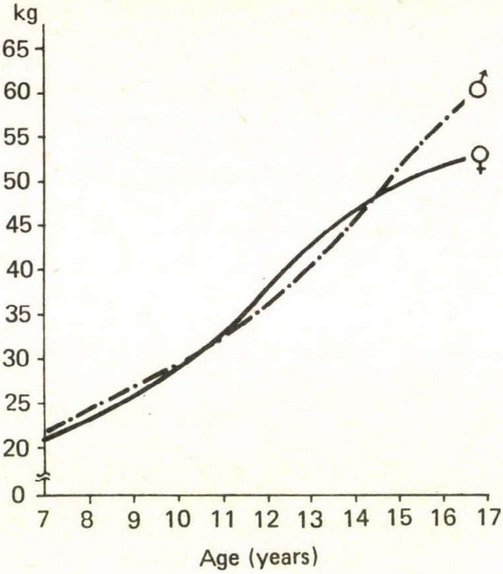


Fig. 2: Growth curves of height and weight in Portuguese boys and girls based on the whole sample (mixed longitudinal)

Table 2. Means of height and weight of Portuguese boys and girls, based on the whole sample (mixed longitudinal) and on the selected sample, „pure" longitudinal

Age (years)	Height				Weight			
	Boys		Girls		Boys		Girls	
	Whole sample	Sample „pure"	Whole sample	Sample „pure"	Whole sample	Sample „pure"	Whole sample	Sample „pure"
7	117.7	119.0	117.0	117.3	21.8	22.3	21.6	21.4
8	122.2	123.8	121.8	122.0	23.8	24.3	23.5	23.5
9	127.6	129.3	126.4	127.7	26.5	27.3	26.3	26.6
10	132.7	134.4	132.0	133.2	29.3	30.2	29.4	29.6
11	137.7	139.6	138.2	139.3	32.2	33.1	33.0	33.1
12	142.8	144.7	144.6	145.7	35.6	36.5	37.7	37.9
13	148.9	150.9	150.2	151.2	40.0	41.0	42.7	42.5
14	155.5	157.8	153.9	154.5	45.1	46.3	46.9	46.3
15	162.7	165.0	156.5	156.9	51.0	52.3	49.6	49.0
16	167.9	169.2	157.7	158.0	56.6	56.4	51.7	50.9
17	171.1	171.9	158.5	158.7	60.8	60.2	52.7	51.8

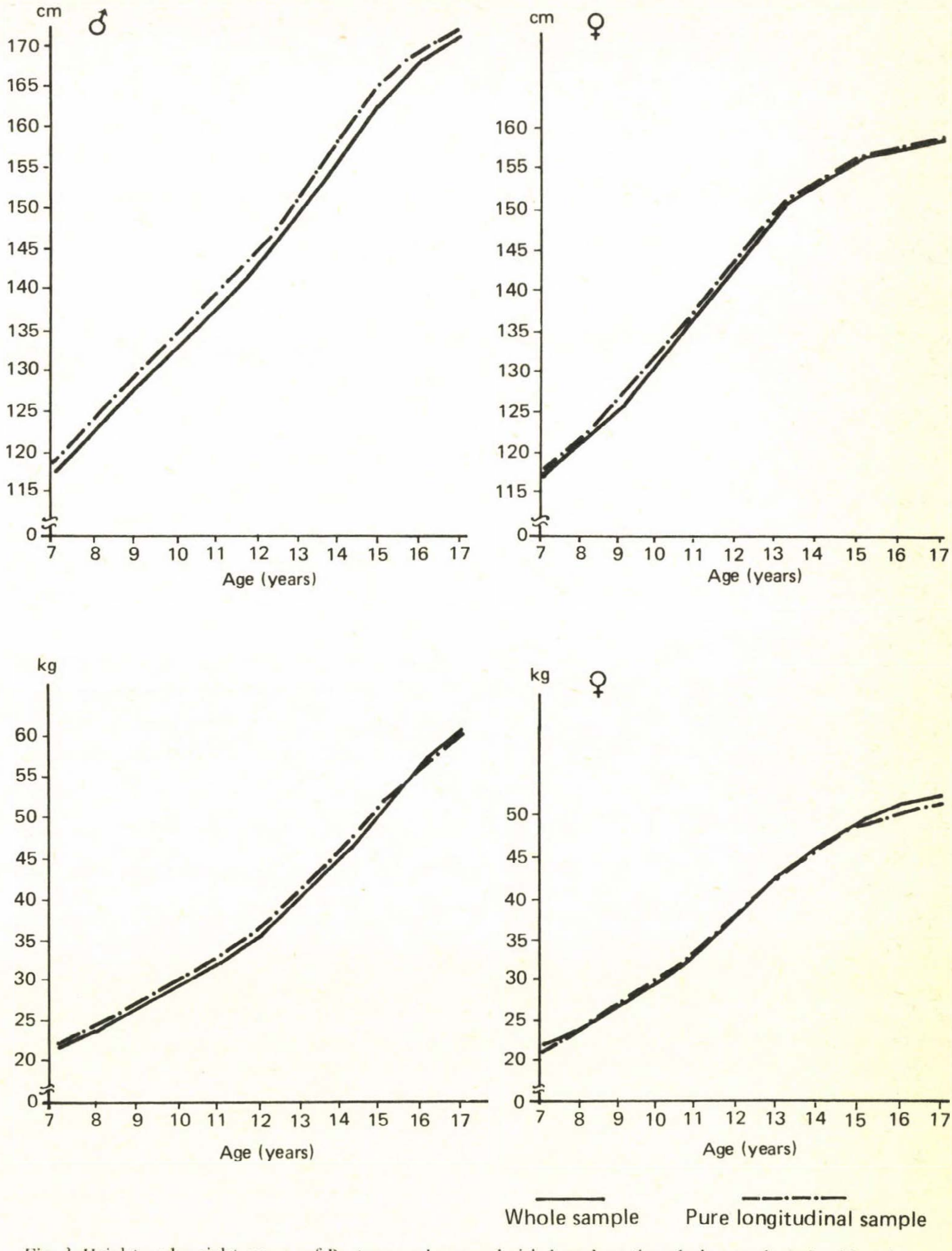
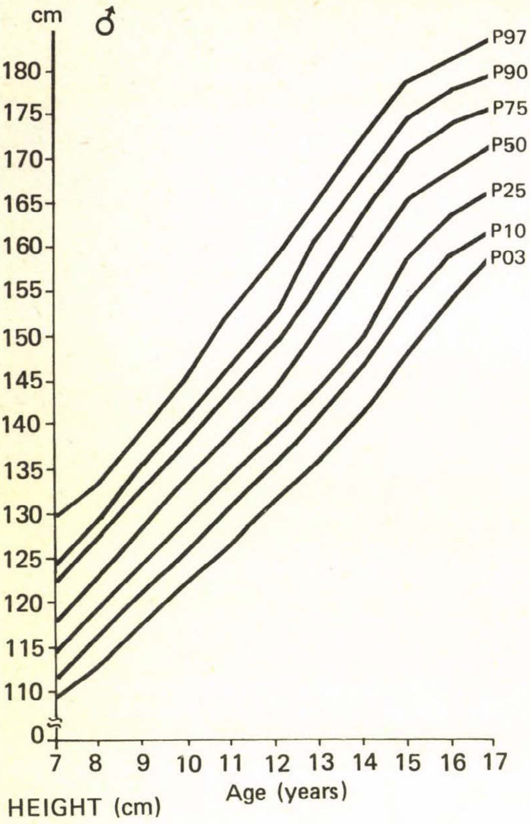
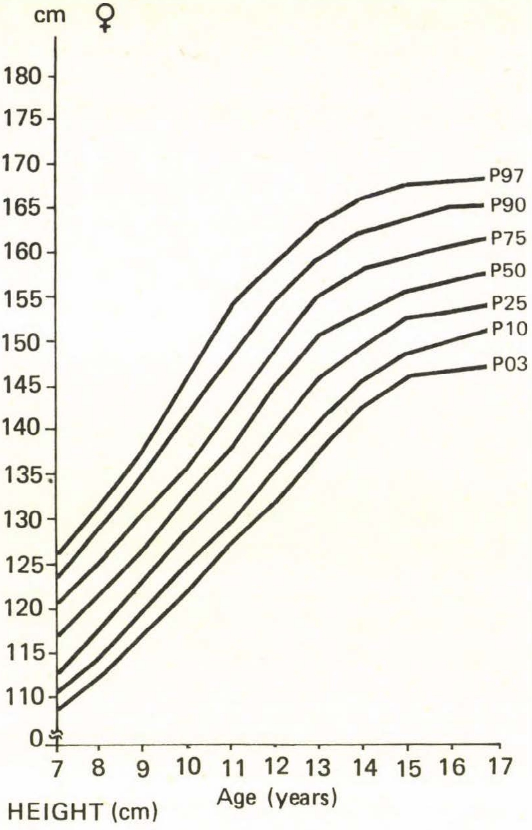


Fig. 3: Height and weight curves of Purtuguese boys and girls based on the whole sample (mixed longitudinal) and on the selected sample, a pure longitudinal one

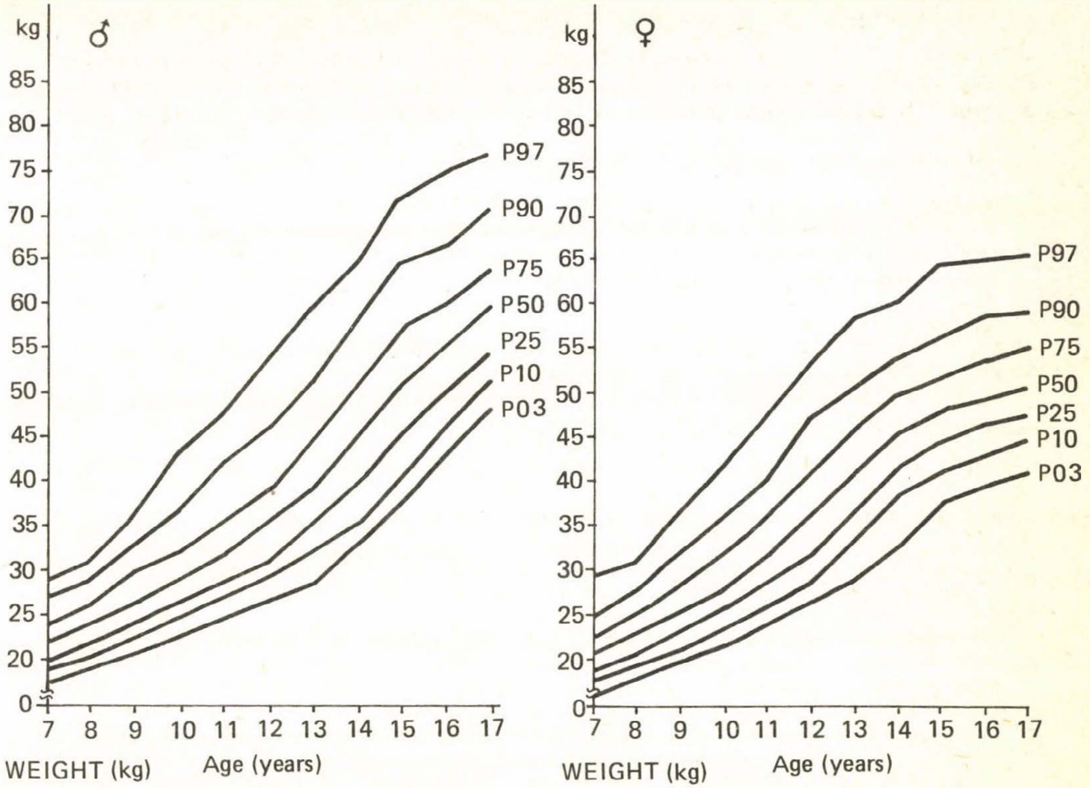




Age	P03	P10	P25	P50	P75	P90	P97
7	110,0	112,0	115,0	118,5	123,0	125,0	130,5
8	113,5	117,0	120,0	123,5	128,0	130,0	134,0
9	118,5	122,0	125,0	129,5	133,5	136,5	140,0
10	123,0	126,5	130,0	134,5	138,5	141,5	146,0
11	127,0	131,5	135,0	139,5	144,0	147,5	153,5
12	132,5	136,0	139,5	144,5	149,5	153,0	159,5
13	136,5	141,5	144,5	151,0	156,5	161,8	166,0
14	142,0	147,0	150,5	158,5	164,5	169,0	173,0
15	149,0	154,5	159,0	166,0	171,0	175,0	179,0
16	155,0	160,0	163,8	169,0	174,5	178,0	181,5
17	160,0	162,5	167,0	172,0	176,0	180,0	184,0

Age	P03	P10	P25	P50	P75	P90	P97
7	109,0	111,0	113,0	117,2	121,0	124,0	126,5
8	113,0	115,0	118,0	122,0	125,5	129,5	132,5
9	118,0	120,5	123,5	127,0	131,5	135,5	139,0
10	122,5	125,5	129,0	133,0	136,5	142,5	146,0
11	128,0	130,0	134,0	138,5	143,5	149,0	155,0
12	132,5	136,5	140,5	145,8	150,0	155,5	159,5
13	138,5	142,0	146,8	151,2	156,0	160,0	164,0
14	143,5	146,5	150,5	154,0	159,0	163,0	167,0
15	146,5	149,5	153,5	156,5	160,5	164,5	168,5
16	147,5	151,0	154,0	157,5	161,5	166,0	169,0
17	148,0	152,0	155,0	158,5	162,5	166,0	169,0

Fig. 4: Percentiles of height in Portuguese boys and girls



Age	P03	P10	P25	P50	P75	P90	P97
7	17.600	18.900	19,850	22,000	24,125	27,150	28,950
8	18.800	20.300	21,750	24,025	26,400	29,075	31,200
9	20,600	22,450	24,350	26,300	30,000	33,200	36,350
10	22.500	24,750	26,875	29,325	32,225	36,900	43,850
11	24.500	27.250	29,075	31,950	35,950	42,125	48,000
12	26.650	29,450	31,800	35,625	39,175	46,100	54,050
13	28.700	32,575	35,575	39,125	44,750	51,675	60,000
14	33.350	35,450	40,150	45,350	50,800	58,400	64,850
15	37 700	40,500	46,700	51,325	57,775	65,000	71,950
16	43,600	46,600	51,025	55,600	60,650	66,850	75,500
17	48.550	51,400	54,600	59,800	64,300	70,900	77,000

Age	P03	P10	P25	P50	P75	P90	P97
7	16,300	17,850	19,050	21,000	22,800	25,050	29,900
8	18,050	19,500	20,850	23,000	25,300	28,100	31,425
9	20,050	21,450	23,350	25,650	28,700	32,500	37,100
10	21,700	23,750	25,900	28,350	32,200	36,400	42,100
11	24,150	26,250	28,700	32,000	36,300	40,500	48,250
12	26,700	29,350	32,450	36,700	41,525	47,400	54,450
13	29,450	33,800	37,050	41,550	46,350	51,000	58,650
14	33,250	38,600	41,950	45,800	50,050	54,200	60,900
15	37,900	41,700	45,050	48,400	52,000	56,950	65,000
16	40,100	43,600	47,050	50,000	54,200	58,800	65,400
17	41,300	45,100	48,000	51,100	55,300	59,300	65,800

Fig. 5: Percentiles of weight in Portuguese boys and girls

We wanted to see *differences in school boys and girls of the various districts* of our country. Analising the regression lines we can see the districts (Fig. 1) where the best correlations were obtained: Lisboa, Santarem and other low regions, with wild climate, as Porto, Aveiro, Braga, Coimbra, Leiria, contrasting with the poverty of the interior regions, as Guarda, Castelo Branco, followed by Vila Real, Bragança, Portalegre, that we have mentioned as having the worst indicators of development (mountainous regions, cold climate, monotonous nourishment, etc.) This is an evidence we have known for a long time. Problems to be discussed, to be resolved in each region.

As it was mentioned above, we have done *a pure longitudinal profile,* collecting boys and girls, who were observed, at least, ten times over the work.

These numbers are without statistical value for the regions. We think to be important, however, to use the national values (as „median") in the whole country, and to give them in percentiles in growth curves to our collegues (endocrinologists, adolescentologists, pediatricians, school doctors).

We have seen how similar are the mixed and the pure longitudinal profiles. Now, we can see that the values of the median and of the mean do not differ statistically.

In case of height the median is greater by 0.1 cm than mean in boys, but it is smaller by 0.2 cm than mean in girls. In case of weight median is smaller than mean in both sexes, in boys by 0.4 kg and in girls by 0.7 kg, resp. In Table 3 we summarized the data of height and weight in 17 year-old boys and girls, the means of the whole (mixed longitudinal) sample, the selected i.e. pure longitudinal sample and the median i.e. 50th percentile value of the last one.

The numerical values and the graphs we have obtained are the „end products" of our national pure longitudinal growth study (Figures 4 and 5).

As conclusions:

This work makes worthy of importance of the team and its continuity over the years. It underlines the value of the collaboration between pedagogical and health authorities.

It allowed the knowledge of Portuguese longitudinal profile of growth (7 to 17 years), national and districtal, the pure longitudinal profile and, considering the skewed distribution of weights, the use of the median as the central value. It confirms, with accuracy, what we know about growth and development of boys and girls and the secular trends towards a greater adult size.

It constitutes an element for study of growth to scientists working on the fields of Endocrinology, Pediatrics, Social Adolescentology, etc.

Table 3. Means and medians (50th percent values) of height and weight in 17year-old Portuguese boys and girls

Mean/Median	Boys		Girls	
	Height	Weight	Height	Weight
Whole sample mean (mixed longitudinal)	171.1	60.7	158.5	52.7
Selected sample mean (pure longitudinal)	171.9	60.2	158.7	51.8
50th percentile	172.0	59.8	158.5	51.1

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ITALIAN STANDARDS FOR WEIGHT, LENGTH AND HEAD-SIZE AT BIRTH

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Abstract: Neonatal cross-sectional standards for weight, length and head-size here discussed were based on 16336 reference babies born in six towns of North, Centre and South Italy, between 1973 and 1981, and included in an obstetric-pediatric survey, sponsored by the National Research Council (CNR – grant no. 85. 00660.56). Single liveborn infants without congenital anomalies, and whose mothers did not have any risk factor for pregnancy (such as diabetes, hypertension, previous stillbirths or abortions), were considered reference babies. They made up a sample drawn from one reference population, regardless birthplace: actually, large differences in social and environmental conditions typical to the six towns appeared to exert trifling effects on reference neonates' dimensions. So, these neonatal standards, unlike those previously published in Italy, can safely be applied by obstetricians and neonatologists to any neonate born between 32 and 43 weeks of gestation.

Key words: Head-size, Lenght, Neonatal standards, Reference neonates, Weight.

Introduction

The stage of maturity of a newborn infant, assessed by neonatal standards, provides a rough but useful indicator of risk as regards not only morbidity and mortality, but also mental and neuromotor retardation (Wong and Scott 1972, Fujimura and Seryu 1977, Brandt 1978). The importance of low birth weight infants has been recognized for many decades, and led to international agreement that babies weighing 2.5 kg or less should regarded as forming a high-risk category, and to the further concept of the small-for-dates baby, i.e. light-for-gestational-age baby (Thomson 1978). As to the other traits, special emphasis has been put on the role of length and head-size in the diagnosis of impaired growth (Lubchenco et al. 1966, Holmes et al. 1977, Olowe 1981). In particular, head-size is related to brain growth and to changes in intracranial pressure (Babson and Benda 1976, Marks et al. 1979, Maisels and Marks 1981) and may be an aid in detecting microcephaly and hydrocephalus (Usher and McLean 1969).

Standards which may apply to every Italian neonate are to date available for birthweight only (Bossi et al. 1980). Growth charts for length and head-size are few, and concern limited geographical areas, a province or a region. Particularly worth of mention are the charts published by Pantarotto et al. (1974) based on 1204 babies born in Genoa, by Castello et al. (1975) based on 4194 babies born in Rome, and by Santoiemma et al. (1981) based on 5576 babies born in Ferrara. On the other hand, length and head-size standards most widely known in Italy (Lubchenco et al. 1966, Usher and McLean 1969, Sterky 1970, Finnstromm 1971, Gairdner and Pearson 1971, Chosh et al. 1971, Miller and Hassanein 1971, Wong and Scott 1972, Babson and Benda 1976; Fujimura and Seryu 1977, Holmes et al. 1977, Olowe 1981) refer to populations with different somatic features, and environmental and nutritional conditions, so that their application to italian neonates seems inappropriate.

Cross-sectional standards for weight, length and head-size at birth discussed in this paper were based upon 16336 „reference neonates" born in six towns of North, Centre and South Italy, and selected according to strict criteria, so that they can be sensibly thought of as outcome of „ideal" pregnancies, unaffected by any apparent pathological condition and risk factor.

Subjects and Methods

Target population and selected sample

Weight, length, and head-size at birth were recorded in the „neonatal data" section of an ad hoc questionnaire of an obstetric-pediatric multicentre survey, one of the goals of which was the definition of cross-sectional standards for Italian neonates. The survey was supported by National Research Council (CNR – Target Project: Preventive Medicine and Rehabilitation, subproject SP1, grant n. 85.00660.56).

The six hospitals in which data have been collected are situated so as to supply information on health conditions and care of mothers and babies in regions of Italy which largely differ in social and demographic features and life habits, as thoroughly discussed by Milani et al. (1983) and by Cortinovis et al. (1986).

Some 45 thousands babies participate in the survey, but only 16 thousands (i.e. about 1/3) had those characteristics that we, on the basis of a wide review of obstetric literature, considered typical to a *healthy reference population.* Reference subjects were single liveborn infants, without detectable congenital anomalies; moreover, their mothers did not have any of the risk factors identified in the questionnaire (see Table 1), and which seem to impair intrauterine growth (Bossi et al. 1980). This paper deals only with „reference subjects", whose gestational age was reliably known and in the range 32–43 weeks (see Table 2).

Table 1. Risk-factors for pregnancy and outcome adopted as criteria for selecting reference neonates

Maternal history	
– Uterine fibroids	– Renal diseases
– Uterine surgery	– Hypertension
Previous pregnancies	
– Spontaneous abortions	– Low-birthweight-babies
– Stillbirths	
Present pregnancy	
– Lues	– Hypertension
– Urinary infections	– Eclamptic Strokes
– Tuberculosis	– Epilepsy
– Asthma	– Vaginal bleeding
– Jaundice	– Placental abruptio
– Diabetes	– Isoimmunization
– Endocrine diseases	– Intrauterine transfusion
– Heart diseases	– Smoking $\geqslant$ 10 cgts/day

Table 2. Whole sample size and reference set size according to centre and sex (data collected between 1973 and 1981)

Centres		Whole Sample		Reference Set	
		Girls	Boys	Girls	Boys
Trieste	(North-East)	5121	62	1881	1994
Milan	(North)	6022	6590	1707	1920
Parma	(North)	3227	3344	1430	1479
Rome	(Centre)	3475	3777	1535	1673
Naples	(South)	1707	1835	507	520
Bari	(South)	2078	2274	863	827
Total		21630	23282	7923	8413

Variables

All measures were taken within one hour of delivery, as a part of routine care. Weight was recorded to the nearest 10 g. Crown-heel length was measured with baby flat on its back and both legs extended in a measuring device containing a built-in centimetre rule; head-size was measured by a tape at the largest occipito-frontal circumference. Length and head-size measures were recorded to the nearest centimetre. The measuring error, including both „between-nurses" and „within nurse" components, was less than 2% (Bossi and Milani 1980).

Gestational age was expressed as completed weeks since the first day of the last menstrual priod. The estimate of gestational age was considered reliable if the date of beginning of the last menstrual period was recorded accurately, the period itself was normal with respect to flow, duration and expected date, and menstrual cycles preceding pregnancy were regular (within 5 of 28 days).

Statistical analysis

Distributional aspects of the above traits at each gestation week have been previously investigated (Marubini et al. 1978; Bossi and Milani 1980; Bossi and Milani 1985). No significant departure from the Gaussian distribution was found, but small sample size for preterm and postterm babies limits normality tests' power. Moreover, between-subjects variability tends to decrease with increasing gestational age, mainly for length and head-size. Therefore, it seemed sensible to compute the prefixed quantiles of the empirical distributions and their confidence limits, by nonparametric method (Conover 1971): this makes no distributional assumption, and hence is a more general and safe method to adopt (Solberg 1981), although its efficiency is somewhat lower, chiefly for extreme centiles (Healy 1974). The estimates of quantiles were then smoothed, so as to reduce random variability and elicit the shape of the relationship of traits to gestational age. Weighted moving averages (Kenney and Keeping 1954) of the quantiles of three contiguous weeks were used as smoothed values, weights being the product of sample size by binomial coefficient, i.e. 1, 2, 1, in the case of 3 values. Such a simple technique was preferred to polynomial regression, because low degree polynomials fit well the relationship of weight to gestational age, but not those of length and head-size.

Results

From left to right, Figure 1 shows neonatal standards of Italian *girls* for weight, length and head-size, as a function of gestational age. Most of births (some 90%) occurred between 37 and 41 gestation weeks, so that the quantiles for the other weeks could be estimated on few scores of babies only. Dotted lines denote estimates with poor precision, i.e. with 95% confidence interval not included in the range ±5% about the estimated quantile. In the range 32–36 weeks, poor precision affects estimates of quantiles, chiefly those of weight.

Median increments, in the interval between 32 and 41 weeks of gestation, were quite small both for length (4–5cm) and head-size (3–4cm), i.e. about 10% with respect to values observed at 32 weeks. In the same interval, increments of weight were 1.1 kg (girls) and 1.5 kg (boys), i.e. about 50 and 70% with respect to values at 32 weeks. Actually, it is well-known that prenatal growth in size precedes growth in weight: e.g. length of a 20 weeks fetus is a half of birthlength, whilst its weight is still one tenth of birthweight (Gramellini et al. 1984).

For length and head-size, between-subjects variability is larger at 34 weeks than at 40 weeks. At 34 weeks, intervals between 5th and 95th quantiles were 1.5 times wider

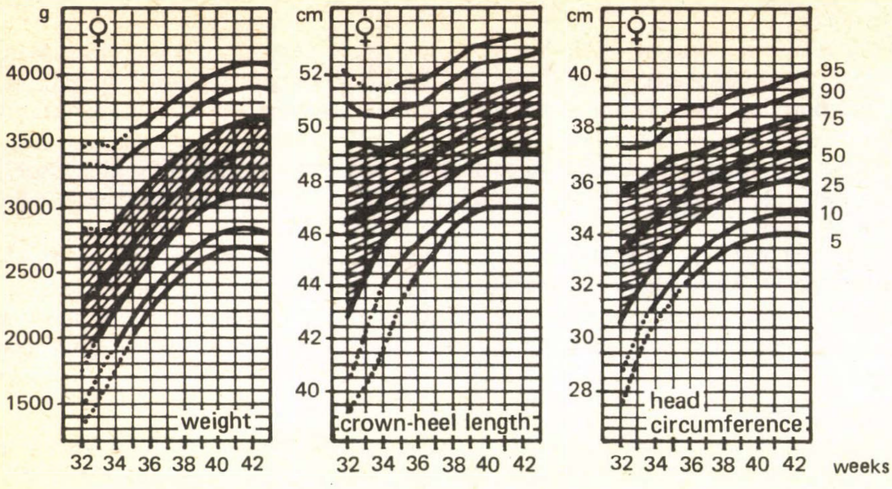

Fig. 1: Italian standards for weight, length, and head-size, as a function of gestational age: (GIRLS). Dotted lines denote estimates with poor precision, i.e. with 95% confidence interval not included in the range ± 5% about computed quantile

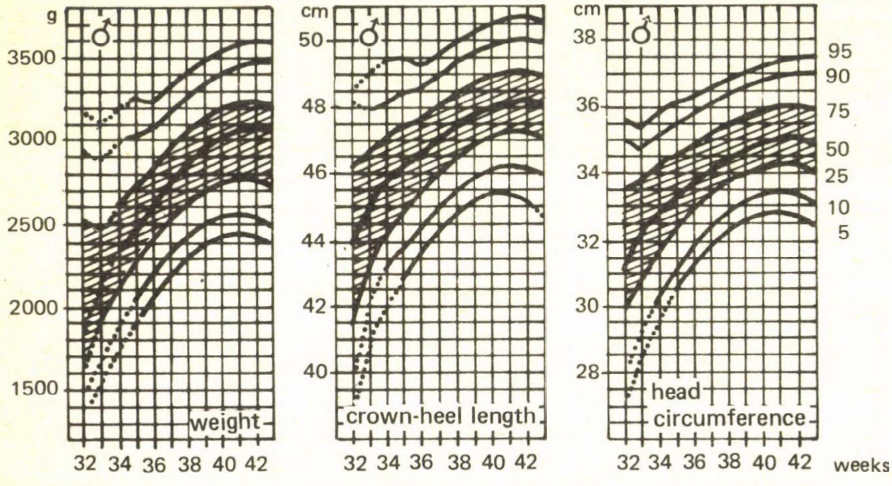

Fig. 2: Italian standards for weight, length, and head-size, as a function of gestational age: (BOYS). Dotted lines denote estimates with poor precision, i.e. with 95% confidence interval not included in the range ± 5% about computed quantile.

than at 40 weeks: from 9 to 6 cm for length, and from 6 to 4 cm for head-size. As regards weight, by contrast, interval between 5th and 95th quantiles was only 1.2 times larger at 34 weeks than at 40 weeks: from 1.7 to 1.4 Kg. Thus, low growth rate and large biological variability seem to limit the importance of knowing gestational age in the assessment of length and head-size at birth, but not in the assessment of weight.

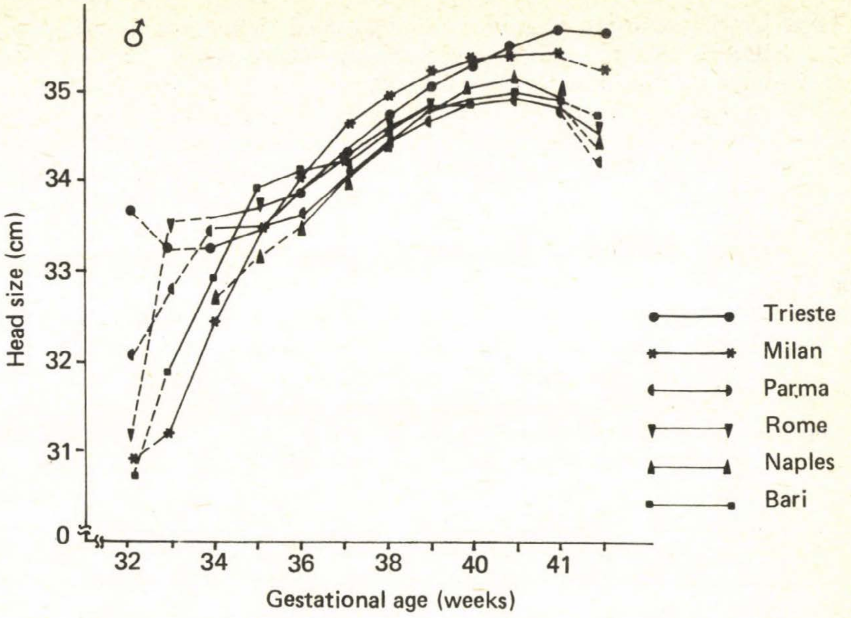

Fig. 3: Between-centres differences in median head-size of boys. Dotted lines denote estimates with poor precision, i.e. with 95% confidence interval not included in the range ±5% about computed medians.

On the average, postterm *male neonates* displayed values slightly lower than babies born at 41 weeks (see Figure 2). This finding, as well as many analogous results given in literature (Usher and McLean 1969, Sterky 1970, Ghosh et al. 1971, Miller and Hassenein 1971, Wong and Scott 1972, Pantarotto et al. 1974, Castello et al. 1975, Santoiemma et al. 1981), is quite paradoxical, mainly for length and head-size. So, it should be ascribed to either undetected errors in the assessment of gestational age, or unidentified pathological conditions occurred in pregnancy, despite the strict criteria adopted to select reference set. All traits were in boys consistently larger than in girls: 5th and 90th quantiles of boys correspond to 10th and 95th quantiles of girls, respectively.

Italian standards here described were based on the whole set of reference subjects, regardless of birthplace, so as to reduce irregularities due to sampling errors. This way of proceeding seemed to be sensible, because no systematic difference have emerged between values of the reference babies born in six centres under study. Actually, large differences are very rare and regard only those estimates that have poor precision (Bossi et al. 1980, Bossi and Milani 1986). As an example, Figure 3 shows between-centres differences in median head-size of boys. In the interval between 35 and 42 weeks of gestation, medians differ by 1 cm or less: the largest difference (3 cm at 32 weeks) is between Trieste (6 boys) and Bari (3 boys only!).

Comments

Cross-sectional standards, derived from anthropometric measures of neonates with different gestational ages, should be regarded mainly as a tool for evaluating body size and proportion of neonates, rather than as growth standards for monitoring fetal development. As to length and width measures, standards more appropriate to this latter aim, should be preferably based upon ultrasound studies, since prenatal growth of fullterm babies may have a pattern different from that shown by measures taken at birth on premature children (Falkner 1985). Longitudinal intrauterine standards are claimed as fundamental to a good obstetric management of any pregnancy (Deter et al. 1982): as far we know (Keen and Peers 1985), unfortunately, new techniques in fetal ultrasonography have not until now provided longitudinal growth data sufficient to replace cross-sectional standards.

In any case, the standards here presented possess two features particularly worth of mention.

First, the set of babies used to construct standards may be though of as a sample drawn from a target population defined on the basis of clear-cut a-posteriori criteria (Siest 1981), i.e. a reference population according to the acceptation introduced by Alstrom (1981), in the field of Clinical Chemistry. Selection criteria adopted in this study reflect a goal-oriented concept of reference values (Grasbeck 1981): not only stillbirths and neonates with congenital anomalies were excluded, but also all babies whose mothers had any known risk factor for pregnancy and outcome, connected with impaired fetal growth. Hence, the reference population so defined is expected to have perinatal morbidity and mortality risks lower than those of the entire population of neonates, so that these standards fit well the ultimate goal of a standard, i.e. as emphasized by Babson and Benda (1972), „to serve as a screening test to identify otherwise unrecognized diseases, such as fetal malnutrition, metabolic and endocrine disorders, and infective diseases".

Second, the standards can be safely applied by obstetricians and neonatologists to the large majority of Italian neonates born between 32 and 43 weeks of gestation. In fact, between-centres differences of weight, length and head-size at birth were rather large in the unselected sample, but negligible in the reference set (Bossi et al. 1980, Bossi and Milani 1980), likely because prevalence of risk-factors related to fetal growth, rather than fetal growth itself, is affected by social and environmental conditions typical to different Italian areas and by heterogeneity of hospital populations included in this study.

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HEIGHT AND WEIGHT STANDARDS OF 0–14 YEAR-OLD BUDAPEST CHILDREN BASED ON A LONGITUDINAL GROWTH STUDY

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Abstract: In 1970 a growth study was started, covering the overwhelming majority of children born in Budapest in the period between 15 October 1969 and 15 October 1970. After the first cross-sectional investigation (1970) 25 percent of children was randomly selected for the longitudinal growth study. Sixteen body measurements of about 4000 children were taken once a year, and data were collected concerning their health and sociodemographic status.

The authors present the standards of Budapest children from 0 to 14 years of age for height and weight. They also deal with some methodological problems emerged connected with the data processing.

Key words: Budapest Longitudinal Growth Study, Height, Weight, Growth Standards.

Introduction

Since the last decades growth studies have been living their „golden age", however, the overwhelming majority of them are cross-sectional. Longitudinal studies are laborious and timeconsuming, but they give outmost important information about the growth process. It is worth mentioning some world-famous longitudinal growth studies, e.g. the Harpenden Growth Study, the Fels Growth Study, the Solna Growth Study, etc. In Hungary there were two longitudinal growth studies carried out at Hajdusámson, East-Hungary (Rajkai 1967, 1970) and at Szombathely West-Hungary (Eiben 1970) as well as a mixed longitudinal one (Bakonyi et al. 1969).

In 1970 we brought a longitudinal growth study into action in Budapest. The main purposes of this study were:

(1) to establish the characteristics of somatic development of Budapest infants and children,

(2) to elaborate growth standards of Budapest children, and

(3) to study the environmental (first of all the sociodemographic) factors influencing their growth process.

Material and Methods

The research programme was started in 1970 with a complex cross-sectional growth study in almost all of the Budapest infants aged 0–1 year of age, than it was followed by a longitudinal investigation on 25 per cent of the entire original sample, gained by a selection with a representative (random) method. A regular registration concerning the sociodemographic conditions, circumtances of care and rearing, morbidity and other selected health data of children was included in the study series. In this way it was possible to be acquainted with the growth and development of children belonging to different social strata, taking into consideration the weight at birth, the socio-economic and cultural background of the parents, their educational level, characteristics of care and mode of life in the families.

Table 1. Number of children investigated and measurements taken in frame of the Budapest Longitudinal Growth Study

Year of investigation	Number of children investigated	Number of body measurements	Number measurements taken	Children dropped-out N	Children dropped-out %
1970	18670	8	149.360	–	–
1971	4047	7	28.259	–	–
1972	3797	13	49.361	240	5.9
1973	3573	10	35.730	224	5.9
1974	3344	10	33.440	229	6.4
1975	3189	11	35.079	155	4.6
1976	3118	12	37.416	71	2.2
1977	3010	12	36.120	108	3.5
1978	2898	15	43.470	112	3.7
1979	2825	15	42.375	73	2.5
1980	2750	15	41.250	75	2.7
1981	2697	19	51.243	53	1.9
1982	2667	19	50.673	30	1.1
1983	2630	19	49.970	37	1.4
1984	2532	19	48.108	98	3.7
1985	2385	19	45.315	147	5.8
Sum total	64122		777.169	1652	40.9

During the fifteen years of the study the number of children decreased from 4037 to 2385, i.e. today we have the 59.1% of the original sample (Table 1). In 1984 the children completed their study in general schools, and they changed their school or started their employed career, and this is the reason for the remarkable decrease of pupils in the sample. (We intend to follow this study till the 18th year of age of the children.)

The co-operation of several institutes and departments permitted the realization of the envisaged programme (the Heim Pál Children's Hospital, the Demographic Research Institute of the Hungarian Central Statistical Office, the Department of Anthropology of the Eötvös Loránd University, the Section of Biometry of the Hungarian Academy of Sciences, the Centre of Infants' Homes of the Capital, etc.).

The members of the multidisciplinary working group (pediatricians, health visitors, anthropologists, statisticians, experts in demography and biometrics, etc.) took upon the task to prepare the detailed programme of the study, determine the methods to be chosen, compile the documentation as well as to evaluate the data obtained.

The first, practically cross-sectional anthropometric investigation containing eight body measurements was carried out in 1970. Later the 25 per cent longitudinal sample was investigated every year in the same period (between middle October and late November). The anthropometric programme became wider from year to year, and by the prepuberty (by 1981) it was completed with scoring the secondary sexual characteristics (Table 2). Once the height and weight of the parents were also measured. The anthropometric investigatory methods and techniques we-- in accordance with internationally-accepted standards, described by Martin and Sa♂r (1957), and Tanner et al. (1969).

Besides the anthropometric programme, carriea out in each year, detailed data collections were organized in 1970, 1972, 1975, 1982 concerning health, sociodemographic status and mode of life. So we got information about the childrens' health status, micro-environment, and living conditions. In 1976, when they reached the schooling age our study was completed with investigations regarding the maturation level for schooling of the children.

Table 2. Body measurements taken and secondary sexual characteristics scored in frame of the Budapest Longitudinal Growth Study

Weight

Length measurements

in infants:	in children:
Supine length	Height
Trunk length	Sitting height
Length of the upper extremity	Height of the acromion
Length of the lower extremity	Height of the daktylion
	Length of the upper extremity
	Height of anterior superior iliac spine
	Length of the lower extremity

Width measurements
- Biacromial diameter
- Biiliocristal diameter
- Bicondylar humerus
- Bidondylar femur

Girth measurements
- Head circumference
- Chest circumference
- Upper arm circumference (relaxed)
- Calf circumference

Skinfold thicknesses
- Over triceps
- Subscapular
- Supra-iliac
- Medial calf

Secondary sexual characteristics

in both sexes:	Pubic hair
	Axillary hair
in boys:	Male genital development
	Age at oigarche
in girls:	Mamma
	Age at menarche

The data were elaborated and analyzed with computer and we published several publications about certain parts of the study (Vargáné Teghze-Gerber – Gombosiné Gárdos 1976, Sárkány (szerk.) 1977; Eiben – Őry – Vargáné Teghze-Gerber 1981; B. Lukács – Őry 1981; Eiben et al. 1982).

In the course of the elaboration of the anthropometric data we took into consideration the following viewpoints:

– The data of children suffering from serious anomalies or congenital defects and those who were born with a smaller weight than 2500 g were excluded. Although we examined the individual growth curves of these children while calculating the reference values we dod not take into consideration these data.

– During the data elaboration the usual mathematical-statistical parameters were calculated. In order to gain the reference values we present the percentile values. This is especially needed in the case of those body measurements which are not of normal distribution for example the body weight. In this case the incidence frequency is shiefted towards the „heavy" side.

– The percentile values of the different age groups were corrected with the help of algebraic („moving averaging") and graphical („curve smoothing with quadratic curve fitting") methods.

Results and Discussion

In the present study we bring to light only the percentile values of height and weight and compare the body measurements of children living in Budapest now and earlier. The complex elaboration of the whole investigation will be finished later.

The percentile values of body length or body height and that of the body weight of Budapest boys and girls are shown in Figures 1, 2, 3, and 4.

It is worth mentioning that in the early childhood the girls' height is slightly smaller than that of the boys, moreover in certain cases they are equal. In the case of the girls the puberal growth spurt appears at the age of 10 and from that point they are taller than the boys of the same age. The boys are taller than the girls only after 14 years of age (Figures 1 and 2).

In the case of the weight there is no remarkable difference between the two sexes in the early childhood, but the boys are somewhat heavier. The weight values show the puberal growth spurt of the girls one year earlier than the height values. After 9 years of age the girls are a bit heavier than the same aged boys and this tendency changes at the age of 14 when the boys begin to be heavier (Figures 3 and 4).

The means and the 50th percentile values of body weight were compared. The differences are shown in Fig. 5.

The data of our longitudinal growth study were compared to the results of two large cross-sectional growth studies, carried out in Budapest after the 2nd world war. In 1951 the School-Medical-Service of Budapest (M. Viola 1952), and in 1968/69 Eiben and co-workers (Eiben et al. 1971) realized these studies.

The difficulties of the comparison are obvious. The schoolchildren investigated in 1951 were born before or under the 2nd world war, the nursery-school children were born after the war. All of them were suffering from the consequences of the war like economical crisis, malnutrition, etc. After world war II the socioeconomic changes in Hungary resulted a positive turn in the life of the majority of the children. The children investigated in 1968/69 were born between 1950 and 1965. The migration is worth mentioning among the factors having some influence on their growth process. In this periode of time migration modified the population genetic (relative) balance and the living standards which were slowly getting better.

The comparison of the means of the three investigations are presented in Figures 6 and 7. The Budapest boys and girls investigated at the end of the 1960s were taller and heavier than those investigated almost two decades earlier. The differences are: in the case of the boys: 1.0–5.4 cm and 0.1–5.1 kg, and in the case of girls: 1.4–3.9 cm and 0.2–3.6 kg. The means of the longitudinal study show a rising tendency.

The results of these studies show that the secular trend is detectable in Budapest in the last four decades. We are convinced that as a consequence of the improvement of the factors influencing the growth and development process the Budapest children will be able to realize step by step their optimal growth patterns.

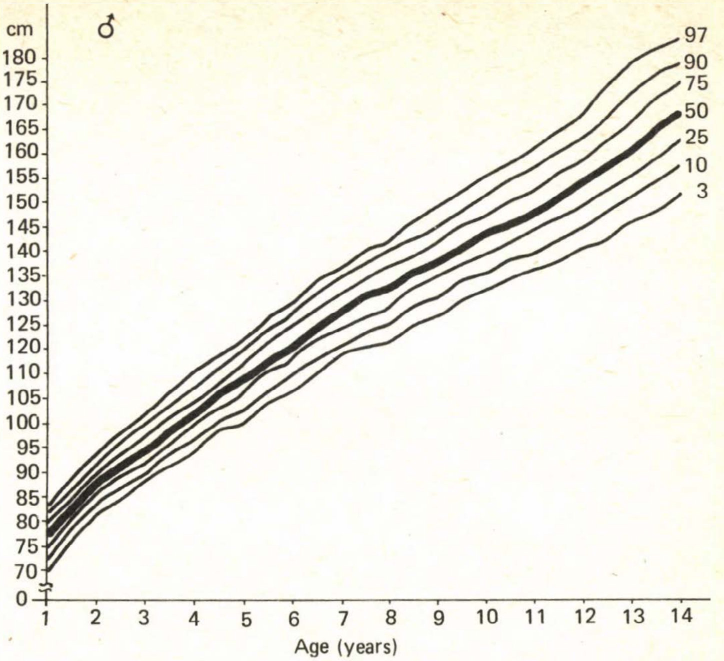


Fig. 1: Height standards of Budapest boys

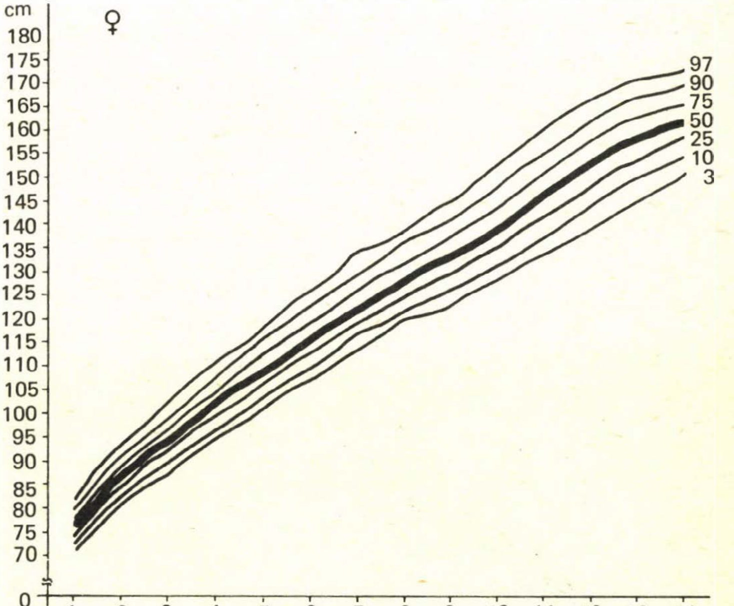


Fig. 2: Height standards of Budapest girls

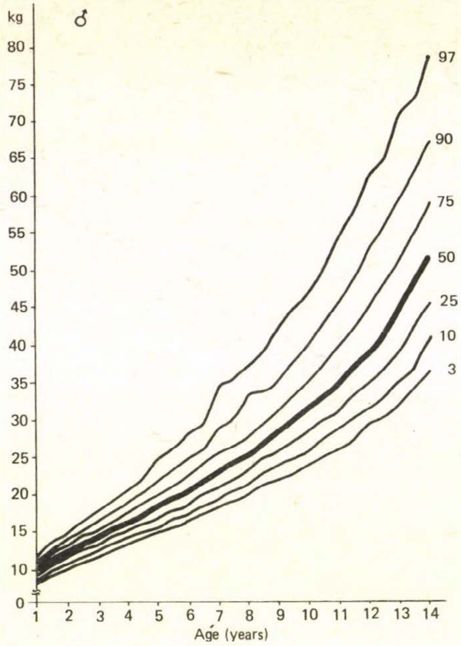


Fig. 3: **Weight standards of Budapest boys**

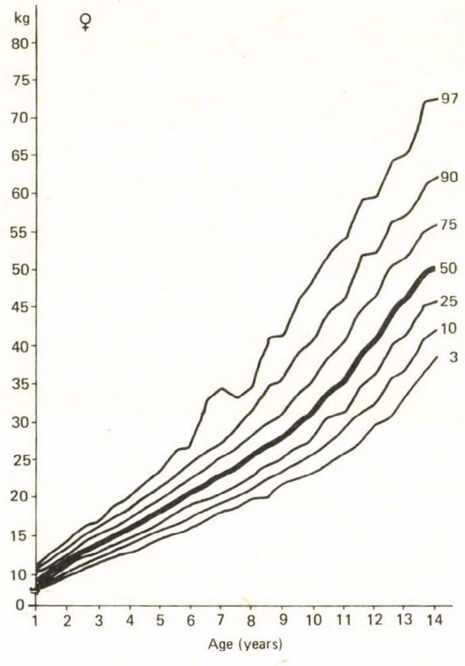
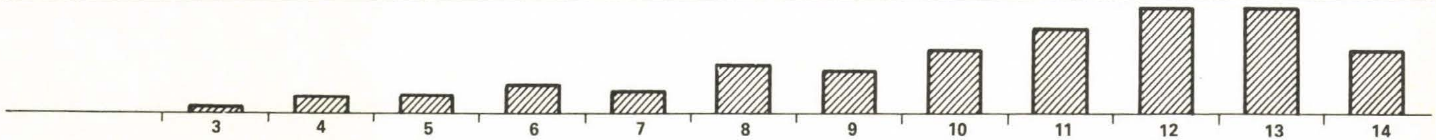


Fig. 4: Weight standards of Budapest girls

Boys ♂

Mean	14.3	16.3	18.6	20.9	23.8	26.1	29.2	32.5	36.4	40.9	46.5	53.2
50th percentile	14.2	16.0	18.3	20.4	23.4	25.2	28.4	31.3	34.8	38.9	44.5	52.0
Difference	−0.1	−0.3	−0.3	−0.5	−0.4	−0.9	−0.8	−1.2	−1.6	−2.0	−2.0	−1.2



Girls ♀

Mean	13.9	16.1	18.3	21.0	23.5	26.0	29.5	33.1	37.6	42.8	48.0	52.5
50th percentile	13.8	15.9	18.1	20.8	23.3	25.3	27.9	31.5	33.5	41.0	46.6	50.8
Difference	−0.1	−0.2	−0.2	−0.2	−0.3	−0.7	−1.6	−1.6	−2.1	−1.8	−1.4	−1.7

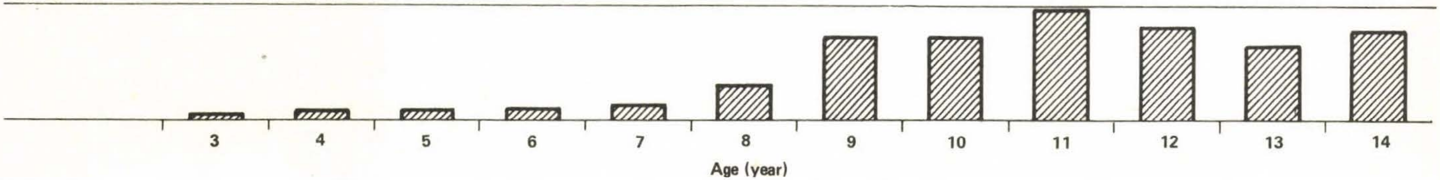


Fig. 5: A comparison of means and 50th percentile values of weight in Budapest children

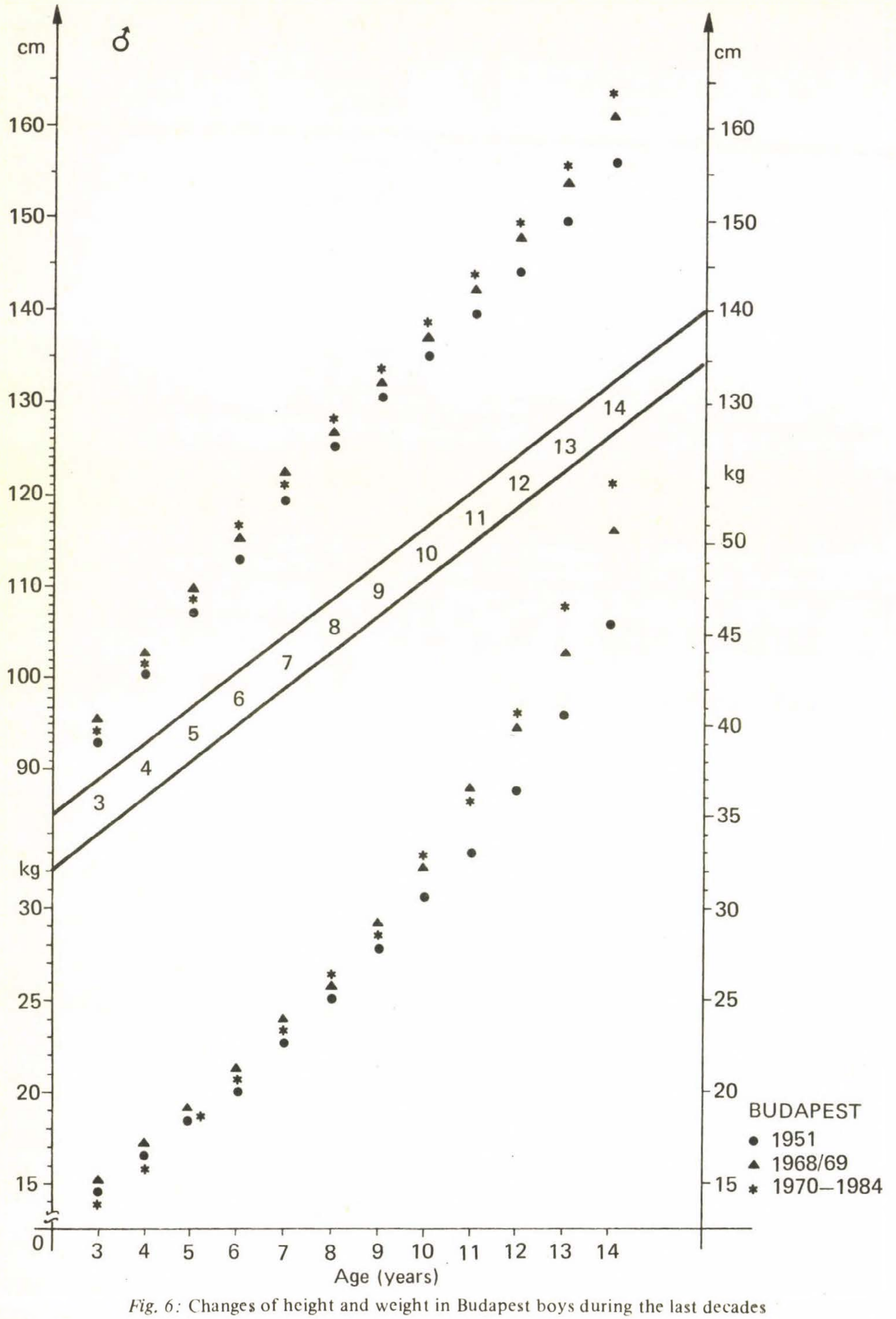


Fig. 6: Changes of height and weight in Budapest boys during the last decades

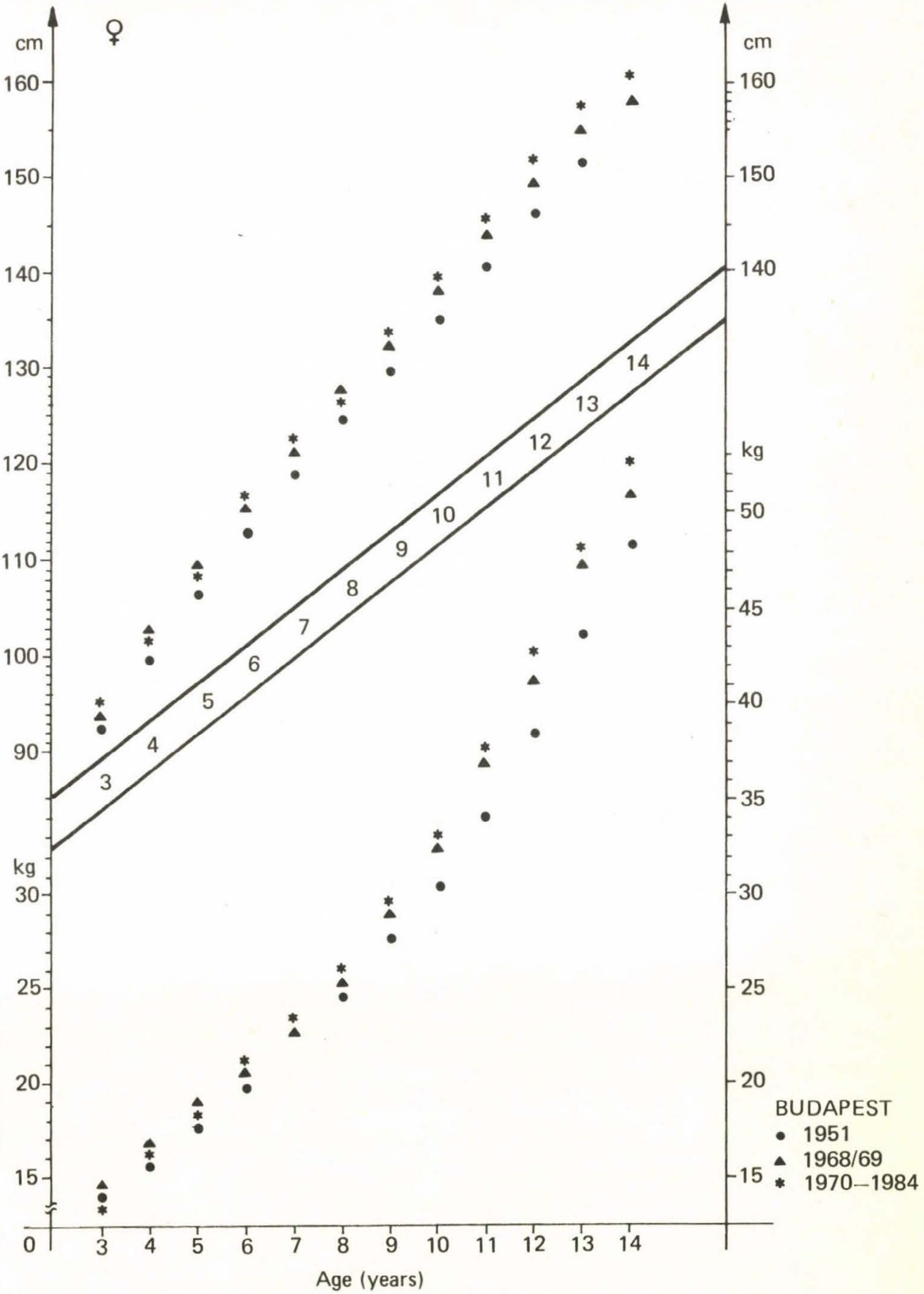


Fig. 7: Changes of height and weight in Budapest girls during the last decades

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SKELETAL MATURATION IN A LONGITUDINAL STUDY OF BELGIAN BOYS

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Abstract: We made use of the Belgian Longitudinal Growth Study of the Normal Child (Graffar 1958) to produce centiles for skeletal maturation scores (TW2 method) and for bone age at each chronological age between 3 and 15 years in boys. Until 4 years of age, skeletal maturation and bone age tend to be advanced with respect to chronological age, but this trend reverses during the later prepubertal ages. At puberty, they seem to catch up again this delay. Maturation rate for the TW2 bone scores shows a regular increase from childhood till puberty. The RUS score increments show a tendency to decrease till 10 years of age, but then show a clear adolescent spurt. The maturation rate of carpal bones shows a peak around 7 to 8 years of age.

Key words: Skeletal maturation

Introduction

Maturation is a measure of the rate of development of a child. It indicates how far a child has progressed in his developmental process towards adulthood. Children with the same adult height, for example, but with varying rates of maturation, will have different heights at any particular age throughout their growth process, simply because slow maturing children take somewhat more time to complete their growth process than fast maturing children. So, one should bear in mind that, in a population, the variation in size (height for example) at a particular age is partly due to a variation in the genetic predisposition for being small or tall, but also to a variation in maturation, or tempo of growth. This relationship between growth and maturation makes that chronological age has its limits in evaluating the growth of a child.

Maturation is measured on a scale with a fixed starting and ending point, corresponding respectively, with the stages of complete immaturity and full development. Intermediate stages are observed as qualitative changes, independent of size, and occurring in an irreversible order. During childhood, the number of erupted teeth provide a good system for evaluation of the maturation of a child (Demirjian et al. 1973), while at adolescence, various characteristics of pubertal development (pubic hair, axillary hair, menarche, genital and breast development) provide a criterium to estimate maturation (Tanner 1962, Marshall et al. 1969, 1979). However, by far the most commonly used criterium is skeletal maturation, which is based on the fact that osseous development goes through a number of well-defined and easily recognisable stages, that occur in an irreversible order, and are independent of the size of the bones. The final stage in the process of skeletal maturation corresponds with complete closure of the epiphyses of the long bones, and, hence, also coincides with the end of the growth process of the long bones. Skeletal maturation is to some extent related to dental and sexual maturation (Marshall 1974). It is also applicable during fetal development (Birkbeck 1984) and in newborns (Neyzi et al. 1984).

Although various parts of the skeleton can be used to examine bone maturation, most methods are restricted to particular areas of the body, such as the knee (Roche et al. 1975b) or the hand and wrist (Todd 1931, Greulich and Pyle 1959, Tanner et al. 1962, 1975), for example. Particularly, X-rays of the hand and wrist are relatively easy to take and have shown to be very useful in the determination of skeletal maturation, since that area of the skeleton shows a relatively large number of bones, with fairly well-recognisable stages of development, or maturation indicators. The skeletal maturation of a child can be expressed in terms of a maturation score (Tanner et al. 1962, 1975), but in all instances, one can calculate a child's bone age (or skeletal age) which is the average age of children in the normal population who have the same maturation as that particular child.

Skeletal maturation or bone age are powerful tools to evaluate the normality of a child's growth, since they allow to better interpret a child's growth advancement or retardation. Indeed, it allows, for example, to estimate the amount of growth delay that is simply attributable to a lower tempo of growth and the amount of retardation, which is due to factors that may affect its growth potential. It is particularly, the latter sort of information, together with information about the height of the parents, that is important to pediatricians in order to estimate the severity of the growth delay in various growth disturbing diseases. Since skeletal maturation is related to the growth process and can express (in terms of a percentage, for example) how much of the process is completed at a certain age of the child, it also provides possibilities to make predictions of adult size (Tanner et al. 1975, Roche et al. 1974). In terms of public health, skeletal maturation can be used to reveal environmental changes.

Such as for growth, skeletal maturation reflects an interaction between genetic and environmental factors (Garn et al. 1963, 1966), stressing the need for population specific references for maturation scores. The aim of the present study is to present centiles for maturation scores and bone age in Belgian boys, based on longitudinal data (Graffar 1958), and using the TW2 (Tanner-Whitehouse 2) method (Tanner et al. 1975). Several authors have shown that the TW method (TW1) is more reliable than the Greulich–Pyle method (Roche et al. 1970; Johnson et al. 1973, Roche 1978).

Materials and Methods

The data comes from the longitudinal survey of Belgian children, previously described by Graffar (1958), Wachholder et al. (1975) and Hauspie et al. (1980). This study is known as the Belgian Growth Study of the Normal Child and was part of a series of longitudinal growth studies, conducted in different European countries and coordinated by the International Children's Centre in Paris (Falkner 1955). The actual sample is representative of the Brussels' population.

X-rays were taken at yearly intervals, within 14 days from birthdays, between 1 and 15 years of age. The material consists of 581 X-rays, taken on 50 boys. There was an average number of 11.6 radiographs per subject taken over the 14 years period. All radiographs were rated by one of the authors (G. G.) according the TW2 method (Tanner et al. 1975). The reliability of the authors' technique was tested by comparing his ratings of a set of 100 X-rays from the Harpenden Longitudinal Growth Study with ratings of the same set by an expert in the field (Beunen 1985). The overall percentage of agreement between independent ratings of the 100 radiographs was 86.4%, the great majority of the differences was limited to one stage only. Reproducibility of the author's own ratings was checked on a subset of 50 X-rays and the agreement between two ratings of these same subset was 87.2%. These values are in good agreement with those obtained by Beunen and Cameron (1980), higher than those obtained by Baughan et al. (1979), van Vanrooij-

Ysselmuiden et al. (1978), Helm (1979), and Wenzel et al. (1982). The difference in bone age between the independent ratings was only 0.045 years (S.D. = 0.416 years) and between the 1st and 2nd ratings only 0.124 years (S.D. = 0.316 years).

Results

The centile values of the maturity scores are shown in Figure 1 for the 20 bones, in Figure 2 for the RUS bones and in Figure 3 for the carpal bones. The centile lines of the respective bone ages are shown in Figures 4 to 6. The numerical data are given in Appendices 1 and 2. Figure 7 shows the differences in TW2 (20 bones), RUS and carpal bone age, between the Belgian and British population. At the earliest ages, the Belgian boys are advanced by about 0.5 years at the age of 1 year, but from 4–5 year onwards, they are slightly retarded (maximum delay at age 7). At puberty, they seem to catch up and to be in advance again from the age of 13 years onwards. RUS bones follow more or less the same trend as TW2 bone age, but with a slightly more pronounced delay in the period 4 to 12 years, and a stronger catch-up towards puberty. On the contrary, carpal bones are characterized by an advance till the age of 5 years, and a delay from age 6 years onwards, which does not seem to be catched up during adolescence.

Comparison of the TW2 bone age at each chronological age in the Belgian sample with various other populations is shown in Figure 8. It seems that Belgian boys have a lower skeletal maturity than Finnish (Tiisala et al. 1969, 1971), the Polish of good socio-economic conditions (Kopczynska-Sikorska et al. 1984), and the Australians from British ancestry (Roche et al. 1971). These patterns are different from the Greulich–Pyle bone ages observed by Roche et al. (1975a) for the U.S. population, where a constant decrease of the difference between chronological age and skeletal age was observed between 6 and 11 years of age.

Theoretically, the mean increment of bone age will be one year for each one-year increase of chronological age, but in practise, the range seems to vary between 0 and 2 years in the age range 3 to 16 years (Johnston 1964a, 1971, Marshall et al. 1969, Malina 1970, Tanner et al. 1975). As expected, children with advanced maturation in early childhood have lower rates of maturation later on; those with delayed maturation during childhood have higher rates of maturation at adolescence.

Hewitt et al. (1961) observed a pubertal spurt in the bone maturation. This acceleration and the corresponding sexual differences have been observed by Tanner et al. (1975), but with a different pattern for the RUS and carpal bones. Of course, this phase of acceleration is under the control of androgenic and oestrogenic hormones.

Comparison of maturation rates in the Belgian and British boys are shown in Figure 9 for the TW2 bones, in Figure 10 for the RUS bones, and in Figure 11 for the carpal bones. These figures show the increments of maturation scores calculated from the mean scores at successive ages. The overall pattern in maturation rate is fairly similar between the Belgian and British boys for the three types of maturation scores. However, there is a tendency towards lower maturation rate prepubertal ages and at almost all ages for the carpals. It is also note-worthy that between age 7 and 8 there is a small peak in the maturation rate of Belgian boys. One could postulate that this peak might be related to the pre-pubertal peak in height growth, but a more detailed analysis of the individual patterns of maturation rate in relation to the pattern of growth velocity can only provide more accurate information about this eventual relationship.

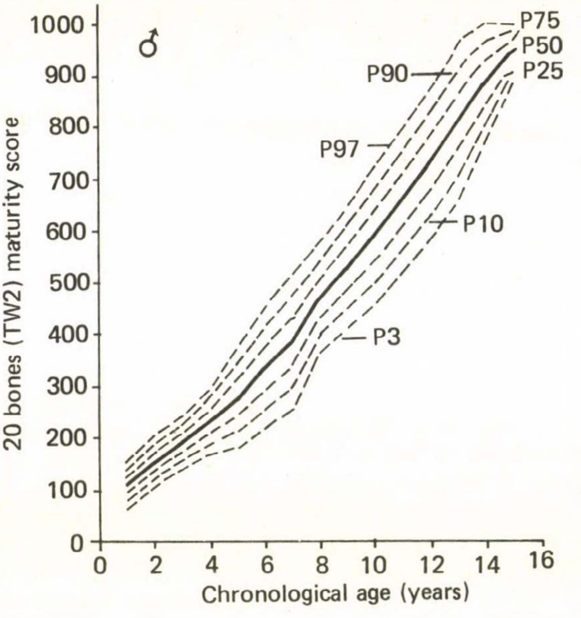

Fig. 1: Centiles of the maturity scores for the 20 TW bones in Belgian boys

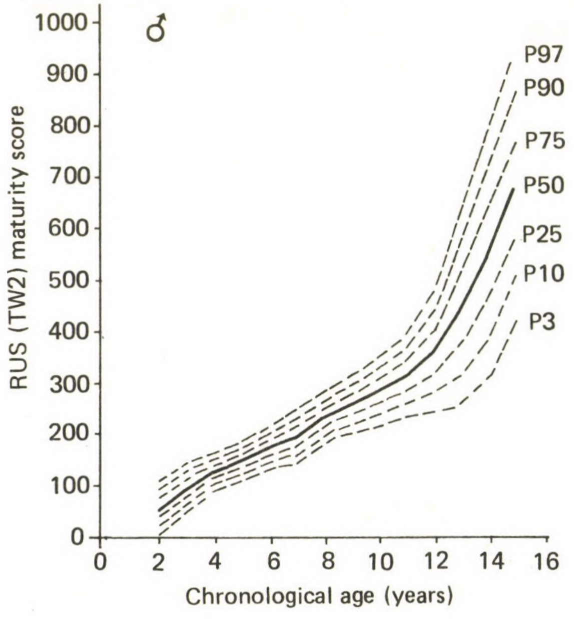

Fig. 2: Centiles of the maturity scorse for the RUS bones in Belgian boys

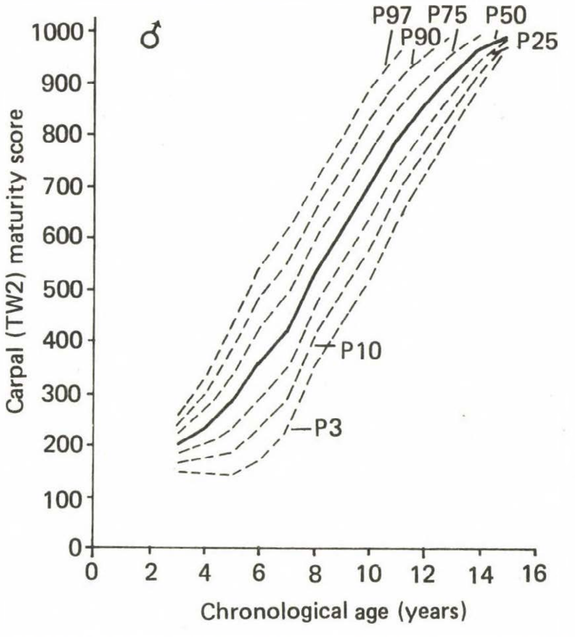

Fig. 3: Centiles of the maturity scores for the CARPAL bones in Belgian boys

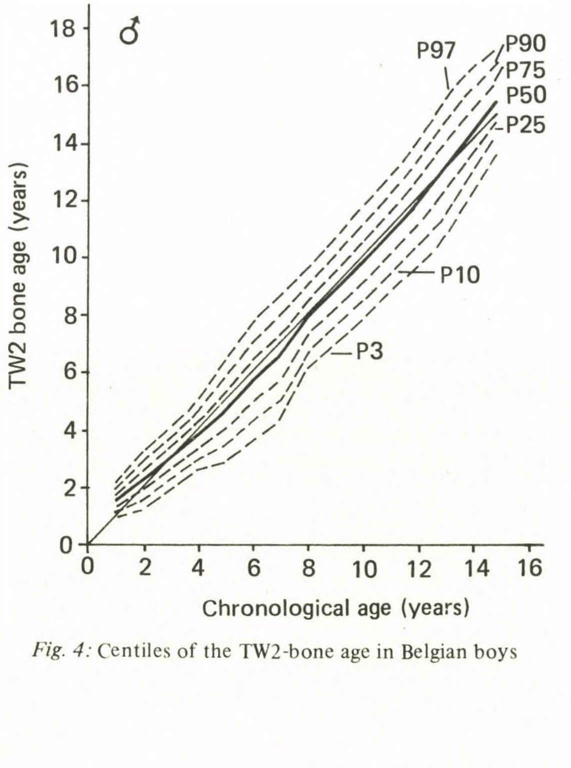

Fig. 4: Centiles of the TW2-bone age in Belgian boys

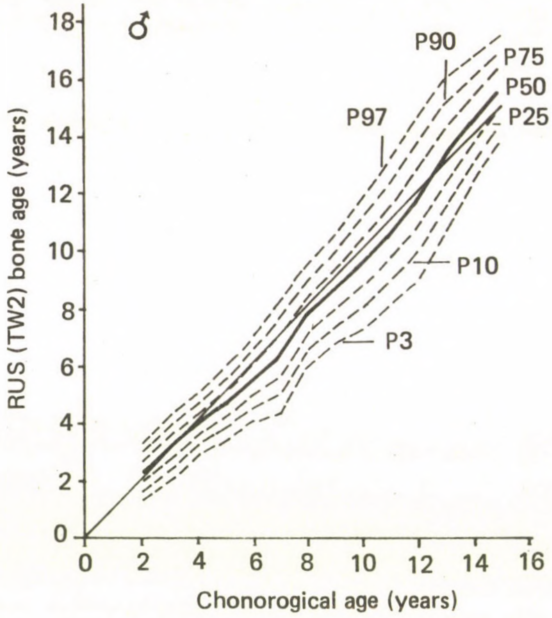

Fig. 5: Centiles of the RUS-bone age in Belgian boys

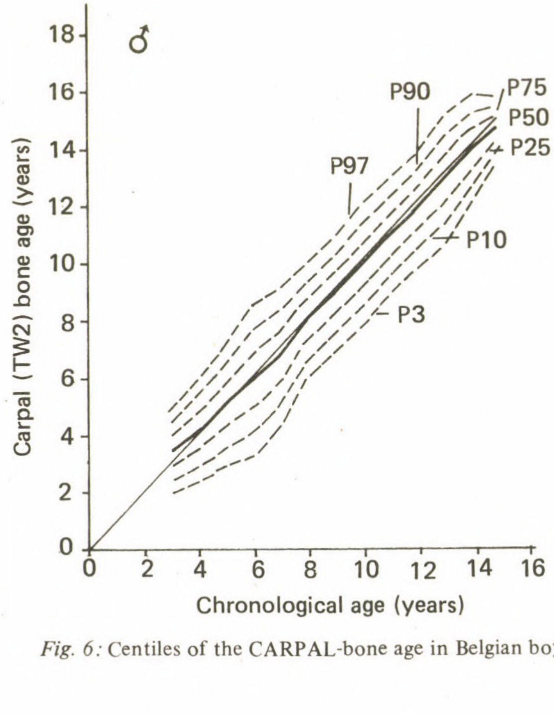

Fig. 6: Centiles of the CARPAL-bone age in Belgian boys

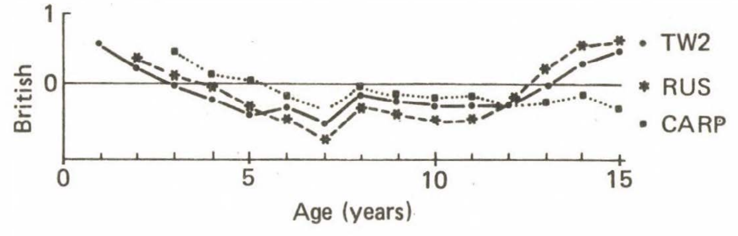

Fig. 7: Differences in TW2, RUS and CARPAL bone ages between Belgian and British boys

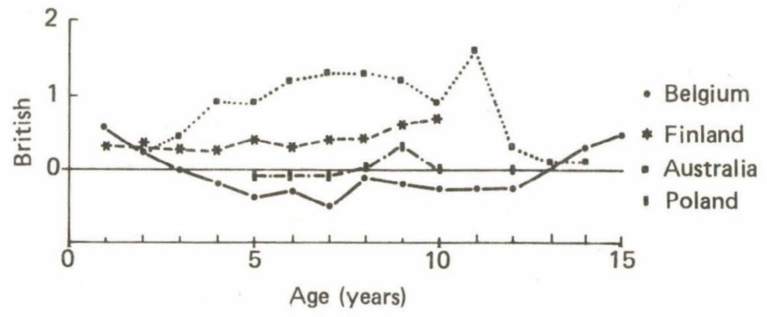

Fig. 8: Comparison of the TW2 bone age in Belgian boys with various other populations

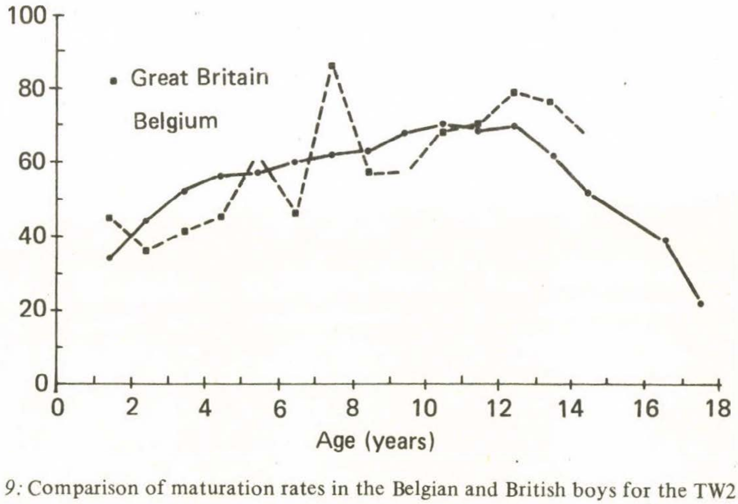

Fig. 9: Comparison of maturation rates in the Belgian and British boys for the TW2 bones

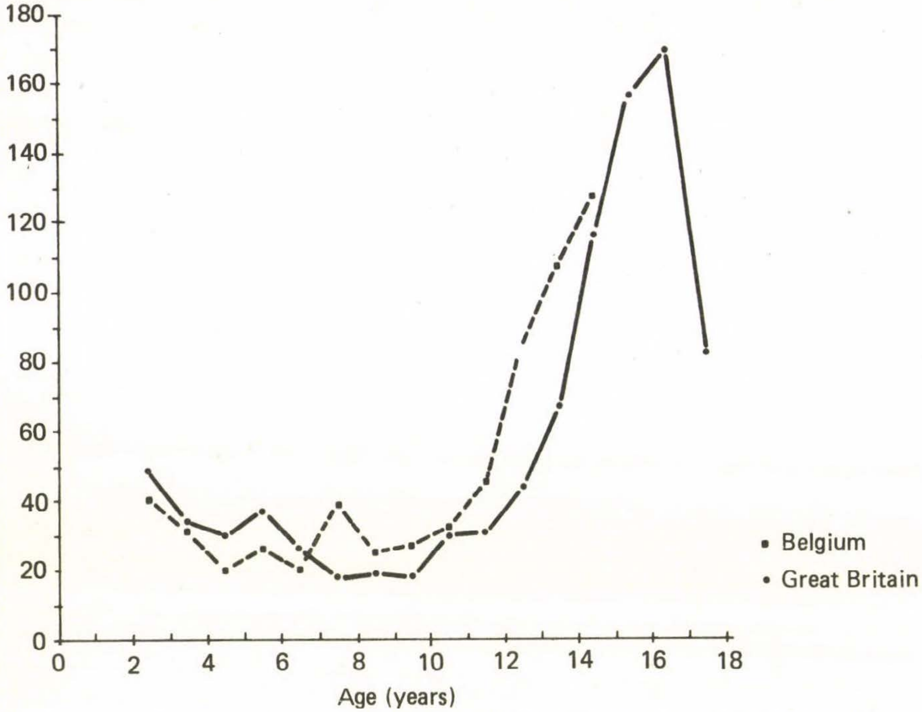

Fig. 10: Comparison of maturation rates in the Belgian and British boys for the RUS bones

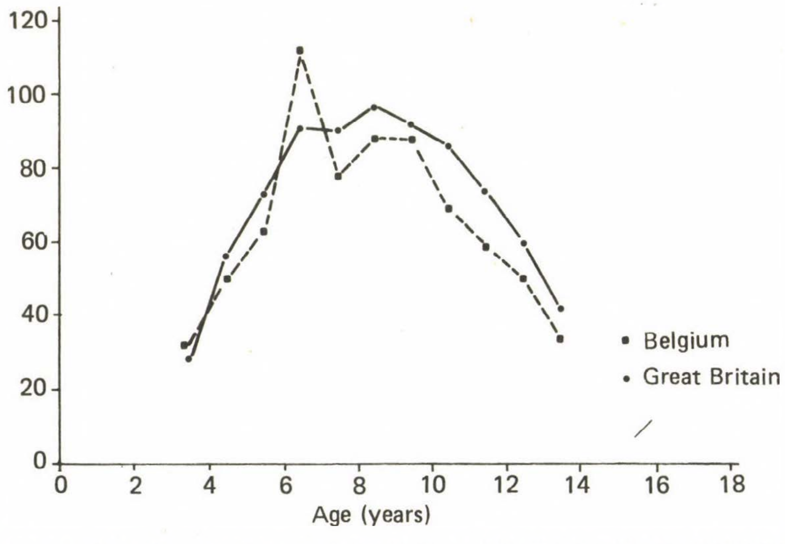

Fig. 11: Comparison of maturation rates in the Belgian and British boys for the CARPAL bones

Discussion

Comparison of different populations is difficult because of the variation in genetic and environmental factors. Socio-economic differences in skeletal maturation have been observed within the same population by De Wijn (1053), Greulich et al. (1953), Chang et al. (1963), Low et al. (1964), Kopczynska-Sikorska (1964), Andersen (1968), Rea (1971), Garn et al. (1973), and Kristmundottir et al. (1984a). However, it appears that socio-economic conditions have less effect on skeletal maturation than on growth in height or other somatic traits (Kopczynska-Sikorska et al. 1984). This might explain why in some populations only slight or no social differences were observed (Asiel 1966, Sempé 1968, Graffar 1971, Descamps et al. 1974, Roche et al. 1975a, 1978).

Low nutritional status is related to a retardation of skeletal maturation (Blanco et al. 1972). In early infancy, children do not show a clear retardation, but at the time of weaning or in conditions of undernutrition, children tend to delay in skeletal maturation (Massé et al. 1963, Bala 1974). Effects of undernutrition have been observed also by Abbott el al. (1950), Snodgrasse et al. (1955), Dreizen et al. (1958), Spies et al. (1959), Acheson et al. (1962), Malcolm (1970), Frisancho et al. (1970), and Garn et al. (1975). Boys are more sensible towards adverse nutritional conditions than girls (Abbott et al. 1950, Widdowson et al. 1954). Moreover, skeletal maturation in boys is more sensitive to other environmental factors than in girls (Acheson et al. 1954, Falkner 1958). This phenomenon can explain why bone age in boys, sometimes, shows a greater dispersion than in girls (Tiisala et al. 1968).

On the other hand, chronic protein-energy malnutrition has a relatively greater effect on growth than on skeletal maturation (Frisancho et al. 1970, Lampl et al. 1978, Martorell et al. 1979, Johnston et al. 1984). It has also been observed that supplementary protein intake results in an acceleration of maturation (McNair et al. 1938, Dreizen et al. 1954, Lampl et al. 1978, Martorell et al. 1979). In general, overnutrition and obesity is associated with an accelerated skeletal maturation (Bruch 1939, Garn et al. 1959, 1960, Frisk et al. 1966, Maresh 1966).

Skeletal maturation is positively correlated with weight, subcutaneous fat thickness, but the association with these growth variables is rather low (Simmons et al. 1943, Garn et al. 1961, Johnston 1964b, Maresh 1966). It is also positively correlated with height growth (Tiisala et al. 1969, 1971, Mazess et al. 1971), and with percentage attainment of adult stature (Bayley et al. 1952) and with maturation of sexual characteristics (Simmons et al. 1943).

Factors such as frequency of diseases (Douglas et al. 1958) also influence skeletal maturation. Chronic diseases are related to a delayed maturation (Hewitt et al. 1955, Falkner 1958, Tiisala et al. 1966, Hauspie et al. 1977, Kristmundottir et al. 1964b).

It is difficult to talk in terms of „racial" differences in skeletal maturation, since we are then considering groups that differ in so many factors: socio-economic status, nutrition, hygienic situation, climate, physical activity, etc. At least from family studies, it has been shown that there is genetic involvement in the order of appearance and ossification of the different bone centers (Garn et al. 1962). All together, there are many reports in the literature on so-called racial differences in skeletal maturation, which we would like to call either geographic or ethnic differences (Todd, 1931, Massé et al. 1963, Meredith 1968, Malcolm 1970, Malina 1970, Wingerd et al. 1974, Roche et al. 1975a, 1978).

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APPENDIX 1

Age	P3	P10	P25	P50	P75	P90	P97
			Centiles of TW2 MATURITY SCORES for age in Belgian boys				
1.0	67.36	80.92	94.59	109.85	125.11	138.78	152.34
2.0	107.12	122.19	137.38	154.33	171.28	186.47	201.54
3.0	141.44	157.19	173.07	190.79	208.51	224.39	240.14
4.0	168.60	188.77	209.10	231.79	254.48	274.81	294.98
5.0	179.85	210.66	241.73	276.39	311.05	342.12	372.93
6.0	222.72	259.54	296.68	338.11	379.54	416.68	453.50
7.0	255.25	296.60	338.30	384.82	431.34	473.04	514.39
8.0	365.67	399.08	432.77	470.35	507.93	541.62	575.03
9.0	413.95	450.31	486.98	527.88	568.79	605.45	641.81
10.0	456.67	499.22	542.12	589.98	637.84	680.74	723.29
11.0	523.95	566.88	610.16	658.45	706.74	750.02	792.95
12.0	583.20	629.70	676.59	728.90	781.21	828.10	874.60
13.0	656.38	705.37	754.77	809.88	864.99	914.39	963.38
14.0	771.34	808.55	846.06	887.92	929.78	967.29	1000.00
15.0	879.26	900.12	921.15	944.61	968.07	989.10	1000.00
			Centiles of RUS MATURITY SCORES for age in Belgian Boys				
2.0	6.52	23.12	39.86	58.54	77.22	93.96	110.56
3.0	52.10	67.01	82.05	98.82	115.59	130.63	145.54
4.0	95.85	106.68	117.61	129.80	141.99	152.92	163.75
5.0	112.39	124.47	136.64	150.22	163.80	175.97	188.05
6.0	136.47	149.10	161.83	176.03	190.23	202.96	215.59
7.0	142.86	159.84	176.96	196.06	215.16	232.28	249.26
8.0	185.89	201.66	217.56	235.30	253.04	268.94	284.71
9.0	206.02	223.48	241.09	260.73	280.37	297.98	315.44
10.0	219.11	240.78	262.63	287.00	311.37	333.22	354.89
11.0	241.20	265.77	290.55	318.19	345.83	370.61	395.18
12.0	248.33	285.14	322.26	363.67	405.08	442.20	479.01
13.0	259.38	319.03	379.18	446.29	513.40	573.55	633.20
14.0	311.03	388.31	466.23	553.17	640.11	718.03	795.31
15.0	418.20	502.02	586.54	680.84	775.14	859.66	943.48
			Centiles of CARPAL MATURITY SCORES for age in Belgian Boys				
3.0	149.02	165.64	182.41	201.11	219.81	236.58	253.20
4.0	143.97	172.46	201.18	233.23	265.28	294.00	322.49
5.0	140.76	186.20	232.03	283.15	334.27	380.10	425.54
6.0	171.28	230.81	290.84	357.81	424.78	484.81	544.34
7.0	226.45	288.37	350.81	420.47	490.13	552.57	614.49
8.0	355.03	411.66	468.75	532.45	596.15	653.24	709.87
9.0	434.35	491.72	549.56	614.10	678.64	736.48	793.85
10.0	515.93	575.58	635.72	702.82	769.92	830.06	889.71
11.0	629.09	680.76	732.86	790.98	849.10	901.20	952.87
12.0	721.63	765.73	810.20	859.81	909.42	953.89	997.99
13.0	806.56	842.27	878.27	918.44	958.61	994.61	1000.00
14.0	897.52	920.31	943.30	968.94	994.58	1000.00	1000.00
15.0	968.08	976.43	984.85	994.25	1000.00	1000.00	1000.00

APPENDIX 2

Age	P3	P10	P25	P50	P75	P90	P97
Centiles of TW2 BONE AGE for age in Belgian boys							
1.0	0.95	1.14	1.33	1.55	1.77	1.96	2.15
2.0	1.22	1.55	1.88	2.24	2.60	2.93	3.26
3.0	1.96	2.29	2.62	2.99	3.36	3.69	4.02
4.0	2.62	2.99	3.37	3.80	4.23	4.61	4.98
5.0	2.88	3.43	3.99	4.61	5.23	5.79	6.34
6.0	3.70	4.33	4.97	5.69	6.41	7.05	7.68
7.0	4.32	5.01	5.70	6.48	7.26	7.95	8.64
8.0	6.21	6.74	7.28	7.88	8.48	9.02	9.55
9.0	7.06	7.61	8.17	8.79	9.41	9.97	10.52
10.0	7.77	8.40	9.03	9.73	10.43	11.06	11.69
11.0	8.79	9.41	10.03	10.73	11.43	12.05	12.67
12.0	9.63	10.30	10.99	11.75	12.51	13.20	13.87
13.0	10.57	11.35	12.13	13.00	13.87	14.65	15.43
14.0	12.10	12.80	13.51	14.30	15.09	15.80	16.50
15.0	13.70	14.27	14.84	15.47	16.10	16.67	17.24
Centiles of RUS BONE AGE for age in Belgian Boys							
2.0	1.31	1.62	1.94	2.29	2.64	2.96	3.27
3.0	1.95	2.32	2.69	3.10	3.51	3.88	4.25
4.0	2.90	3.23	3.57	3.95	4.33	4.67	5.00
5.0	3.32	3.74	4.15	4.62	5.09	5.50	5.92
6.0	4.07	4.53	5.00	5.52	6.04	6.51	6.97
7.0	4.29	4.92	5.55	6.26	6.97	7.60	8.23
8.0	5.91	6.48	7.06	7.71	8.36	8.94	9.51
9.0	6.73	7.33	7.94	8.61	9.29	9.89	10.49
10.0	7.24	7.96	8.69	9.51	10.33	11.06	11.78
11.0	8.08	8.86	9.66	10.54	11.42	12.22	13.00
12.0	8.93	9.83	10.74	11.75	12.76	13.67	14.57
13.0	10.48	11.35	12.23	13.22	14.21	15.09	15.96
14.0	12.35	13.05	13.75	14.53	15.31	16.01	16.71
15.0	13.71	14.31	14.92	15.59	16.27	16.87	17.47
Centiles of CARPAL BONE AGE for age in Belgian boys							
3.0	2.00	2.46	2.92	3.43	3.94	4.40	4.86
4.0	2.40	2.95	3.51	4.13	4.75	5.31	5.86
5.0	3.01	3.66	4.32	5.06	5.80	6.46	7.11
6.0	3.22	4.06	4.91	5.85	6.80	7.64	8.48
7.0	4.30	5.06	5.82	6.67	7.52	8.28	9.04
8.0	6.00	6.63	7.26	7.96	8.66	9.29	9.92
9.0	6.88	7.51	8.14	8.84	9.54	10.17	10.80
10.0	7.70	8.37	9.06	9.82	10.58	11.27	11.94
11.0	8.84	9.48	10.13	10.85	11.57	12.22	12.86
12.0	9.81	10.43	11.05	11.75	12.45	13.07	13.69
13.0	10.51	11.23	11.96	12.78	13.60	14.33	15.05
14.0	11.95	12.56	13.18	13.87	14.56	15.18	15.79
15.0	13.63	13.97	14.32	14.70	15.08	15.43	15.77

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BIRTH DATA OF PATIENTS WITH DOWN SYNDROME

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Abstract: Gestation weeks and three body measurements of newborn patients with Down syndrome were recorded. The mean of these data including the gestation weeks were significantly less than that of the control. 62.8% of the patients were born at time, 20% of them had less birthweight than 2500 g.

Introduction

Body measurements of the newborn with Down's syndrome have been poorly studied, and their fetal development is prospectively irregular because of the frequency of developmental disorders:

According to several reports the measurements of the newborn with Down's syndrome are nearly normal. No significant differences were found in Downs' and Controls' birth weight by Southwick (1939). Comparing the size at birth of 563 newborns with Down's syndrome, who were born between the 28th and 44th weeks of gestation, Kucera (1971) did not describe significant differences.

Smith and McKeown (1955) did not find differences in the birth weight of control or Down's syndrome subjects, who were born between the 30th and 38th weeks of gestation. Those who were born between the 38th and 45th week had lighter weight. The mean gestation period of Down's syndrome subjects was 268.9 days, lower than that of the control (278.4 days). The authors suggested that the low birth weight of Down's syndrome subjects resulted not only from the shorter gestation period but also from the low rate of growth in intrauterine life.

Hall (1964) also described shorter gestation periods in Down's syndrome newborns (176.5 days) than that of the controls (282.8 days).

Most of the publications described considerable differences in the size at birth between the Down's syndrome and „normal" newborn babies. Katz and Taylor (1967) found that two thirds of Down's syndrome subjects had a birth weight under 2500 g. According to other authors the average birth weight of Down's syndrome newborns is about 3 kgs, considerably less than that of the controls (Smith and McKeown 1955, Chen et al. 1970).

Using linear regression analysis Pueschel et al. (1976) reported significantly lower birthweights of Down's syndrome subjects than that of their siblings. The mean recumbent length at birth in Down's syndrome patients was reduced by 0.5 SD from the mean of the control study (Cronk 1978).

Material and Methods

Birth length, weight, head girth and length of the gestation period of 144 newborns with Down's syndrome (72 boys and 72 girls) were recorded. The gestational age was counted from conception so it is two weeks shorter than if it had been calculated from the last menstruation.

Body measurements of most of the patients were investigated over the first ten years of age. The connection between the body weight and height and the corresponding size at birth were analyzed by the multiple linear regression analysis.

Results and Discussion

The Table 1 shows the means and standard deviations of our recorded data which are consistently lower than that of the Hungarian birth data. No significant sex differences were found in the Down's patients, so the data will be discussed together.

Table 1. Birth data of Down patients

Body measurements and gestation	boys		girls	
	$\bar{x}$	SD	$\bar{x}$	SD
Birth weight (gr)	2913	58.2	2934	54.8
Birth lenght (cm)	51.3	3.4	50.3	3.3
Head girth (cm)	32.4	1.5	32.7	1.7
Gestation (days)	254.1	2.6	254.8	2.5

Most of our patients were born in the 38th week (Table 2). This lenght of gestation period seems to be an optimum: lower sizes result either from shorter or longer periods.

Table 2. Birth data according to the gestation period

Gestation period	%	Birth weight	Birth lenght	Head girth
above	1.4	2800	50.5	–
38 weeks	61.8	3139	48.8	33.1
under	36.8	2556	46.2	32.3

Patients were also grouped according to their birth weight (Table 3). Only one fifth of them had less birth weight then 2500 g. Both the gestation period and the sizes are less in this group.

Table 3. Birth data according to the birth weight

Birth weight	%	Gestation weeks	Birth lenght	Head girth
at or above 2500 gr	79.2	36.9	51.9	33.1
under	20.8	34.4	46.5	31.9

The correlation coefficients among the recorded data were also calculated (Table 4). We found significant correlations between all data pairs.

Table 4. Correlation matrix of birth data

	Birth weight	Birth lenght	Head girth	Gestation period
Birth weight	=======			
Birth lenght	.6985	=======		
Head girth	.5487	.5924	=======	
Gestation period	.4920	.3977	.3628	=======

Growth rate of the children with Down's syndrome after birth is less than that of the control. At this age, the mean of the recumbent length of Down's syndrome subjects was 2 SD below that for normal children. The mean weight reduction of that age was 1.5 SD (Cronk 1978).

We use the multiple linear regression analysis to investigate the influence of the birth data on the growth of height and weight, as mentioned above. The growth of these measurements is not completely linear so this model is not the best. This calculation was intended to be the first approximation of the problem.

In our calculation the appropriate body measurements were used as the dependent ones. The first independent variable was the age of the child and the second one was the corresponding data at birth.

If the independent variable is the body weight (Table 5) about 60% of its variation can be explained in this way. The significance of determination coefficients was computed by the F test. We also calculated the relative importance of the independent variables.

Table 5. Regression analysis of body weight

$$y = a + b_1 x_1 + b_2 x_2$$

1.	Dependence of body weight (y) upon the age (x_1) and the birth weight (x_2)			
	$y = 15.067 + 1.784 x_1 + 0.135 x_2$	$R^2 = 64.75\%$	$F = 34.90^{++}$	$\hat{b}_1/\hat{b}_2 = 21.88$
2.	Dependence of body weight (y) upon the age (x_1) and the birth lenght (x_2)			
	$y = -38.857 + 2.149 x_1 + 0.979 x_2$	$R^2 = 69.50\%$	$F = 31.91^{++}$	$\hat{b}_1/\hat{b}_2 = 4.11$
3.	Dependence of body weight (y) upon the age (x_1) and the gestation weeks (x_2)			
	$y = 4.107 + 0.0323 x_1 + 0.344 x_2$	$R^2 = 56.82\%$	$F = 25.00^{++}$	$\hat{b}_1/\hat{b}_2 = 15.14$

This method can explain the variance of body height (Table 6) about 50% only. Of course, the more important independent variable was the children's age. On the other hand, some influence of the birth data can be supported. This influence is perhaps a little more apparent in body weight than body height.

Table 6. Regression analysis of body height

$$y = a + b_1 x_1 + b_2 x_2$$

1.	Dependence of body height (y) upon the age (x_1) and the birth lenght (x_2)			
	$y = 77.980 + 2.082 x_1 + 0.583 x_2$	$R^2 = 45.39\%$	$F = 12.05^{++}$	$\hat{b}_1/\hat{b}_2 = 6.70$
2.	Dependence of body height (y) upon the age (x_1) and the birth weight (x_2)			
	$y = 98.021 + 2.010 x_1 + 3.489 x_2$	$R^2 = 45.05\%$	$F = 11.89^{++}$	$\hat{b}_1/\hat{b}_2 = 7.98$
3.	Dependence of body height (y) upon the age (x_1) and the gestation weeks (x_2)			
	$y = 23.761 + 0.0418 x_1 + 2.260 x_2$	$R^2 = 51.53\%$	$F = 15.42^{++}$	$\hat{b}_1/\hat{b}_2 = 2.63$

The influence of the recorded birth data itself at birth on the actual body size cannot be proven in this way (Table 7).

Table 7. Regression analysis of body weight and body height

1.	Dependence of body weight (y) upon the birth weight (x_1) and birth lenght (x_2)		
	$y = -17.396 + 7.934 x_1 + 0.779 x_2$	$R^2 = 7.58\%$	$F = 1.15^{-}$
2.	Dependence of body weight (y) upon the birth weight (x_1) and gestation weeks (x_2)		
	$y = 42.712 + 6.759 x_1 + 0.576 x_2$	$R^2 = 2.56\%$	$F = 6.53^{-}$
.	Dependence of body height (y) upon the birth weight (x_1) and birth lenght (x_2)		
	$y = 159.178 - 0.957 x_1 + 8.542 x_2$	$R^2 = 2.77\%$	$F = 0.41^{-}$
.	Dependence of body height (y) upon the birth lenght (x_1) and gestation weeks (x_2)		
	$y = 221.059 - 0.169 x_1 - 2.103 x_2$	$R^2 = 7.49\%$	$F = 1.13^{-}$

On the basis of this correlation matrix interactions between our data could be supposed. Perhaps if we consider the birth data as the 3rd independent variable, then an interaction could be proved.

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BODY DEVELOPMENT OF MENTALLY RETARDED BOYS – A MIXED LONGITUDINAL STUDY

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Abstract: Body size of moderate and severe mentally retarded boys have been studied for 12 years in an institution of Hungary. Twelve body measurements of 220 pupils were measured year by year but the body height and weight twice a year.

The average age of peak height velocity (PHV) was found at 13.5 year and the peak weight velocity (PWV) one year later. There were remarkable differences in individual growth curves either in PHV or in PWV. Heath– Carter somatotypes of the mentally retarded boys are presented.

Key words: Mentally retarded boys, Somatotype.

Physical development of mentally retarded children has been reported by several publications. All of them are based on cross sectional studies. These studies have clarified that the mean of body measurements of mentally retarded children are less than that of the normal control (Culley et al. 1963, Moiser et al. 1965, Buday 1974, Buday et al. 1977).

All kind of groups of mentally retarded children have been selected from educational viewpoints, so the aetiological factors are different. Therefore these groups are not homogeneous from biological point of view. It can be recognized from the high level of standard deviation of body measurements. Disregarding the studies of some special groups or particular type of analysis, no further results can be obtained from the cross-sectional studies; weither whan the number of measured children is extremly high. No longitudinal studies have been known in this field.

Material and Methods

Pupils from one of the largest Hungarian institutions for mentally retarded children have been measured over a 12 year-period. The institution is at the village of Homok, Szolnok county. All the children are from this county. There are 220 mild and moderate mentally retarded boys aged from 5 to 18 years in the institution. However, there are only few patients aged under 6 and over 17 years of age in this study.

Twelve body measurements were measured year by year. Ten measurements gave the anthropometric somatotype and two the breadth. Height and weight were measured twice a year. The children were not grouped for this study according to their IQ. Children with genetical disorders e.g. Down's syndrome were excluded. Therefore the time of the subjects' damage was after the conception.

The control was chosen from the Nation-wide Growth Study of Hungarian Children and Youth by the random number generator of an IBM computer. We wish to thank to Prof. O. G. Eiben for these data.

The results were also compared with a relatively large sample of children with Down's syndrome.

We agree with the opinion of Roche (1968) on choosing the control for studies of mentally retarded. Our control groups are probably not the best ones. For example we have to take into consideration their cross sectional character.

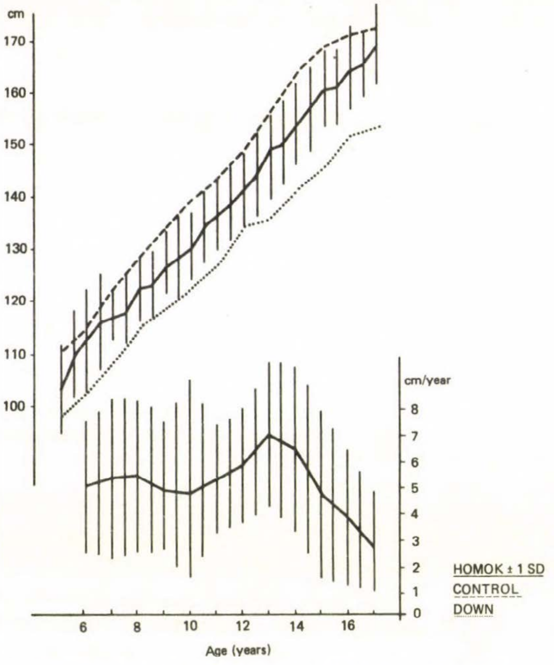


Fig. 1: Height in mentally retarded boys

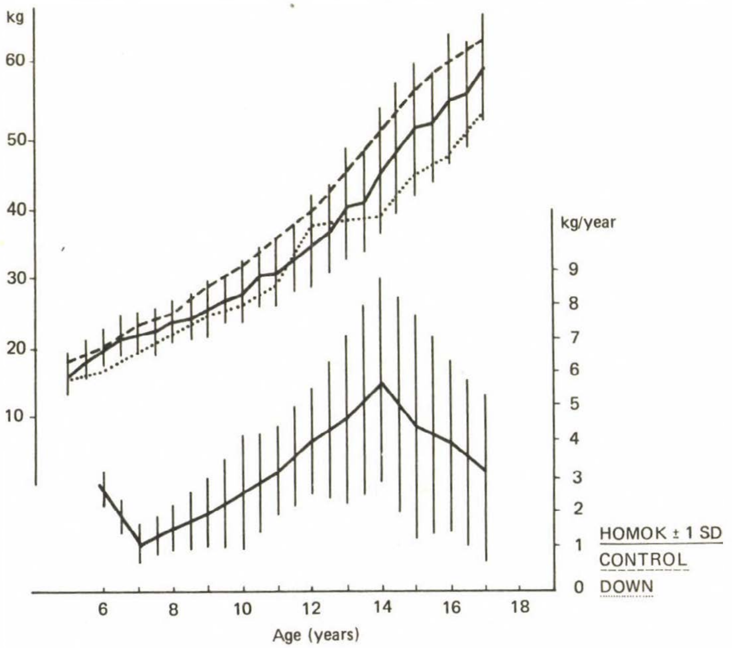


Fig. 2: Weight in mentally retarded boys

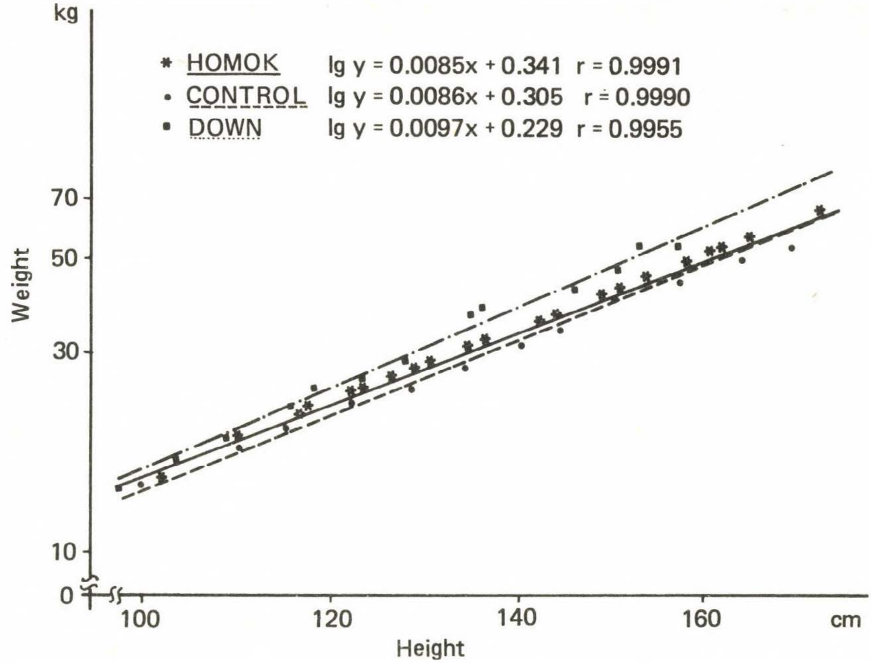


Fig. 3: Weight-for-height of the three groups

Results and Discussion

Growth of the body height can be seen in Fig 1. Considering the limited number of our patients the centiles were not computed. The shadowed areas show the mean ±1 SD. The control's curve falls into this area but the Down's one is below the shadowed area.

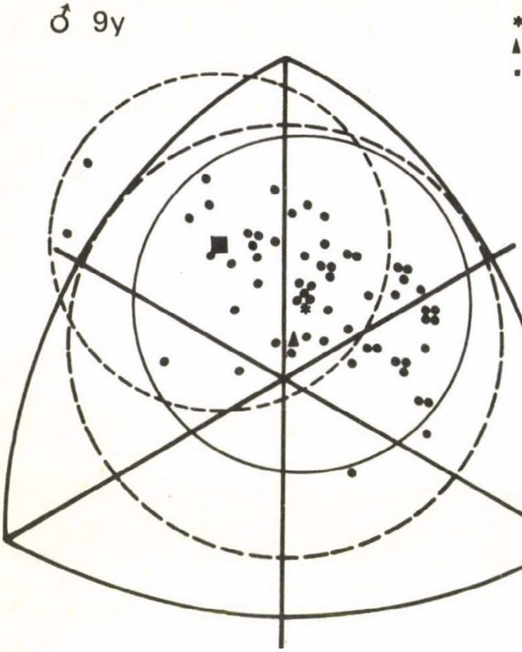
Some computed parameters of the velocity curve: the minimal prepubertal height velocity was 4.6 cm/year at 10 years of age with 130.8 cm corresponding average of body height. Peak height velocity is 6.9 cm/year at age 13 with 149.0 cm corresponding average of body height. The total adolescent gain is 31 cm.

Fig. 2 shows the growth of body weight. Both the curves of the control and the Down's deviate from the mean of the mentally retarded, but they are in the range of ±1 SD. Peak weight velocity is 6.0 kg/year at the age of 14, one year later than the peak of height one.

Range of both velocity curves is wide which corresponds to one of the previous suppositions on the puberty of the mentally retarded (Rundle and Sylvester 1973, Buday 1981).

Previously, analysis of the distribution of body height and weight of mentally retarded adolescents led us to the conclusion that the period of puberty is longer than that of the control (Buday 1979). Many kinds of individual variation were found including the pathological ones.

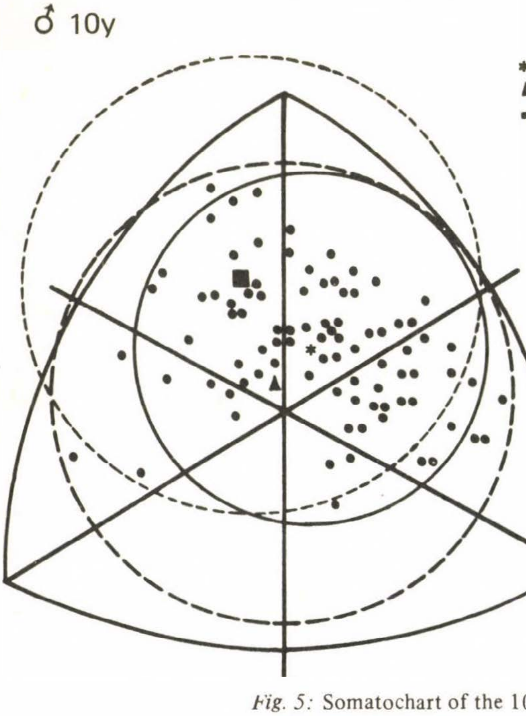
The weight-for-height curve was evaluated by the logaritmic model of regression analysis. In spite of the fact that our sample is not large enough significant correlations were found between the data pairs. The three regression lines are not parallel (Fig. 3).



	I.	II.	III.	SDI.
* Homok	2.54	4.18	3.57	3.59
▲ Control	2.84	4.10	3.64	4.51
▪ Down	3.13	4.18	1.70	3.63

	SDD	I	T^2
H–C	1.91	50.3	35.34
H–D	3.07	31.2	43.89
C–D	4.39	20.4	47.81

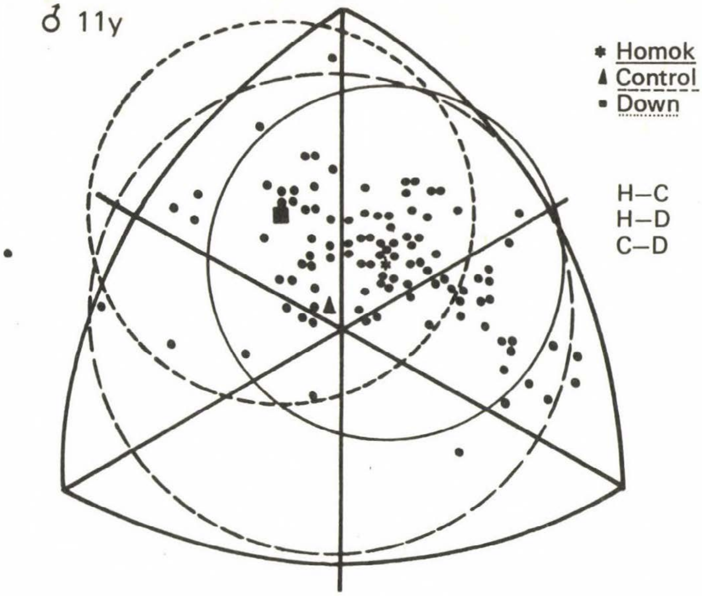
Fig. 4: Somatochart of the 9 year-old boys



	I.	II.	III.	SDI.
* Homok	2.71	4.29	3.24	3.88
▲ Control	3.08	4.17	3.61	4.78
▪ Down	3.04	4.97	2.29	4.84

	SDD	I	T^2
H–C	1.73	55.3	30.34
H–D	2.23	48.0	26.02
C–D	3.62	36.3	17.80

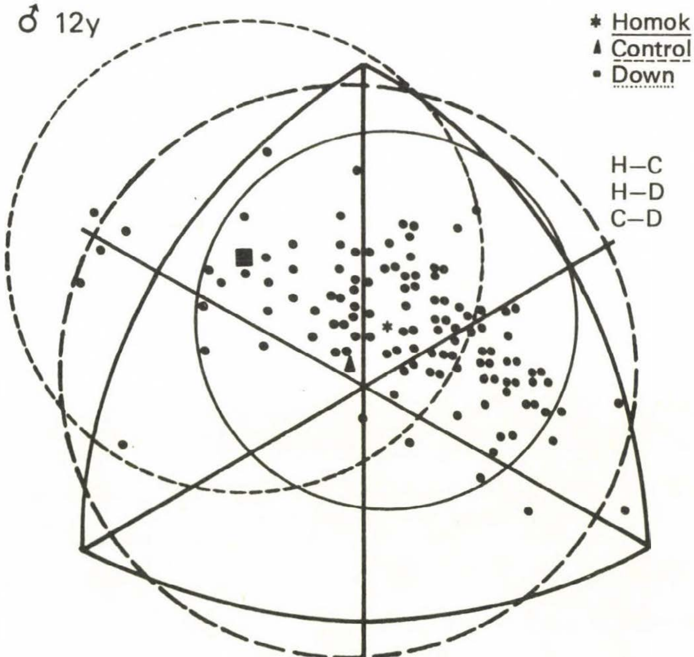
Fig. 5: Somatochart of the 10 year-old boys



	I.	II.	III.	SDI.
Homok	2.56	4.15	3.38	3.73
Control	3.35	4.09	3.64	5.15
Down	3.30	4.77	2.14	4.06

	SDD	I	T^2
H–C	1.99	47.9	40.82
H–D	2.62	40.5	51.81
C–D	1.73	55.3	22.99

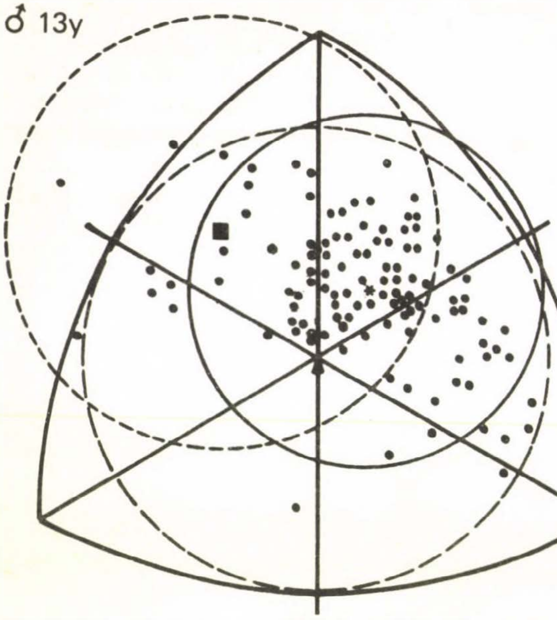
Fig. 6: Somatochart of the 11 year-old boys



	I.	II.	III.	SDI.
Homok	2.69	4.19	3.37	4.08
Control	3.64	4.14	3.73	6.19
Down	4.27	5.32	1.69	5.03

	SDD	I	T^2
H–C	2.09	43.4	51.66
H–D	4.02	28.6	63.78
C–D	4.76	30.3	38.45

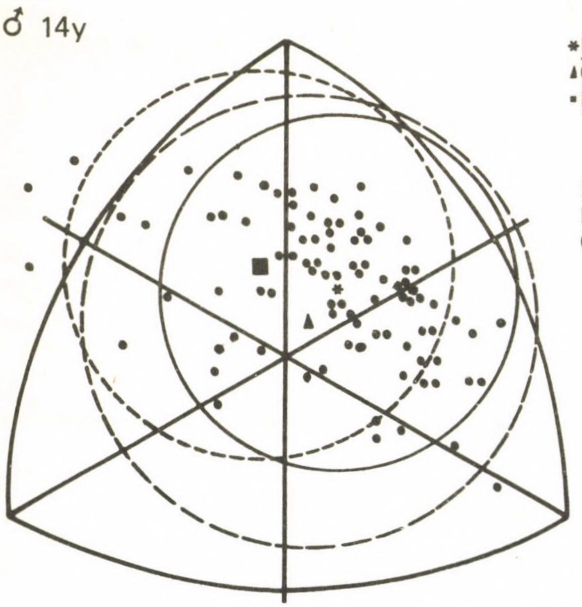
Fig. 7: Somatochart of the 12 year-old boys



	I.	II.	III.	SDI.
* Homok	2.57	4.29	3.36	3.66
▲ Control	3.65	3.91	3.97	5.09
• Down	3.93	5.28	1.92	4.61

	SDD	I	T^2
H–C	2.81	38.2	85.18
H–D	3.48	30.3	74.78
C–D	5.20	21.2	42.65

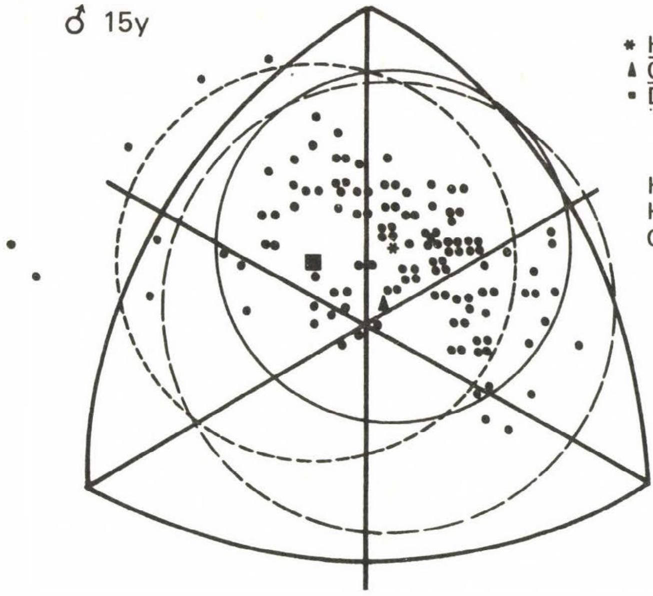
Fig. 8: Somatochart of the 13 year-old boys



	I.	II.	III.	SDI.
*Homok	2.52	4.27	3.23	3.90
▲Control	3.16	4.04	3.69	4.97
•Down	3.23	4.59	2.66	4.08

	SDD	I	T^2
H–C	1.56	56.9	21.92
H–D	1.50	61.3	16.40
C–D	2.37	48.1	8.91

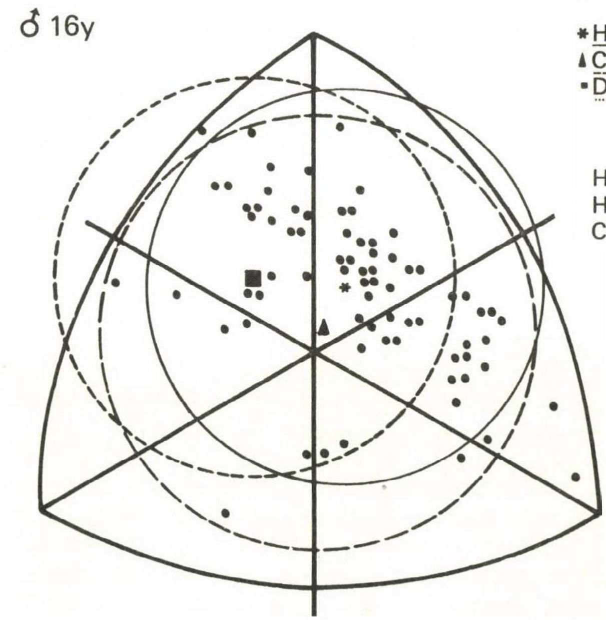
Fig. 9: Somatochart of the 14 year-old boys



	I.	II.	III.	SDI.
* Homok	2.52	4.23	3.16	3.83
▲ Control	3.25	3.80	3.65	4.83
▪ Down	3.59	4.27	2.44	4.14

	SDD	I	T^2
H–C	2.07	49.9	32.83
H–D	1.79	55.3	45.70
C–D	2.38	48.5	16.06

Fig. 10: Somatochart of the 15 year-old boys



	I.	II.	III.	SDI.
* Homok	2.64	4.19	3.59	4.22
▲ Control	3.42	3.78	3.34	4.53
▪ Down	3.75	4.40	2.37	4.28

	SDD	I	T^2
H–C	1.72	59.6	20.79
H–D	1.90	55.9	27.36
C–D	2.26	51.0	7.99

Fig. 11: Somatochart of the 16 year-old boys

	I.	II.	III.	SDI
* Homok	2.59	4.22	3.66	0.33
▲ Control	3.29	4.00	3.65	0.58
▪ Down	3.53	4.82	2.15	1.32

	SDD	I	T^2
H–C	1.49	0.00	24.20
H–D	2.69	0.00	28.04
C–D	3.52	0.00	18.67

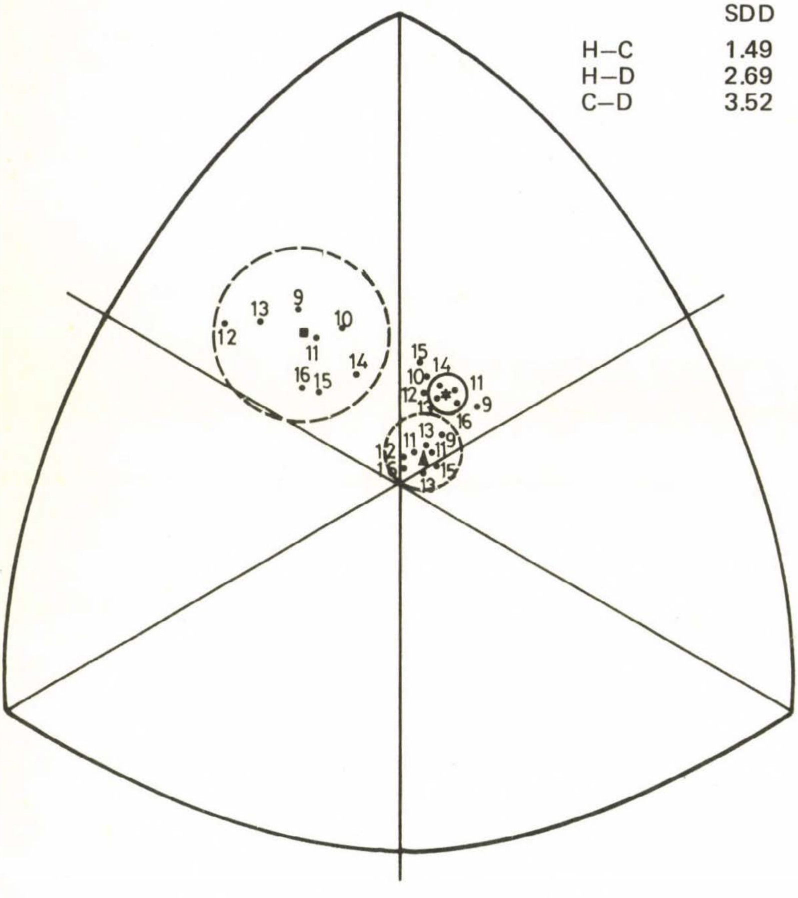


Fig. 12: A comparison of mean somatotypes of the three groups

The somatotype of our patients was evaluated by the Heath–Carter anthropometric technique. The mean somatotypes and the somatotype dispersion index (SDI) of children aged from 9 to 16 years will be shown in the next 8 figures. We have no room here to analyze these figures in detail. The circles, determined by the mean somatoplots and with the SDI as radius, overlap each other. The common field is shown by the I-index. The longest radius usually belongs to the group of Down's syndrome which means that bigger differences occur between individual somatotypes and therefore they have a higher heterogeneity than normal. Frequently the control's SDIs are bigger than the group of mentally retarded ones.

The differences between the samples were tested by Hotelling T^2 method. The degree of freedom of denominator of the corresponding F test was more than 50. The critical value at 0.01 probability level was less than 5.06. Accordingly we found significant differences between the free samples in all of the age groups (Figures 4–12).

Analyzing these figures the coordinates of the mean somatoplots seemed to be close to each other. So they were plotted from 9 to 16 year old as an individual somatoplots (Fig.12). The mean somatotypes of these groups and the SDI were also computed.

The previously mentioned age range is the pubertal period. The mentally retarded adolescents are in the ecto-mesomorph area, the controls are in the central, and the adolescents with Down's syndrome are far in the endo-mesomorph area. In the adult patients of the last group the extreme value of the meso-endomorph is characteristic (Buday and Eiben 1982). All the three adolescent groups are isolated from each other; they have no common fields. Moreover the small annual changes of the mean somatoplots in that period are also quite remarkable.

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GROWTH AND DEVELOPMENT OF MENTALLY DEFICIENT CHILDREN IN THE REGIONS OF THE SZABOLCS-SZATMÁR COUNTY

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Abstract: In 1976–1981 the author studied growth and development of 1246 children with mental deficiency (715 boys, 531 girls) from 7 to 16 years of age. Based on her data, the children investigated can be divided into three different groups: (1) feeble-minded (72.49%), (2) imbecile (19.46%) and (3) idiot (8.05%).

A comparison of the three groups resulted in some differences in relation to body development dependent on mental deficiency. There are significant differences in the function of socio-demographic factors, age of the mother, and birth weight of the children.

Keywords: Growth and development, Birth-weight, Socio-demographic factors.

In this papers the author wants to demonstrate the body development of the feeble-minded, imbecile and idiot children in Szabolcs-Szatmár county, analyzing their most characteristic body measurements. She shall analyze the relationship between the mother's age and their infant's birth-weight, and demographic factors as factors having an active role in the development of mental deficiency.

Material and Methods

Since 1976 we have carried out our research in educational establishments for mentally deficient children, auxiliary schools, auxiliary classes and establishment of health in the Szabolcs-Szatmár county.

Using Martin's prescriptions (Martin–Saller 1957–66) we have investigated 1246 children with mental deficiency from 7 up to the age of 16 included 909 feeble-minded (72.49%), 244 imbeciles (19.46%), and 93 idiots (8.05%). 56% of them were males and 44% females.

Results and Discussion

Mother's profession

The majority of mothers are working at home (44.73–57.02%). Those who have a job are working as unskilled workers or helpers especially in agriculture. Only a few of those working as unskilled workers/helpers are mentally deficient. 20% of the total number are those working in the fields of industry and agriculture and only 1.7–2.3% of them are doing intellectual work. The average of mentally deficient children brought up and educated under state care is very high in all of the three groups (26.84–33.71%).

In spite of any favourable changes that have occurred in the social and demographic fields of Szabolcs-Szatmár county, the gipsy population living under bad conditions and consists of 7.3% of the total population of Szabolcs-Szatmár county, resulting in unfavourable effects on the county. The number of *gipsy pupils* taking part in our research is very high. We can find the major part of the feeble-minded and idiot children among them.

Mother's age

The mother's age as a biological and demographic factor can have a certain influence over the developmental process of uterogestation (Moore 1968, Illsley 1967). The birth of mentally deficient children in Szabolcs-Szatmár county generally occurs with women at the age of 20 to 34, but the frequency of those giving birth at a younger or older age is much higher (12% and 20%, resp.) than the average in Hungary.

Analysing the *birth of children* in chronological order we can see that imbeciles and idiots are the first-born. The majority of the feeble-minded are the 4th–5th born. There are some connections between the birth-weight and the mental development of children (Dann et al. 1964, Illey et al. 1971, Drillien 1959). New-born under the weight of 2500 g are often mentally deficient. In our sample 19.38% of feeble-minded children, 26% of imbeciles and 40.68% of idiots were born under-weight.

The author wants to demonstrate the characteristics of body development and the changes of the age groups of mentally deficient children, analyzing their body-height, body-weight and chest circumference. From the great number of anthropometric studies published in Hungary (and abroad) the author used the data from the Szabolcs-Szatmár county; this way the environmental factors influencing growth and development of children (both healtly and mentally deficient) are similar. These data from the geographic region of Rétköz (Szabolcs-Szatmár county, Nyilas 1978) was used as a „group of normal children" in this work.

Body-Height

The mean-values of the children's mental deficiency fall behind the normal means at any age group. Depending on the seriousness of the children's deficiency the level of backwardness proves to be changeable. The greatest deviation can be observed in the idiots, both boys and girls (Table 1). The growth trend of feeble-minded children represents a similar trend of development to normal children (Fig. 1). The prepubertal and pubertal growth impulse at the age of 9–10 and 12–13 can be principally observed in the girls. The periodicity of growth within the age groups can also be observed in the female imbeciles but the time of pubertal changes occurs a little later, at the age of 10–11 and at 13–14. In male imbeciles and female and male idiots the growth develops with changing intensity, deviating from the periodicity of normal age groups.

Body-weight

The body weight falls bekind that of the normal children in each group mentally deficient children, both boys and girls (Fig. 2). Depending on the seriousness of deficiency the children's weight trends to decrease. The least value of body weight can be observed in the idiots.

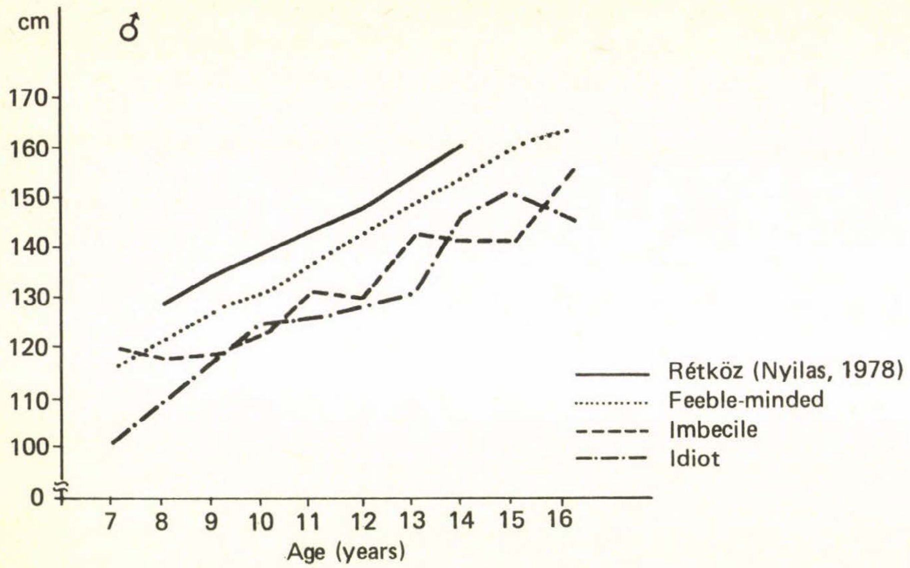
In respect of the children's sex, the males overbalance the females except in the case of the idiots. The characteristic periodicity of body weight can be observed in the feeble-minded. The growth impulse emerges at the age of 9–10 and 12–13 for girls and 10–11 and 14–15 for boys (Table 2). For the idiots as a whole, and for the male imbeciles, the growth of body weight is changeable in different age groups. Characteristic periodicity of growth for different age groups can not be proved.

Kaup-index

The Kaup-index values for the feeble-minded emerge as the nearest to normal values (1.54–2.09). They change at the values 1.2–1.8 in the idiots. Kaup-index changes prove to be quite different in the age groups of idiots and imbeciles (Table 3).

Table 1. Parameters of height

Age (year)	Feeble-minded			Imbecile			Idiot		
	n	x̄	s	n	x̄	s	n	x̄	s
Boys									
7	10	116.17	9.73	9	120.68	11.28	4	101.20	0.70
8	41	122.03	8.67	12	117.01	9.21	9	109.71	7.11
9	65	128.34	6.96	10	119.41	5.82	–	–	–
10	55	131.49	6.02	19	123.93	9.88	5	126.86	7.93
11	39	138.29	8.96	11	132.33	8.03	5	126.76	6.72
12	85	143.31	8.36	17	130.84	11.29	6	129.50	8.06
13	67	148.43	8.65	26	143.34	9.27	6	131.95	9.12
14	66	164.75	8.84	23	141.83	10.00	6	147.12	6.70
15	66	160.65	7.69	9	141.78	7.89	8	151.02	9.94
16	36	164.78	8:92	11	155,78	18.07	11	148.71	12.07
Girls									
7	13	120.74	15.40	7	108.08	6.89	4	102.16	12.79
8	36	120.63	5.09	16	119.87	6.90	1	154.00	–
9	46	125.04	8.33	9	119.05	6.63	5	107.65	5.44
10	48	133.35	7.03	8	127.15	7.15	1	112.30	–
11	54	140.53	8.10	7	136.16	18.45	4	119.40	8.91
12	62	143.45	10.04	14	141.46	12.92	9	126.60	1.83
13	59	150.59	7.89	9	143.47	10.09	–	–	–
14	39	151.51	6.49	12	148.22	6.75	1	119.70	–
15	36	154.88	7.39	8	151.25	12.27	1	145.70	–
16	7	153.81	9.95	7	156.82	8.11	–	–	–



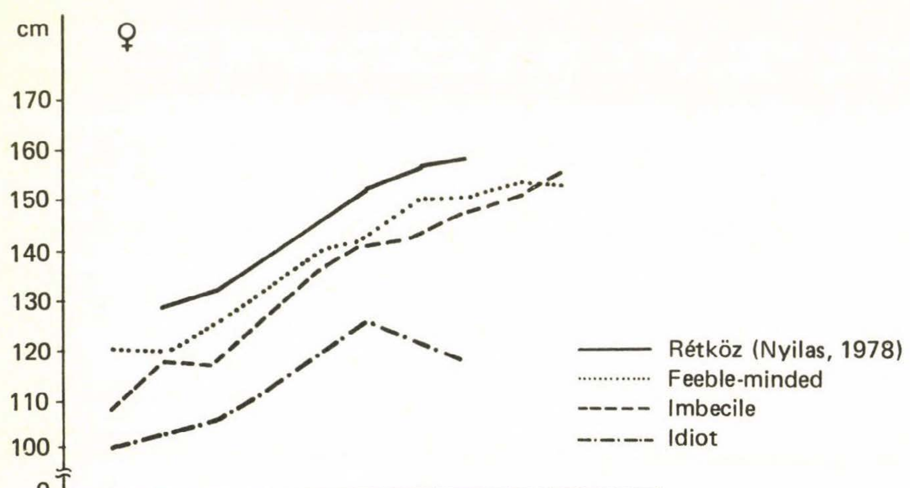


Fig. 1: Height of mentally deficient children

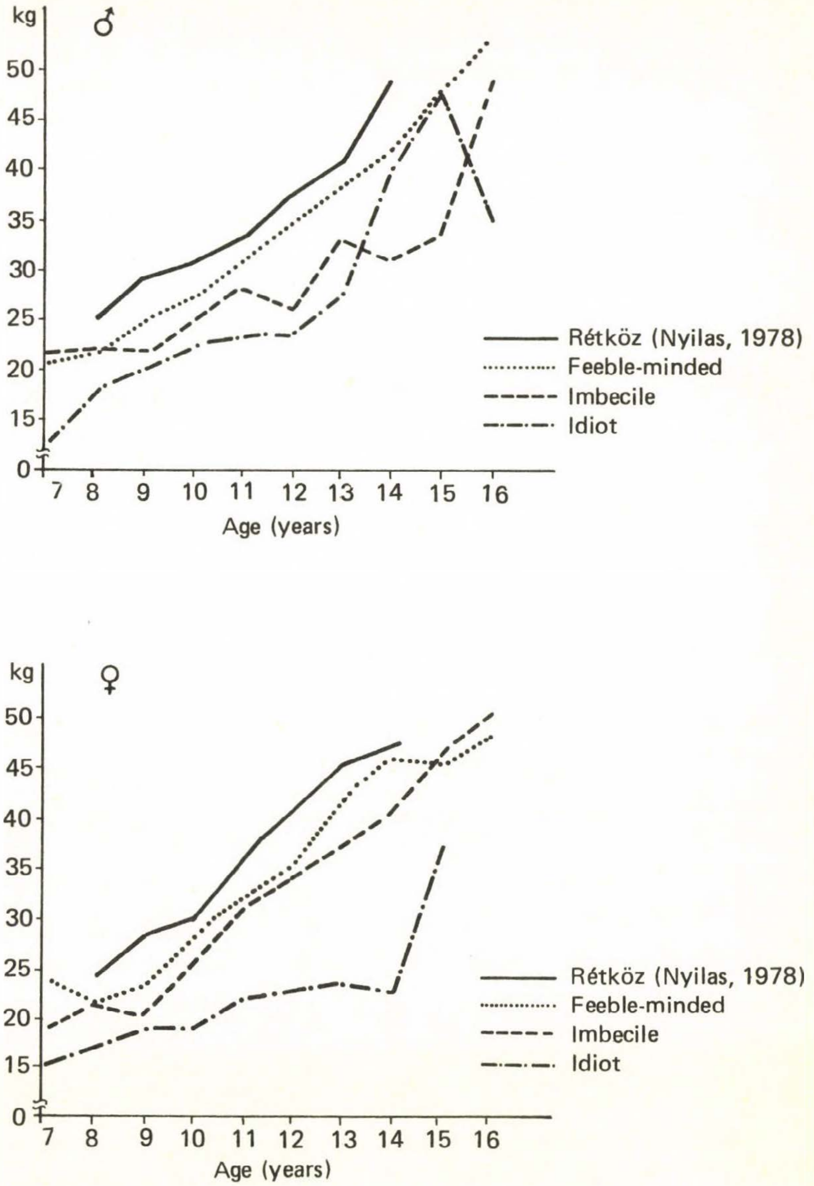


Fig. 2: Weight of mentally deficient children

Table 2. Parameters of weight

Age (year)	Feeble-minded			Imbecile			Idiot		
	n	$\bar{x}$	s	n	$\bar{x}$	s	n	$\bar{x}$	s
Boys									
7	10	20.98	3.80	9	21.14	2.73	4	12.75	1.76
8	41	22.99	4.14	12	22.95	10.92	9	17.08	1.11
9	55	26.04	3.49	10	21.44	2.21	–	–	–
10	55	27.34	4.47	19	25.32	4.01	5	22.16	3.32
11	39	31.51	7.34	11	28.63	5.73	5	23.33	4.04
12	85	35.00	6.56	17	26.85	4.60	6	23.25	3.88
13	67	38.37	9.03	26	33.96	7.45	5	27.00	9.89
14	56	42.70	9.01	22	31.85	5.89	5	40.00	11.66
15	66	48.64	9.27	9	33.43	6.95	8	48.50	11.20
16	36	53.10	10.98	11	49.90	6.00	11	35.55	12.58
Girls									
7	13	24.07	10.80	7	18.60	2.30	4	15.00	4.24
8	36	22.20	3.80	16	22.83	3.73	1	78.00	–
9	46	23.57	3.93	9	20.85	4.05	5	18.50	3.53
10	48	28.47	5.81	8	25.00	6.23	1	17.00	–
11	64	32.77	8.28	7	31.50	15.98	9	22.00	11.31
12	62	35.67	8.51	14	34.75	7.87	3	22.50	2.12
13	58	42.95	10.53	9	37.66	12.10	1	26.00	–
14	39	46.62	9.50	12	40.90	7.58	1	25.00	–
15	36	45.20	7.93	8	46.00	12.35	1	37.00	–
16	17	48.16	10.24	7	51.80	15.35	–	–	–

Table 3. Parameters of the Kaup-index

Age (year)	Feeble-minded			Imbecile			Idiot		
	n	$\bar{x}$	s	n	$\bar{x}$	s	n	$\bar{x}$	s
Boys									
7	10	1.54	0.10	8	1.47	0.28	4	1.24	0.15
8	41	1.53	0.12	12	1.61	0.43	9	1.40	0.17
9	55	1.51	0.11	10	1.50	0.14	–	–	–
10	55	1.57	0.19	19	1.60	0.18	5	1.37	0.09
11	39	1.62	0.19	11	1.61	0.16	5	1.44	0.09
12	85	1.69	0.17	17	1.56	0.15	6	1.38	0.06
13	67	1.71	0.27	26	1.63	0.19	5	1.52	0.35
14	56	1.78	0.23	23	1.56	0.11	5	1.82	0.36
15	66	1.87	0.25	9	1.64	0.19	8	1.64	0.35
16	36	1.93	0.26	11	2.20	0.83	11	1.60	0.30
Girls									
7	13	1.58	0.25	7	1.53	0.09	4	1.42	0.50
8	36	1.61	0.16	11	1.58	0.21	1	3.27	–
9	46	1.60	0.15	9	1.46	0.15	5	1.61	0.46
10	48	1.68	0.21	8	1.52	0.22	1	1.34	–
11	64	1.64	0.31	7	1.80	0.38	4	1.49	0.56
12	62	1.71	0.27	14	1.72	0.22	9	1.40	0.17
13	58	1.89	0.38	9	1.73	0.41	–	–	–
14	39	1.98	0.42	12	1.84	0.20	1	1.74	–
15	36	1.78	0.26	8	2.00	0.80	1	1.74	–
16	7	2.03	0.36	7	2.10	0.64	–	–	–

Table 4. Parameters of chest circumference

Age (year)	Feeble-minded			Imbecile			Idiot		
	n	$\bar{x}$	s	n	$\bar{x}$	s	n	$\bar{x}$	s
Boys									
7	10	58.77	4.58	9	60.63	3.57	4	55.60	7.53
8	41	60.55	3.13	12	61.87	9.96	9	59.81	1.72
9	55	62.02	3.20	10	61.06	2.40	–	–	–
10	55	64.48	4.24	19	64.48	4.10	5	58.53	2.57
11	39	66.90	5.43	11	66.00	2.90	5	62.00	2.64
12	85	69.18	4.91	17	60.60	3.41	6	63.25	3.88
13	67	70.45	5.09	26	69.84	5.09	5	63.20	4.00
14	56	74.55	6.02	23	71.80	4.89	5	74.25	7.92
15	66	79.36	6.68	9	70.78	8.04	8	72.70	4.52
16	36	81.09	6.63	11	80.45	6.30	11	73.27	6.13
Girls									
7	13	60.78	8.35	7	56.52	3.96	4	56.75	5.30
8	36	60.02	3.87	16	62.70	5.10	5	89.10	11.17
9	46	60.62	3.21	9	60.81	3.90	5	60.00	2.82
10	48	64.42	4.48	8	64.00	7.01	1	59.00	–
11	64	67.14	6.06	7	69.00	9.55	9	66.85	10.11
12	62	69.94	5.60	14	72.08	6.18	3	63.40	5.09
13	58	75.02	7.17	9	73.55	10.61	–	–	–
14	39	77.39	7.34	12	77.09	4.15	1	66.00	–
15	36	76.89	6.42	8	81.80	8.40	1	75.50	–
16	7	78.64	4.99	7	80.30	10.03	–	–	–

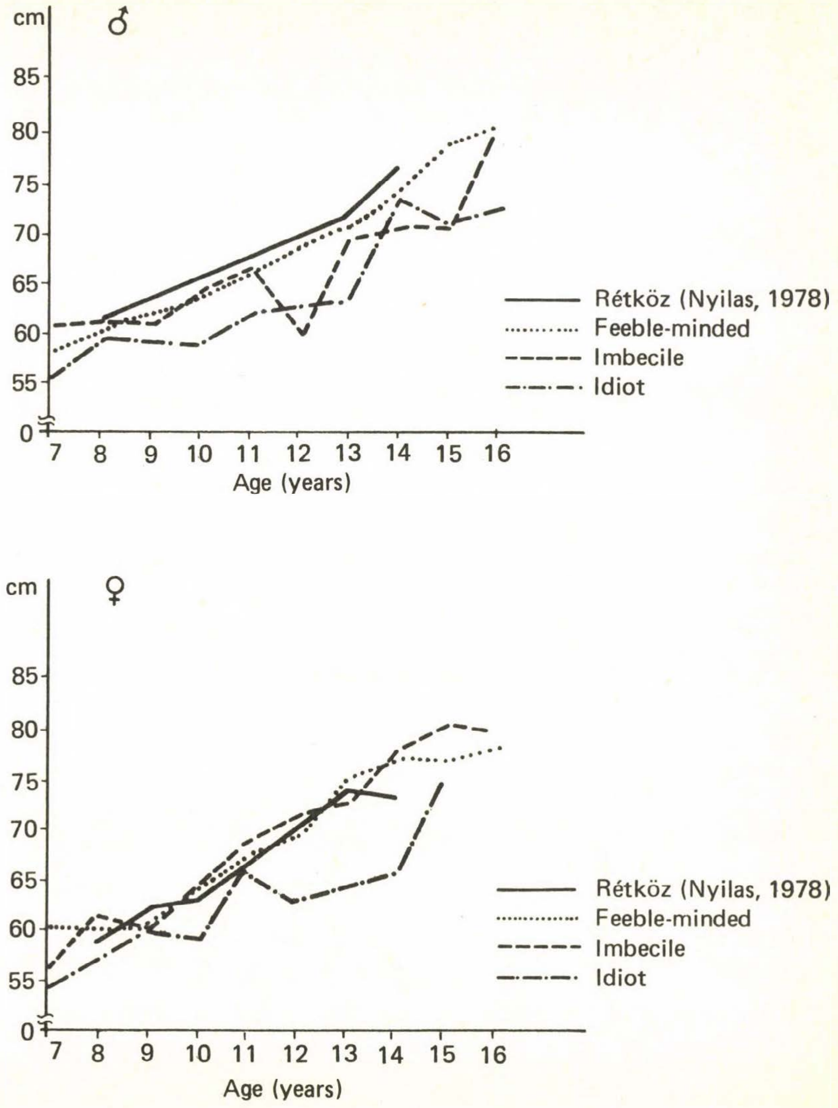


Fig. 3: Chest circumference of mentally deficient children

Chest circumference

The chest circumference gives different results from the other body measurements. The retardation from normal values is especially characteristic in boys, whose deviation depends on the seriousness of their deficiency (Fig. 3). Concerning the girls, only the idiots fall behind the normal but the pubertal and prepubertal growth impulses can also be observed in the feeble-minded and imbecile girls (Table 4).

Heterogeneity was demonstrated by Bartlett-testing for the values of body-measurements of children belonging to the three groups. The body weight and height are $P < 0.1$ for boys at the age of 8, 9 and for girls at the age of 8, 10, 13. The features whith possible heterogeneity corresponded to a certain systematic character. The analysis has been carried out be F- and t-testing. There were no significant differences in the results.

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RELATIONSHIPS BETWEEN THE DIFFERENT FACTORS AND THE AGE AT MENARCHE IN HUNGARY

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Abstract: The author studied the age at menarche and its relationship with socio-economic factors in 29 915 10–18.5 year-old girls in Hungary, based on a data collection with status quo method. He analysed the deviation of menarche-median in detail according to 19 different factors (for example: birth-order of girls, number of siblings, size of the girl's domicile, education level and occupation of the parents, etc.).
This is a large sample in which in one population we could simultaneously investigate the relationship between 19 factors and the change of the menarche-median.
Key words: Menarche-median, Hungarian girls, Socio-economic factors.

Introduction

Based on reviewing the international literary data it could be said that studies have been carried out on the time of the first menstruation of girls (i.e. menarche) in connection with the factors influencing it in many countries, from several viewpoints. The literature on the topic is extremely large (Farkas 1986). Most of the experiments, however, only focused on the determination of the median in the studies aiming to determine the age at menarche. It also became evident on the basis of the observations that age at menarche could be related to several factors (Farkas 1980, Grimm 1966). These influencing factors could be divided into three groups:

I. Endogeneous factors or typical biological effects, such as the (1) somatometrical and somatoscopical characters. These are: race and genetic determination, somatic measurements, secondary sexual characters, colour of eyes and hair of the person in question, skeleton-age and their connection with the maturity. (2) physiological characters, for example the similarity of the age at menarche between mother and her daughter, absolute menarche-age (the difference between the time of birth and menarche), vitalcapacity.

II. Endogenuous and exogenuous (biological and social) effects at the same time. These are on the one hand (1) natural factors, such as the meteorological (climatical) effects, height above sea level of domicile, radiation effect and on the other hand. (2) social factors, such as the ethnical and national status of girls, education level and occupation of the parents, number of living or dead brothers and sisters, number of members in a family, living space for one person, nutrition, quality of food, in what type of schools the girls study, school achievement of girls, effect of sport, size of domicile, seasonal changes in menarche, coincidency between the month of birth and month of menarche.

Sample and Methods

From these factors we studied 19 in Hungary between 1981 and 1984 in 10–18.5 year-old girls (Farkas et al. 1983b).

The data were collected with status quo and anonymous questionnaire method.

One part of the questions was filled out during the course of examination and the other part of the questions was requested to be filled out by the parents in such a way that the pupil took the questionnaire home and asked her parents to answer these questions.

Taking a unified classification system as a basis, the occupation of the parents was divided into 9 categories.

On the basis of the parents' school education we differentiated 5 groups.

We collected 34 different types of information, which makes it possible to evaluate them independently as well as combined with one another.

The girls are divided into half-year age groups in all the information and this is also performed with the help of a computer using the decimal life-table.

The data were evaluated by a R–55 type computer using the Osiris program package. The medians were calculated by probit analysis.

For our work we have received moral and financial support from the Ministry of Health and Ministry of Education.

Results

The most important results of our research are the following (Farkas 1982, 1983, 1984, 1985, 1986, in the press. Farkas et al. 1983a, 1983b, 1985, Farkas–Szekeres 1982, 1982a, 1982–83, Fazekas et al. 1982, 1983):

The number of the investigated girls is 29915.

We calculated for the total sample 12.79 years menarche-median an 12.544 years as arithmetic mean of the absolute age of menarche.

The medians for the secondary sexual characters are the following: in the case of the breast 12.44, at the axillary hair and pubic hair 12.60 years (Table 1).

Table 1. The medians of secondary sexual characters

Character	n	M_e
Breast	16436	12.44
Axillary hair	16440	12.60
Pubic hair	16431	12.60

In the town of Szeged (Southern-Hungary) we could observe the changes of the menarche-median between 1958 and 1982 (Table 2). The decrease of the median (from 13.20 to 12.68 year) during 24 years is 0.52 year (Farkas 1986, Farkas in the press).

Table 2. The change of menarche-median in Szeged (Southern-Hungary) between 1958 and 1982

Time of the survey	n	M_e
1958/1959	1182	13.20
1961	1473	13.03
1966/1967	1136	12.75
1981/1982	1099	12.72

According to the year of birth of the girls we have also found differences in the menarche-median between 1966 and 1973. In this case we could observe the manifestation of the deceleration, too.

According to the crow-flight distance of the parents' birth-places we have not found important differences in the menarche-median of their daughters (Table 3, factor 1).

Table 3. Change of menarche-median in the case of various socio-economic factors

Studied factors		Total cases	M_e	95 p.c. conf. interval.
1	2	3	4	5
1. Crow-flight distance of birth-places of the parents	0 km	10846	12.56	11.00 – 14.12
	1 – 25 km	6355	12.68	10.85 – 14.50
	1 – 50 km	9362	12.66	11.24 – 14.07
	26 – 100 km	5504	12.66	10.85 – 14.47
	101 – 200 km	3139	12.70	10.44 – 14.95
	201 – 400 km	1386	12.65	10.33 – 14.98
2. Size of domicile (inhabitants)	200 000 – 100 000	4623	12.69	12.29 – 13.09
	100 000 – 50 000	4244	12.73	12.50 – 12.96
	50 000 – 10 000	6294	12.81	12.54 – 13.08
	10 000 – 5 000	2909	12.92	12.65 – 13.20
	lass than 5 000	5885	12.83	12.40 – 13.25
3. The order of birth	1	13088	12.74	12.42 – 13.05
	2	8330	12.83	12.73 – 12.92
	3	1552	12.88	12.42 – 13.35
	4	472	12.85	10.29 – 15.40
	5	112	12.85	12.52 – 13.17
4. Number of living brother	0	12011	12.75	12.37 – 13.13
	1	10084	12.80	12.59 – 13.01
	2	1666	12.87	12.47 – 13.27
	3	340	12.99	12.21 – 13.77
5. Number of living sister	0	12040	12.74	12.62 – 12.87
	1	9650	12.80	12.36 – 13.23
	2	1603	12.88	11.54 – 14.23
	3	380	13.00	12.06 – 13.93
6. School achievement	2.0 – 2.5	573	12.97	12.47 – 13.47
	2.6 – 3.0	3491	12.89	12.57 – 13.20
	3.1 – 3.5	2417	12.81	12.59 – 13.02
	3.6 – 4.0	6261	12.77	12.39 – 13.15
	4.1 – 4.5	4892	12.71	12.38 – 13.03
	4.6 – 5.0	5777	12.77	12.48 – 13.07
7. Occupation of the mother	Industrial worker	3157	12.80	12.67 – 12.93
	Agricultural worker	1373	12.88	12.57 – 13.19
	Other worker	7501	12.76	12.56 – 12.95
	Intellectual (with high education)	1497	12.67	12.06 – 13.27
	Intellectual (with secondary school ed.)	7113	12.75	12.52 – 12.97
	Pensioner	326	12.75	12.54 – 12.97
	Housewife	2734	12.93	12.60 – 13.26

Table 3. (continuing)

1	2	3	4	5
8. Occupation of the father	Industrial worker	7657	12.79	12.53 – 13.04
	Agricultural worker	2341	12.92	12.52 – 13.32
	Other worker	5855	12.80	12.47 – 13.14
	Intellectual (with high education)	2781	12.73	12.42 – 13.04
	Intellectual (with secondary school ed.)	3718	12.72	12.51 – 12.93
	Pensioner	648	12.67	11.89 – 13.45
	Father died	663	12.76	12.00 – 13.51
9. Education level of the mother	Has not finished the primary school	1635	12.88	12.37 – 13.38
	Finished the primary school	10309	12.83	12.54 – 13.12
	Finished the school of professional training	3076	12.73	12.54 – 12.91
	Finished the secondary school	7077	12.74	12.51 – 12.97
	Finished the university or academy	1281	12.69	12.06 – 13.32
10. Education level of the father	Has not finished the primary school	1845	12.93	12.43 – 13.44
	Finished the primary school	8112	12.80	12.63 – 12.98
	Finished the school of professional training	5445	12.77	12.58 – 12.96
	Finished the secondary school	5295	12.74	12.07 – 13.42
	Finished the university or academy	2888	12.71	12.32 – 13.10
11. Year of birth of the mother	1926 – 1930	231	12.71	11.97 – 13.45
	1931 – 1935	1284	12.79	12.15 – 13.42
	1936 – 1940	3726	12.77	12.06 – 13.48
	1941 – 1945	7629	12.78	12.64 – 12.93
	1946 – 1950	8370	12.80	12.69 – 12.90
	1951 – 1955	2010	12.66	11.83 – 13.49

The age at menarche of the girls living in larger settlements is lower than that of the girls living in a smaller domicile. The domiciles are grouped according to the number of inhabitant (Table 3, factor 2).

On the basis of the girls' birth order we have also found differences. In Table 3 (factor 3) we present the medians in the cases of first to fifth born girls. As it may be seen in the Table, the first born girls reach puberty earlier than the fourth-born girls.

We examined the age at menarche according to the number of living siblings, too. In Table 3 the medians concerning the living brothers (factor 4) and sisters (factor 5) from 0 to 3 can be seen. If a girl has no brother or sister, the reachs puberty earlier than those girls who have 1–3 brothers or sisters.

In a Hungarian school the best achievement is 5 points and the worst is 1. We divided the school achievements of the girls into six groups. The girls who have the worst school achievement reach puberty later than the girls with better school reports (Table 3, factor 6).

In Table 3 we present the medians of the girls, who are classified according to the occupation of their mothers. The daughters of intellectual mothers with a high education have the smallest menarche-median and the daughters of housewives, the highest. In general the daughters of intellectual mothers reach puberty earlier than the daughters of working mothers (Table 3, factor 7).

The groups of the occupation of the fathers from one to six are identical with the same groups of the occupation of mothers. In the last group we placed the daughters of not the housewives but the cases of those girls whose father had died (Table 3, factor 8). According to the occupation of the fathers we found the same results as the mothers' occupation.

The girls, whose mothers have a lower school education (for example they have not finished the primary school), reach puberty later than those girls whose mothers have higher education level (Table 3, factor 9).

We could also observe identical results with the education-level of the fathers (Table 3, factor 10).

We also divided the mothers into groups according to the years of birth. In doing so, we found that there is not a great difference between the mothers' years of birth and the age at menarche of the daughters (Table 3, factor 11).

Finally, seasonal fluctuation occurs at the time of the first menstruation. Most girls menstruated in January (13.1%), in July (10.5%), and in June (10.1%). The smallest relative frequency of menarche is in February (6.1%).

In the mothers' cases the greatest relative frequency is in January (13.1%), and in August (11.8%), the smallest we found in October (5.6%).

We established a 11.08% coincidency between the month of birth and month of menarche.

In Figure 1 we can see the connections between the median of menarche, the medians of secondary sexual characters and the arithmetic means of the somatic measurements.

With full knowledge of these facts we created a method to predict the time of the menarche for any girl. This enable us to apply the results to the practice of sexual education in primary schools.

As it appears to, this is the first large sample in which in one population we could simultaneously investigate the relationships between 19 factors and the change of the menarche-median.

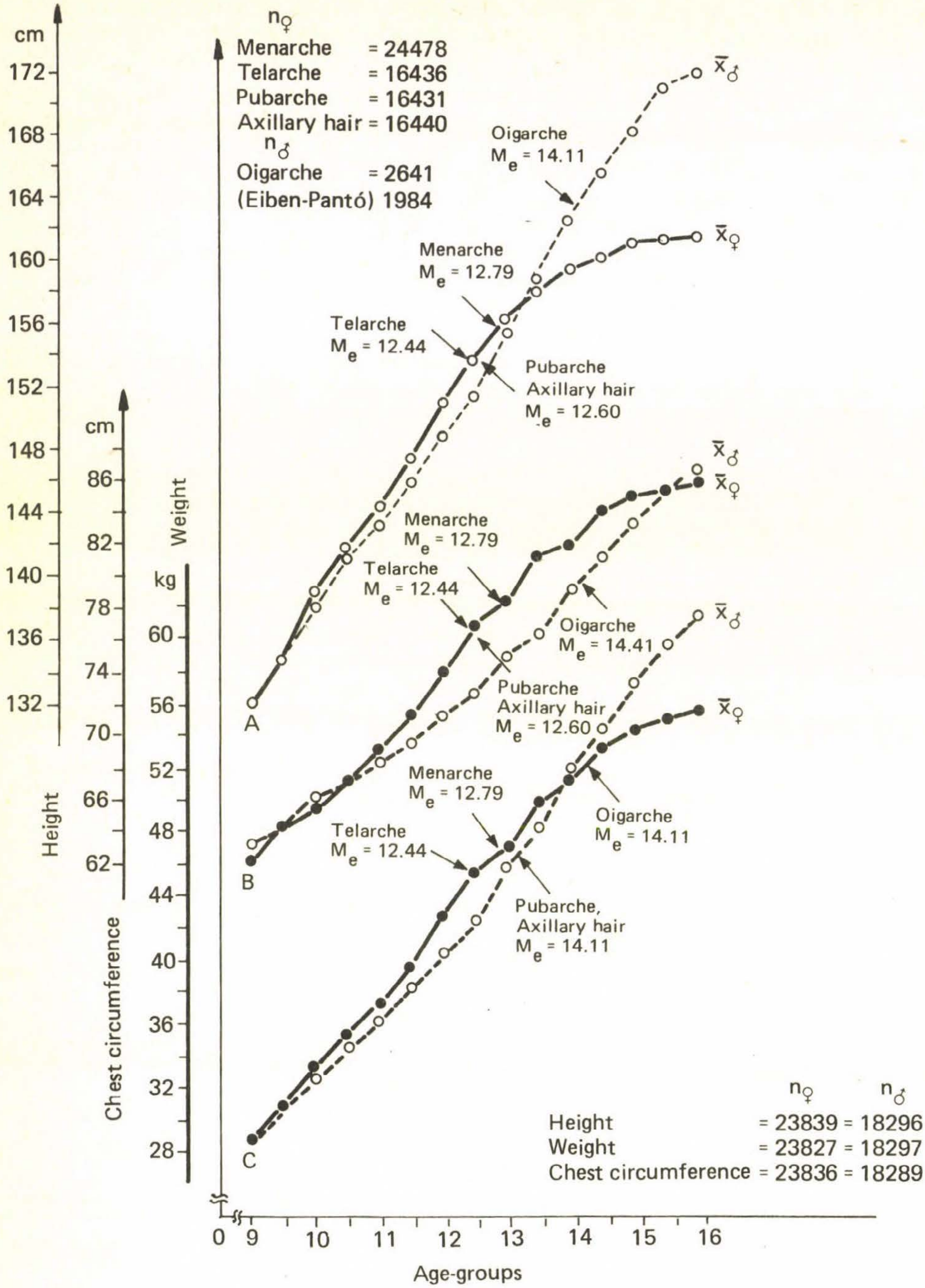

Fig. 1: The medians of menarche and secondary sexual characters and the arithmetic means of the somatic measurements

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LOW REPRODUCTIVE PERFORMANCE AND WOMEN'S AGE AT THE ONSET OF REPRODUCTION

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Abstract: The low reproductive performance of late-maturing women is generally attributed to the impact of education and employment on women's attitudes towards family size. Data from a cohort of Kenyan Kipsigis women, married between 1940–1953, who had no opportunites for education or employment, show that younger-maturing Kipsigis women achieved higher lifetime reproductive success than did older-maturing women; this difference was due primarily to the lengthier reproductive lifespan and higher offspring survivorship of early-maturing women. These findings suggest that the negative correlation between age of a woman at the onset of reproduction and her subsequent reproductive performance may result, in part, from physiological rather than socioeconomic factors.

Key words: Low reproductive performance, Onset of reproduction, Age at menarche, Lifetime reproductive success, Kipsigis women (Kenya).

Introduction

There is growing evidence in both developed and developing nations that the age at which a woman starts to reproduce is negatively associated with her subsequent reproductive performance. Data from the western Malaysian family survey indicates that a woman's age at first birth is negatively correlated with completed family size, controlling for a number of socio-economic and racial effects (Aghajanian 1981). Similarly, in Nepal, a significant negative correlation is found between age of marriage and the number of children ever born to a woman (Gubhaju 1983). Evidence from developed nations is consistent. National Fertility Survey data from the USA indicate that younger-marrying women achieve larger family size than older-marrying women (Bumpass et al. 1978).

Three explanations have been proposed for these findings. First, the sooner a woman starts bearing children after menarche, the more available time remains for her to continue childbearing, assuming that age at first reproduction does not affect age at menopause. Second, it has been suggested that age at first birth affects subsequent reproduction as a result of attitudinal factors: thus Ryder (1969, 1976) argues that initial postponement of reproduction may permit a young woman to revise her fertility preferences downwards, perhaps because the experience of education or employment fosters sources of satisfaction other than motherhood (Aghajanian 1981). Third, closely related to the previous argument, it has been suggested that modernising influences such as education may be more acutely experienced by women without children than those with children (Aghajanian 1981).

Generally human demographers favour the second and third of these explanations (Aghajanian 1978, Bumpass et al. 1978), despite the fact that the association between delayed reproduction, socio-economic experiences and revised fertility goals has not been shown. Indeed, there is no evidence to date to indicate whether or not women's fertility goals are indeed consciously revised as a consequence of delayed initial reproduction.

In this paper the author examines the association between age at menarche and lifetime reproductive success in Kipsigis women of Kenya. This is a population where education has only recently been introduced, where employment opportunites for women are still almost unknown, and where modern techniques of birth control are not used. Given the relatively homogeneous socioeconomic circumstances of this population, the results from this study suggest that the negative correlation between age of a woman at the onset of reproduction and her subsequent reproductive performance may result, in part, from physiological rather than socioeconomic factors.

Methods

Kipsigis are a Nilo-Hamitic Kalenjin-speaking people of Rift Valley Province, Kenya. Almost exclusively pastoralist until 1930, they rapidly shifted to an agro-pastoral economy, selling surplus maize for cash required for medical attention, clothing and additional items. Kipsigis women undergo a clitorectomy operation on reaching menarche (12–19 years), after which they traditionally spend 2–3 years in seclusion huts prior to marriage.

A Kipsigis population little affected by the rapid modernisation transforming much of rural Kenya was studied on the border of Kericho and Narok Districts (June 1982 – December 1983), (see Borgerhoff Mulder 1985). Systematic lifehistory interviews were conducted, determining the date of a woman's birth, circumcision operation and marriage, the number of her live-born children and the date at which the last child was born (see Borgerhoff Mulder 1987). Analyses were restricted to a cohort of women married between 1940–1953, who reported reaching menopause and for whom information on all relevant variables was available (N=33). Lifetime reproductive success (LRS) was measured as the number of surviving offspring born to a woman. LRS was broken down into 3 components – length of reproductive lifespan, fertility per year married and probability that offspring survive. Length of reproductive lifespan was measured as the interval, in years, between a woman's marriage and the birth of her last child, whether or not this child survived; fertility per year married was calculated as the number of liverbirths born to a woman divided by her reproductive lifespan; offspring survivorship was calculated as the number of a woman's surviving offspring divided by the number of livebirths she produced. Finally, age at menarche was estimated as the age of a girl at clitorectomy, because of the Kipsigis custom of performing this operation on a girl within a year of her reaching menarche.

Eighteen months' residence in the area, use of the kipsigis language and thorough checking of interview responses with relatives and neighbours ensure high reliability of these reported data. Past life history events were accurately dated to the year by cross-referencing with male circumcision ceremonies, severe droughts and other events of known date. All probability values are two-tailed.

Results and Discussion

The major factor associated with completed family size in this sample was age at menarche, measured as age at circumcision ($r=-.53$, $p=0.001$). This was independent of the effects of both husband's wealth and age on a woman's LRS (see Borgerhoff Mulder 1987). Women reaching menarche at 15 years of age or less produced, on average, 3 more surviving offspring (8.8 compared to 5.8) than those reaching menarche between 16–19 ($T_{19,14}=4.13$, $p < 0.001$). Further analyses of the components of LRS demonstrated that age at menarche was negatively associated with length of reproductive lifespan and with the probability that offspring survive, but not with fertility per year married (see Table 1).

Table 1. Pearson correlation coefficients between age at circumcision and lifetime reproductive success and its components for 33 Women married between 1940–1953

	Pearsons r	P-value
LRS	–.53	0.001
Reproductive lifespan	–.48	0.004
Fertility per year married	–.06	NS
Offspring survivorship	–.42	0.015

These results suggest that the attitudinal and socioeconomic explanations proposed by human demographers are not implicated in the Kipsigis case. First, the explanation rejected by human demographers, namely that early-maturing girls achieve longer reproductive lifespans, was supported with Kipsigis data. Second, there was no indication that the low reproductive performance of women who start to reproduce relatively late is a consequence of education or employment, in so far as none of the women in this sample received any education or followed any employment whatsoever. Third, the argument that childless women are more acutely influenced by modernisation is unlikely to account for the Kipsigis findings, again because of the homogeneity of the socioeconomic experiences of a cohort of women married within a 13 year period when education and employment for women was not yet available.

The precise nature of the association between age at menarche and both length of reproductive lifespan and probability that offspring survive cannot be determined in a retrospective demographic study such as this, where biological measures were not taken. Nevertheless, the general finding that age at menarche is negatively associated with measures of body condition and fat (Frisch and McArthur 1974, Frisch 1976), despite uncertainties regarding the mechanisms involved (Scott and Johnson 1985), suggests that the high reproductive performance of early-maturing Kipsigis women may be, in part, physiologically mediated. More generally, these results indicate that it may be incautious to attribute reproductive differentials to socioeconomic and attitudinal factors without first examining possible physiological and biological differences among women.

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NUTRITION, PHYSICAL ACTIVITY AND SKELETAL SIZE OF GIRLS AGED 16–18 YEAR

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Abstract: The relations of some bone dimensions with the usual consumption of milk and milk products and with the level of physical activity were investigated. Schoolgirls aged 16–18 year were studied by somatometry and interviewed about nutrition and physical activity. They were groupped according to their usual intake of calcium from milk and milk products and according to their physical activity. Four groups were formed: (A) inactive, low milk consumption, (B) active, low milk consumption, (C) inactive, high milk comsumption, (D) active, high milk consumption.

The highest values of biacromial diameter, wrist diameter, humerus length were found in group D, but the maximum differences between the groups did not exceed 3.4%. In contrast, the breadth of the clavicle in group D was 6.9% larger than in group A.

The clavicular breadth corrected for skinfold thickness might be a useful indicator of skeletal size.

Key words: Nutrition, Milk consumption, Physical activity, Breadth of the clavicle, Skeletal size.

Introduction

Regular physical exercise and high intake of calcium are supposed to increase the skeletal mass and to prevent osteoporotic complications in later life (Albanese 1978, Matkovic et al. 1979, Smith et al. 1981, Speckmann 1985).

We studied the physical activity and the consumption of milk and milk products of girls aged 16–18 year and measured some anthropometric dimensions above their long bones. We tried to find out which dimension, if any, is the most sensitive to the level of physical activity and to the milk-intake of the girls.

Subjects and Methods

167 girls aged 16–18 year and attending secondary school at Pécs, Hungary were studied. They were interviewed about nutrition habits, especially about the usual intake of milk and milk products, about physical activity, health status and menarche. Girls with significant overweight were not accepted for this study (body mass index above 27).

Standard procedures as described by Cameron (1978) were used to measure body mass, height, upper arm length, biacromial width, biepicondylar-humerus and wrist diameter. The diameter of the clavicle was measured at the middle of the left clavicle on standing subjects, with shoulders slightly elevated and let forwards. The measurement was taken in the frontal vertical plane. At the same site, above the clavicle the skinfold was measured as well using Lange caliper. The breadth of the clavicle was calculated by subtracting the skinfold value from the clavicle diameter. The girls were groupped according to the usual daily intake of calcium from milk and milk products and according the to physical activity. Subjects with calcium intake above 1000 mg/day from milk and milk products were groupped into the high milk groups, the others into the low milk groups. Girls having regular sport training exceeding 4 hours a week were considered as physically active. Four groups were formed:

A) inactive, low milk consumption,
B) active, low milk consumption,
C) inactive, high milk consumption,
D) active, high milk consumption.

Results and Discussion

Table 1 shows the age distribution of the subjects in the different groups. The mean ages in the four groups were almost identical (between 16.34 and 16.50 year). The body mass and height were also similar (Table 2). Some dimensions measured above the long bones are summarized in Table 3. The group of physically active girls with high milk consumption had the highest mean values of biacromial diameter, of wrist diameter, of humerus length and of clavicle breadth. However, the inter-group differences were small. The maximum differences, expect clavicle breadth, were less than 3.4%. The difference in clavicle breadth between the low milk + low activity group and the high milk + high activity group was 6.9%.

Table 1. Age distribution of the subjects in the different groups

Age (year)	Number of persons			
	Group A	Group B	Group C	Group D
16	56	17	20	19
17	24	10	9	5
18	3	0	2	2

Table 2. Body mass, height and body mass index (BMI)* of the girls (means ± S.D.)

Groups	N	Body mass (kg)	Height (m)	BMI
A	83	55.73 ± .56	1.62 ± 0.06	21.2 ± 2.2
B	27	55.07 ± 6.85	1.62 ± 0.05	21.0 ± 2.2
C	31	54.77 ± 7.35	1.62 ± 0.07	20.9 ± 2.8
D	26	55.40 ± 6.73	1.63 ± 0.06	21.0 ± 2.2

*BMI $= \frac{kg}{m^2}$

Table 3. Bone dimensions in the different groups (means ± S.D.)

Measurement	Groups			
	A	B	C	D
Biacromial width (cm)	35.44 ± 1.54	35.27 ± 1.96	35.23 ± 1.31	35.77 ± 1.32
Humerus length (cm)	30.50 ± 1.63	30.45 ± 1.78	30.28 ± 1.58	30.69 ± 1.57
Humerus bicondylar width (cm)	6.14 ± 0.33	6.25 ± 0.36	6.05 ± 0.38	6.17 ± 0.21
Wrist diameter (cm)	4.97 ± 0.31	4.89 ± 0.28	4.97 ± 0.28	5.01 ± 0.24
Clavicle breadth (mm)	15.76 ± 2.37	15.85 ± 2.14	16.58 ± 3.50	16.85 ± 3.38

Anthropometry is frequently used in many areas of nutrition research including nutrition and growth, malnutrition and obesity. However, the measurement of the external dimensions of the body has been scarcely used to study the effect of nutrition on the size or mass of the skeletal system. The only exception where external measurements are widely used for the estimation of the size of skeletal frame is the selection of the „ideal" weight for height. Some weight-height tables provide different „ideal" values for different body frames. A variety of body breadths has been suggested as measure of frame size (Frisancho and Flegel 1983, Garn et al. 1983, Himes and Bouchard 1985). In the recent Metropolitan Life Tables (1983) the skeletal mass in specified according to the bicondylar width of the humerus.

At present no low cost field method is used in the literature to study the effects of nutrition on bone mass. The techniques used for measuring bone mass are: radiography, single photon absorptiometry, dual photon absorptiometry, computerized tomography and neutron activation analysis. All these methods require special laboratory facilities, most of them are costly, and some of them involve undesirable doses of radiation as well (Cummings et al. 1985).

Osteoporosis and related fractures represent a major health problem in the developed countries. In women after climax the bone mineral content is decreasing. If bone density decreases under a certain threshold limit fractures become frequent. Women with high-density strong bones have more calcium reserves, so have a lower risk for osteoporotic complications. Thus increasing the bone mass of the teenagers serves the prevention of osteoporotic complications in later life.

Low cost and relatively simple methods are needed for large scale field studies of nutritional and other environmental factors influencing the development of the skeletal frame in teenagers. The results of our pilot study suggest that the measurement of the clavicular breadth might be a useful method for this purpose. It has been reported that the mineral content of certain long bones is positively related with their diameters in young people (Gergely et al. 1978, James 1984). Hovewer, further studies are still necessary to validate that clavicular breadth is a relevant indicator of the mass of skeletal frame in teenagers.

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SOME PROBLEMS IN STUDYING GROWTH AND DEVELOPMENT OF CHILDREN – A METHODOLOGICAL NOTE

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Abstract: The author sketches some methodological problems of growth studies, based on her experiences in India.

Key words: Representative sample, Recording of data, Standardization of measuring instruments, Landmarks, Personality of the investigator, Statistical techniques.

I feel grately honoured to be invited to join the group of scientists at the IVth International Symposium of Human Biology. I wish to owe my special thanks to Dr. O. G. Eiben for providing me this opportunity.

I am very happy to observe the strength of this Symposium. It appears that we all have made it a point, how busy may be, to contribute towards this important and noble field which is absolutely imperative for the advancement of child's health and to monitor morbidity and mortality besides other significances. The very presence of all is testimony to the success of our mission. Children are our links to the future and they are who are going to shape whatever brave new world come into being. This led to develop the need of the child's study which has emerged out at the junction of great many disciplines and not merely as a product of the scientific zeal directed towards understanding child.

Recent advances in social, medical, political, and behavioural sciences have placed a child in perspective significance. The care of the child is no longer subject to a wilful choice of the parents. It has gained a status of a categorical necessity. Every nation developed or developing links its future with the present status of a child and striving their best for optimum development of the child. As a consequence, many countries have formulated the national policy to uplift the overall development of the children, especially related to the field of child's health under banner of health for all by the year 2000 AD. GO BI (G = Growth, O = Oral Rehydration Solution, B = Breast Feeding, I = Immunisation) is a programme developed with the assistance of the UNICEF to monitor the child's health, by reducing morbidity and to prevent mortality and by raising the level of child survival. Keeping in view the theme of this Symposium limiting only to child's growth under the caption of human biology, I would restrict myself only to this.

The child's growth and development, is a major concern of the parents, society and of a nation. It gives the direct expression of the child's health. Despite it is so much significance if one looks at the literature, one does not find adequate record where one can say a word about child's growth with confidence. Of late this has been a matter of deep concern for the competent scientists, particularly physical authoropologists and paediatricians. Further, they are fully aware that it is scientifically wrong to use foreign growth standards to compare the somatic development of the children of their own country. Come what may the scientists of the developing countries still depend upon the foreign growth standard, to evaluate their children.

Emphasis to study child's growth is manifold and varies with interest and disciplines to which a researcher belong. For instances, the interest of an embryologist is to study the intrauterine growth and to investigate the mechanism that makes the embryo grow; Cytologists and histologists study the structure and functions of growing cells. Morphologists are concerned with the problems of organisations, i.e. how the different body organs develop to attain the adult body shape. While the anatomists confine themselves to bone development.

These scientists wish to have deep insight about child's growth though from different stand point yet one thing is common among them all that most of these attempt comprehend growth changes right from the conception to the senescense. The entire life span is further divides into various epochs, i.e. prenatal, infancy, early childhood, pre-puberty, puberty, post-puberty, early adulthood, middle age and old age to facilitate understand mechanism of growth. In addition, there are various types of growth namely physical, physiological, pubertal, skeletal, dental, chemical and cellular, and so on which is required to be explored for the deep and thorough understanding of the growth and development pattern of the children. Be it as it may be, the morphological growth is the mere expression of all types of the internal growth occurring in the body at different ages.

Consequently, everyone who finds himself in the presence of child, whether that be for a short period of time or more or less permanently, is likely to engage in a relatively haphazard manner employing inconsistent methods to study the child's growth. Subsequently, these studies led us neither towards any sound conclusion nor can be comparable with each other. Further, any growth evaluation done based on either of the findings would obviously be not reliable.

It is not my purpose here and it is not feasible to offer a detailed exposition of the research methodology employed in different fields of human growth and development despite its vastness. I will restrict myself to point out only some common problems which need to be taken care of while studying child's growth.

The most common obstacle encountered by the scientists dealing with growth studies is to secure *representative sample* at different age groups. Although, it is relatively easier to get desired sample size at certain ages from school or college compared to new born infants or older adolescents and young adults. This is why the studies relating to latter years of life are scanty. This does not imply, however, that one should overlook the importance of adequate sample size. I would quote an example indeed how many researchers are really conscious. In a recent review held by Madnick and Bair (1981), out of 70 European studies, a careful scruitny of the list whows that only 26 studies have representative sample of well-defined population. Three of these (1946, 1958, 1970) British birth cohrorts are representative of a national child population. It is unfortunate that some workers do not concern over the use of non-representative sample feeling that resulting bias will not be serious when studying change over time. Such opinions are absurd and erroneous.

It is a different matter not to be choosy than adopting a sampling procedure. An appropriate sampling not only reduces the chances of bias but also ensures the representativeness of the sample. I will strongly emphasize the representative sample is a prerequisite of any research and not only for growth studies, otherwise it is a waste of time and money.

To collect data, though appear to be simple but it is not so. One has to be very meticulous and calculative to ensure accurate *recording of the data.* In the growth studies, foremost and the most important is accurate age recording. It is difficult to ellicit correct age of the children. There is no full proof criteria available to check its validity. It is more so in the developing countries where a larger preponderance of population is poor and illiterate and the birth registration are of poor order. The poor population does not understand the significance of remembering the age. Of course, illiteracy of the parants do contribute towards inaccurate age recording. A study was conducted in Bombay where the age information obtained from the child, parents and the school records differed markedly. There is no clear cut way to overcum it except for approximating child's age through the family's, history. In India, Desi calendre, national or personal temporal events of significance are generally associated to estimate age of the child. These are helpful in ascertaining the correct age but involves lengthy procedure and usually takes much longer time than anticipated at face value. On the contrary, the children and parents of the upper strata are age conscious but they do not want to reveal their correct age to an outsider/stranger. The school records are also found biased. At times, also the researchers do not take pains to estimate it thoroughly. Under such circumstances, the investigators resolve to use his insight to arrive at correct age of the child. Inaccurate recording of age is a serious problem in small children where even days and weeks alter the results. Hence it requires due attention of the investigators.

Prior to 1950, there was not much emphasis being given to the *standardization of instruments* used to measure the body. After 1950, the anthropologists did actually realize the standardisation of the instruments. As a result of this, many sophisticated instruments came up into existence to measure the body. Unfortunately, these instruments are available only in some countries and their availablity in other countries including India is almost zero. Consequently, one, as observed is forced to depend upon the local manufacturer. Oftenly, some researchers resort use of indigenous or improvised instruments. This practice restrict comparability of the results across the studies. I wish to pinpoint here that selection of the tools for collecting data requires a special attention. The instruments selected for study on the basis of their availability and ease in administration without caring for their reliablity, validity and accuracy may distort the conclusion of the study. Therefore, it is recommended that before selecting an instrument, a list of the instruments measuring the variables of the interest should be obtained and its description should be thoroughly grasped to know its technical know-how. The sensitive instrument with relatively lesser error with its proven reliability and validity should be preferred for the purpose of research work. The differences in the skinfold values have been observed when measured with Harpenden and when with Una caliper made in India.

The need of sufficient time at the disposal of the researcher and co-operation of the subject is desireable component. Further, if a researcher is unable to built a workable rapport with the subjects, he may likely to ellicit inaccurate information because no body likes that any stranger should pry into the personal affairs. Consequently, he may refuse completely or partly for some of the growth observations.

Next most important is marking of the *landmarks* and finding out an accurate location prior to making growth records. Generally, that the researchers are over-confident with regard to the landmarks and they do not care to pinpoint its location. For example, to measure the upper wid-arm circumference, an investigator should take a trouble of measuring it after marking exactly at mid of between the points acromian and olecranon but in practice, sometimes just eye approximation is done which no doubt would affect the results adversly.

Likewise prior to record any body measurement, an investigator should ensure that the subject is placed in the standard recommended position. For instances for measuring height if the subject is not in the fully erect and in Frankfort horizontal position, there is a likely-hood of difference in height of a few milimetres.

Further, the success of a growth study can depend on the personality of the investigator. We must take into consideration how permissive is a society. But a stranger is a stranger. No one would like to display oneself and especially to the members of the opposite sex whenever it happens, in case of paid volunteers and others, there must be some internal inhibitions causing variation in the measurements which probably have not been ever realized in affluent countries. It is just to recommend that needful caution in this respect may be considered.

In view of the above discussion, it is essential to be meticulous and not in hurry while collecting data, otherwise a researcher may overlock many things resulting in yield of inaccurate data. Simultaneously, the study subjects should be co-operative and relaxed.

We are in a computer age, it has become a fashion that all the analytical problems should be solved with the use of a computer. Those who use computer considered more competent and superior than those who have no accessibility to the computer. It has been noted several times because of dependency on the computer and its simplicity, the statistician over emphasize than what it requires or vice versa. It is further undeniable that computer scientists may not fully understand the nature and the complexity of the growth data. He simply tries to do the best he can offer. Such situations are much disheartening. At times, the complicated statistical procedures are preffered to impress upon. On the contrary the researcher himself is the best person to adjudge the nature of the *statistical techniques* required. The use of simple statistical is much more revealing many times. In one of my recent study, it is found that McOuitty linkage design is simpler and give a better understanding and above objective compared to those of cluster, factorial, discriminate function or multiple regression analysis. With the use of simple statistics, there is an excellent examples of the analysis about the effect of illness on the growth rate from Oxford child health survey. It is very essential to maintain a balance between the practical and theoretical research. If a research is of practical nature, a simple statistics such as cut-off points, percentiles, simple procedures of clustering, etc. are the best. In case of theoretical research complicated statistical designs like factorial, etc. might give some insight in them mechanism of the observation to the theorists. Hence the balance between the two is desirable for adequate inference of the research. I would suggest that use of the statistics should be considered as a mean and not the end.

A number of problems related to growth research methods in the growth studies have been pointed out. These operate at three level: firstly, at the level of the researcher; secondly, at the level of the subjects, and thirdly, at the level of the instruments. I am fully aware of that most of us are known to these but when it comes to practice, we tend to overlook while conducting a study.

As such, it is very difficult to compare growth differences of the populations because of varied economic systems, occupations, cultural patterns, educational systems, welfare facilities, varying eating habits, patterns of morbidity and mortality as well as sanitary and medical facilities. These all are responsible to bring out growth variation. Also, there is no way out to measure, how best method may be, that how much a difference in growth parameters is due to environment or due to genes. What-so-ever may be, it is beyond the human control to demarcate a distinct line between genetically controlled variations and environmentally controlled variations. In fact these are so overlapped that its extent of assessment is highly speculative.

It is clear that the variations occurring in growth of children are of two types, one is naturally or biologically controlled and another is largely under our control.

Latter are those variations, hazards or obstacles which are bound to occur because of planning of inconsistent methodology, carelessness at the part of investigators and inappropriate selection and use of the instruments, etc. In case we do not put sincere efforts to minimise the methodological variations; it will not be possible to highlight the factual growth variations and would remain in confounding state.

In the end, my humble submission to the distinguished delegates, who so-ever has a concern with growth studies, is that due care should be taken to make the study meaningful. Lastly, I strongly feel the emergent need to develop a newer and innovatory strategy on a common platform acceptable internationally in regards to uniformity of methods, techniques, instruments and rationale to be adopted irrespective of the discipline. I am sure this would help better understanding the growth differences among populations and solving out the child's health problems which is consistently prevailing globally.

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HEIGHT-WEIGHT STANDARDS IN ITALY: A CRITICAL REPORT

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Abstract: A review of several national surveys in Italy on height and weight is given and the presuppositions of such are discussed. Using the results of a recent vast Italian survey on growth the need of appropriate growth studies is demonstrated.
Key words: Growth standards, Italian population.

Anthropometric survey in Italy dates back to 1850 when Livi undertook for the first time on a large scale body measurements on Italian conscripts. Since then the increasing interest in questions concerning height and weight in Italy is reflected by numerous studies. The main results of such consist of: (1) The observation of a North-South gradient for height in Italy, being largest in the North and smallest in the South (2) The awareness of a constant increase in weight and height with time, i.e. the phenomenon of a secular trend. From Figure 1 results an average increase in height of 0.7 cm for each decade between 1874 and 1960. A similar trend is also observed from data of various other authors (Table 1) between 1854 (Livi) and 1976 (De Stefano et al.).

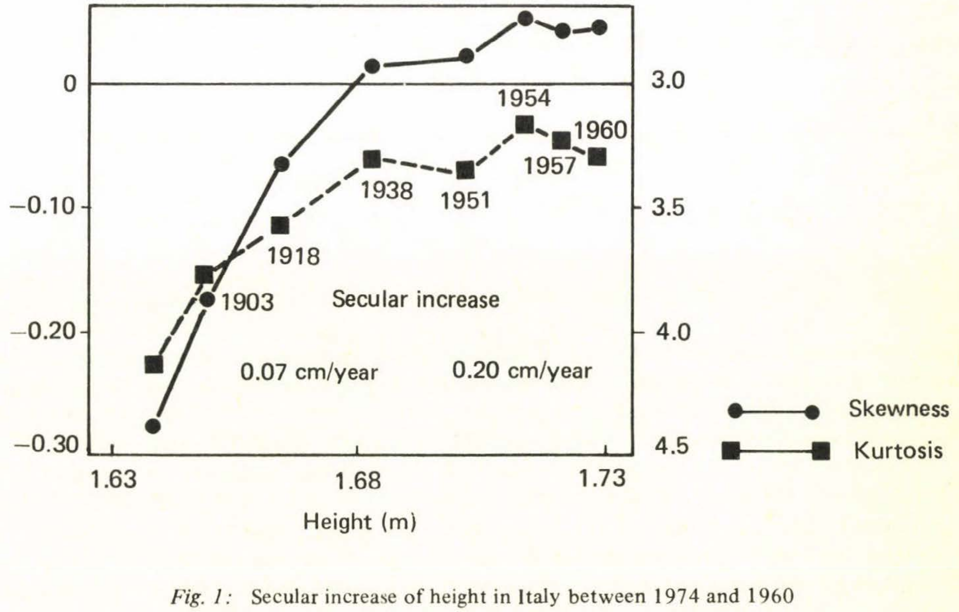

Fig. 1: Secular increase of height in Italy between 1974 and 1960

Table 1. Secular increase of height differentiating between the national average of Italy (Nat. Av.) and data from southern Italy (S. I.). The data relate to conscripts with the exception of those from 1976 which are 18 year old students

Year	National average	Southern Italy
1854	162.6	–
1904	164.2	–
1920	166.4	162.3
1938	–	164.0
1958	–	168.5
1976	173.9	169.3

In contrast to this well-documented interest in the increase of height and in anthropometric changes in general of the Italian population much less attention has been devoted to growth studies in Italy. This is surprising in view of their importance for pediatrics, social child care and epidemiology. A first national survey of data on growth dates back to 1959 when Bacchetta pooled the data from different regions of Italy which had been collected by various authors (mostly pediatricians) between 1910 and 1930. A similar study covering the time between 1940 and 1965 (Figs 2a, b, 3a, b) was done by Bulgarelli et al. (1961, 1965). However, there are strong objections against the claims of both authors that their data represent the national standards for Italy. The two main objections relate to: (1) The fact that in both cases the pooled data cover a period of 20 years and 25 years, respectively, without any differentiation between shorter time intervals; an absolute necessity especially with respect to the effects of the first and second world war. However, pooling data covering long time periods may generally mask secular trend and thus lead to bias. (2) The fact that these data were collected by different researchers with varying training and experience. Thus bias may well result from such incongruences of measuring techniques. A third approach to establishing Italian standards for height and weight was done by De Toni (1946) who introduced for the first time biometric growth tables which, however, did not take into account the different growth velocities at different stages. The results of this approach are shown in Figures 2a, b and 3a, b, and clearly differ from those of his subsequent corrected study in 1964. However, also this corrected approach for a national standard still lacks differentiation according to the period of data collection, he pooled his own data (1940 – 1946) together with those from Bulgarelli (1930 – 1945), as well as differentiation between the main districts. The importance of differentiating between the latter is clearly visible from our data (Capucci et al. 1983) presented in Fig. 4.

In view of this unsatisfactory situation a national survey including a battery of 60 measurements was initiated in 1974 and terminated in 1976. This survey takes into account all the points criticized above – time of sampling, training, control of inter- and intra-observer errors, differentiation of geographic regions, and homogeneity of sample composition. Thesre obtained growth curves for height (Fig. 5a, b) and weight (Fig. 6a, b) show clearly that the trends in Southern Italy (pooling Sicily, Calabria, Puglia, Basilicata) differ from those in Central (Campagna, Abruzzo, Lazio, Toscana) and Northern Italy (Piemonte, Lombardia, Veneto, Emilia Romagna). This is most expressed with height and especially so in females who are constantly below the values of the other two regions in the 50th centile. The Northern and Central regions show a similar pattern. This picture changes for weight. Here (Fig. 6a, b) the South of Italy again shows the greatest deviation

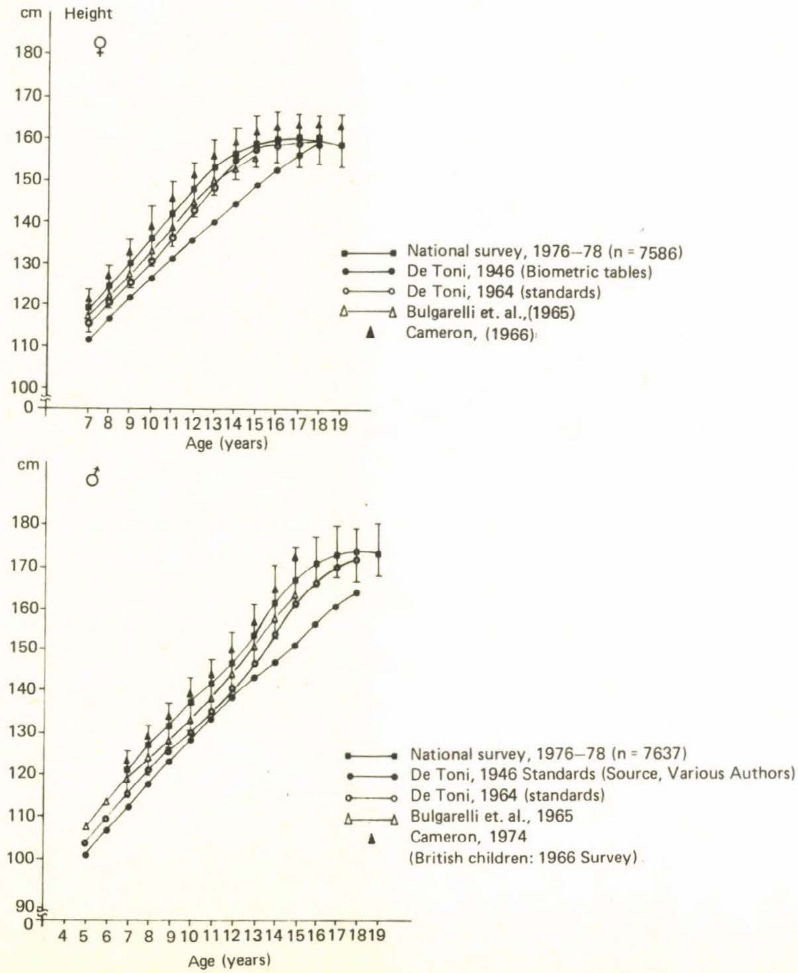

Fig. 2: Height (cm) plotted against age (years) comparing several surveys of Italian females and males

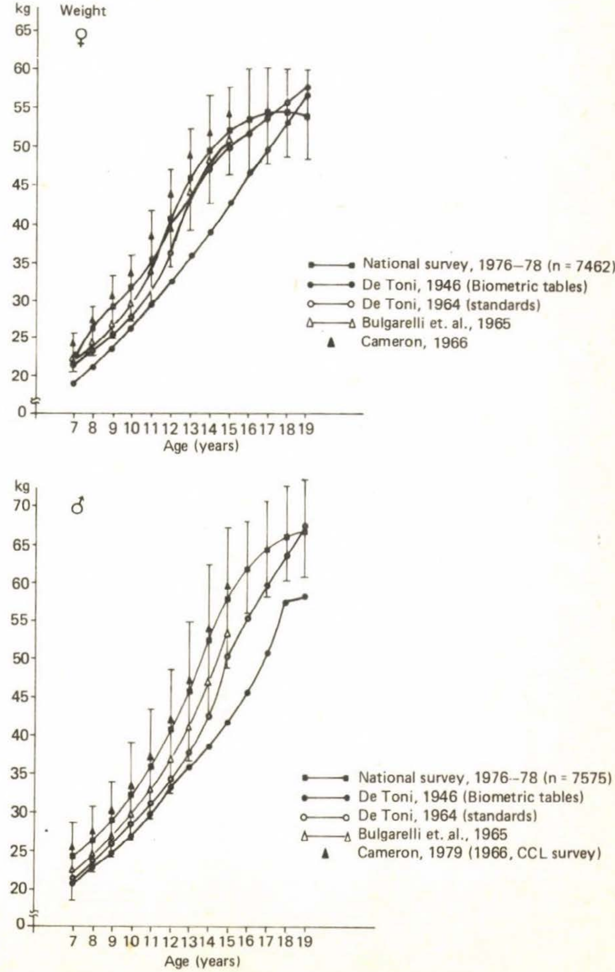

Fig. 3: Weight (kg) plotted against age (years) comparing several surveys of Italian females and males

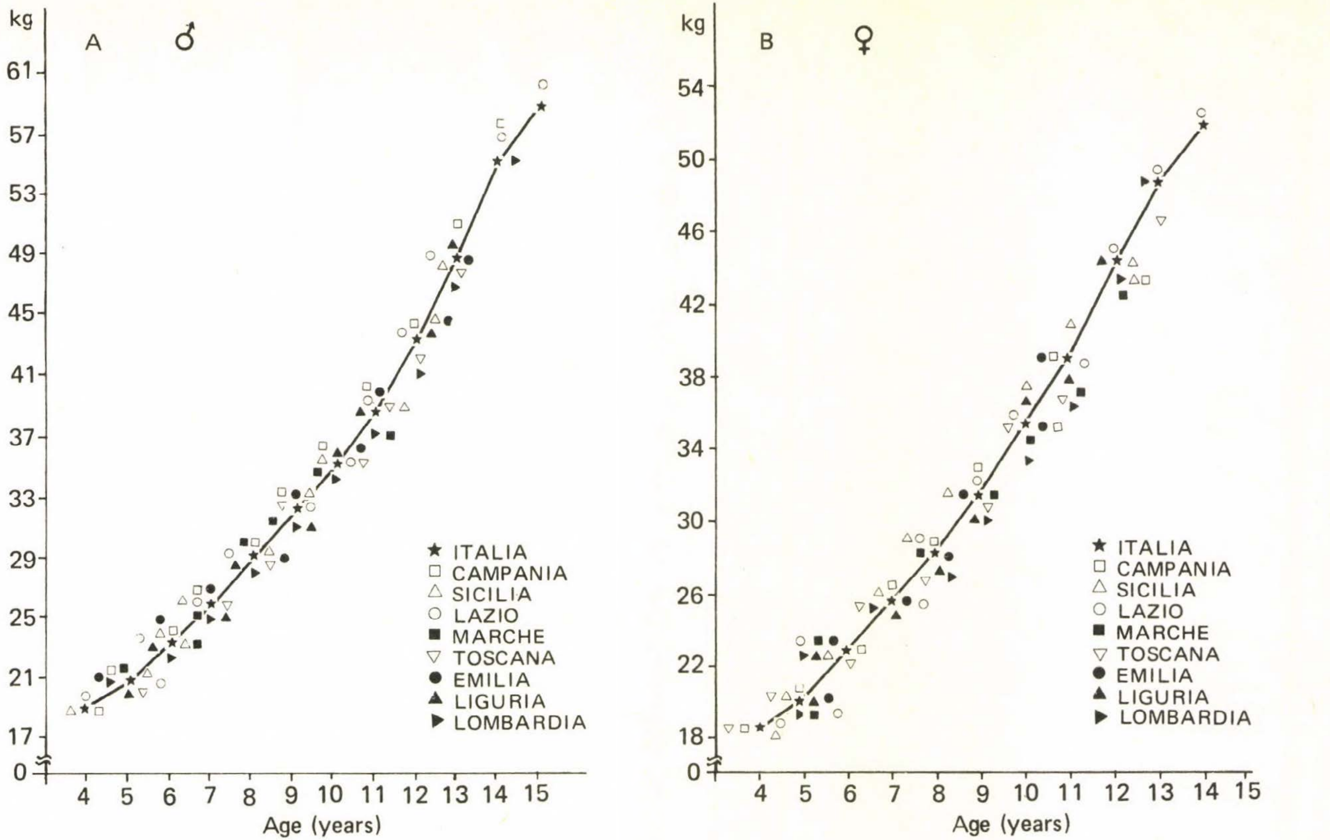

Fig. 4: Means of (a, b) weight (kg) and (c, d) height (cm) against age (years) and relative position of the regional samples for males (A, C) and females (B, D)

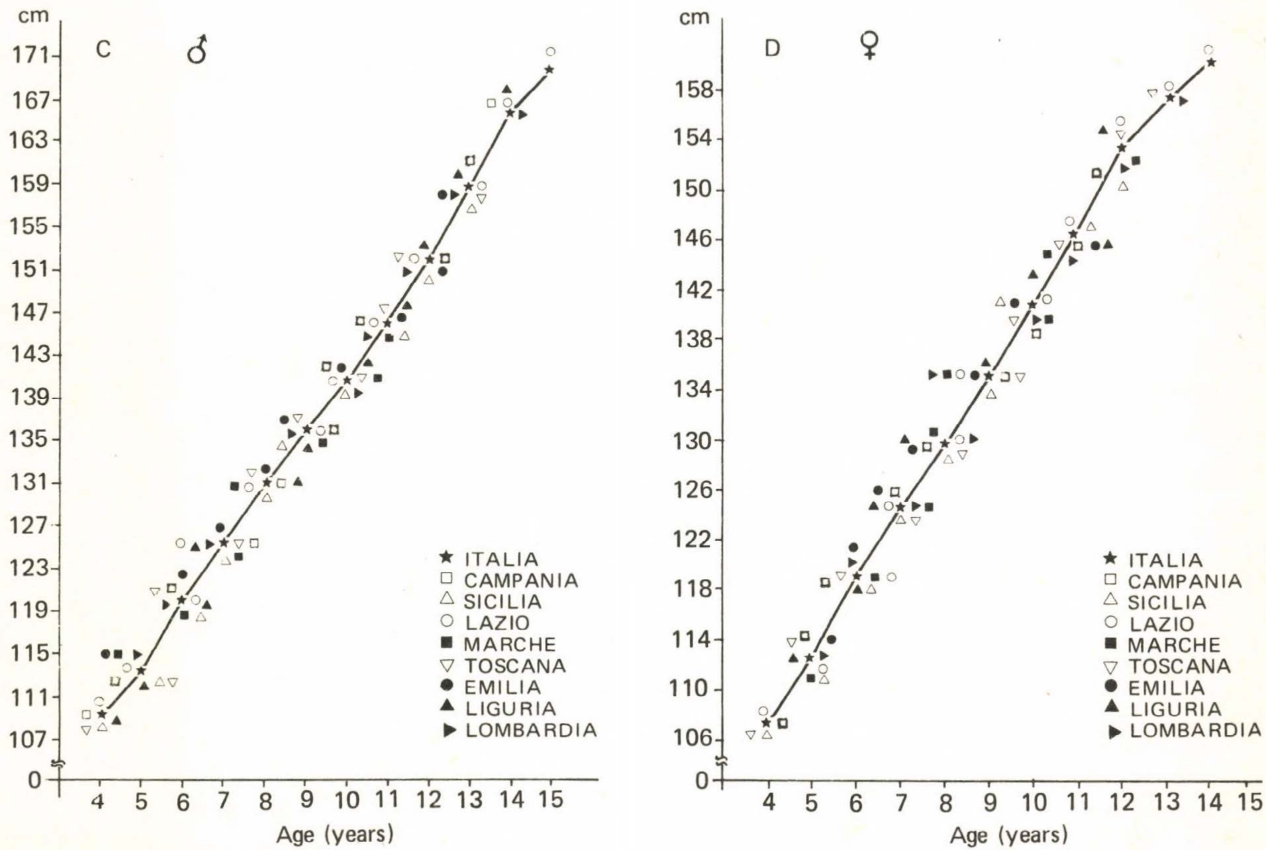

Fig. 4: Means of (a, b) weight (kg) and (c, d) height (cm) against age (years) and relative position of the regional samples for males (A, C) and females (B, D)

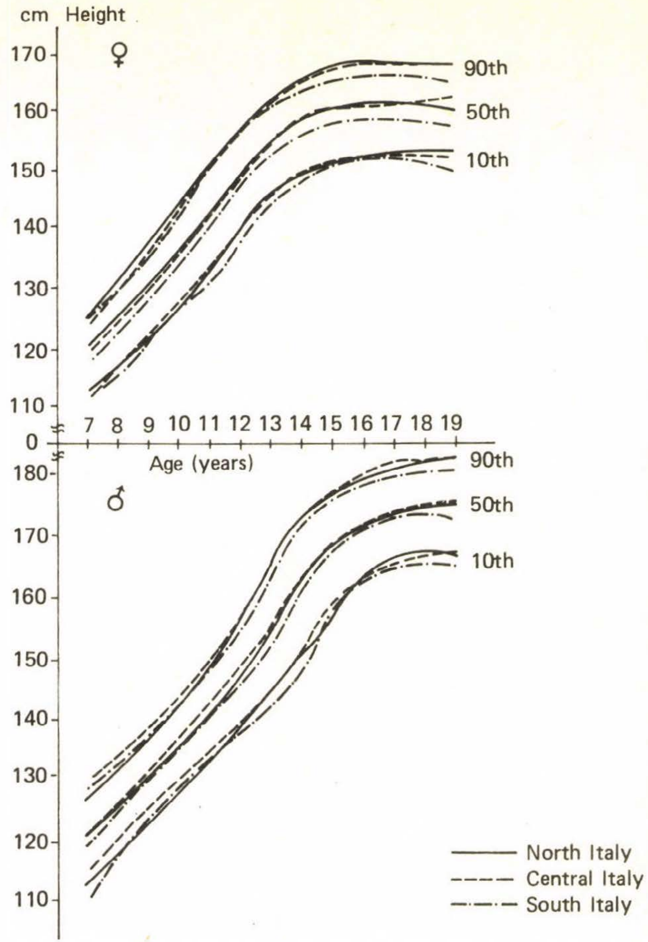

Fig. 5: Percentiles of growth curves plotting height (cm) against age (years) for Italian females and males

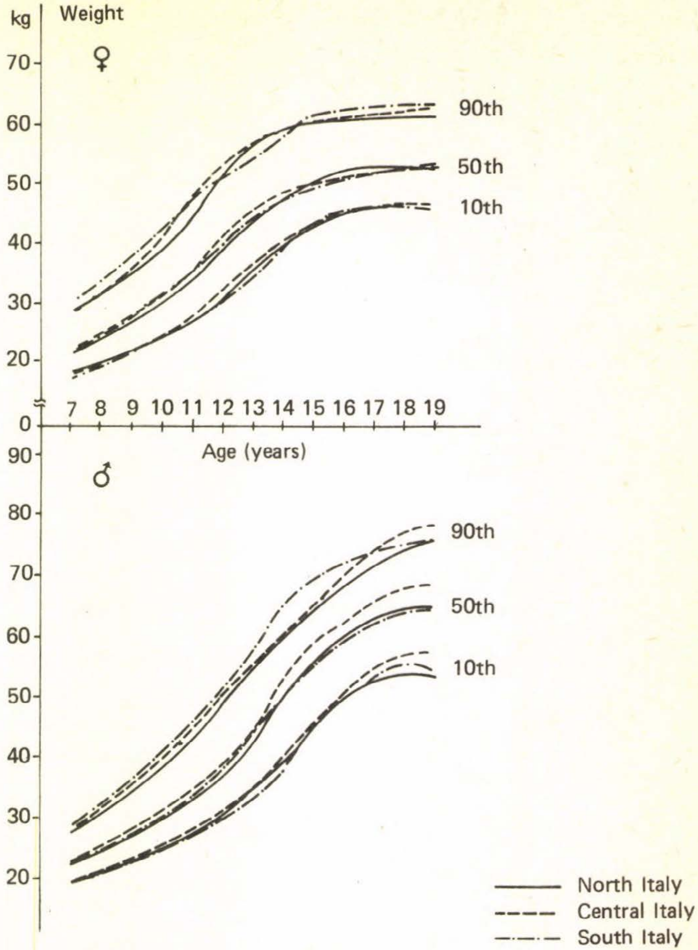

Fig. 6: Percentiles of growth curves plotting weight (kg) against age (years) for Italian females and males

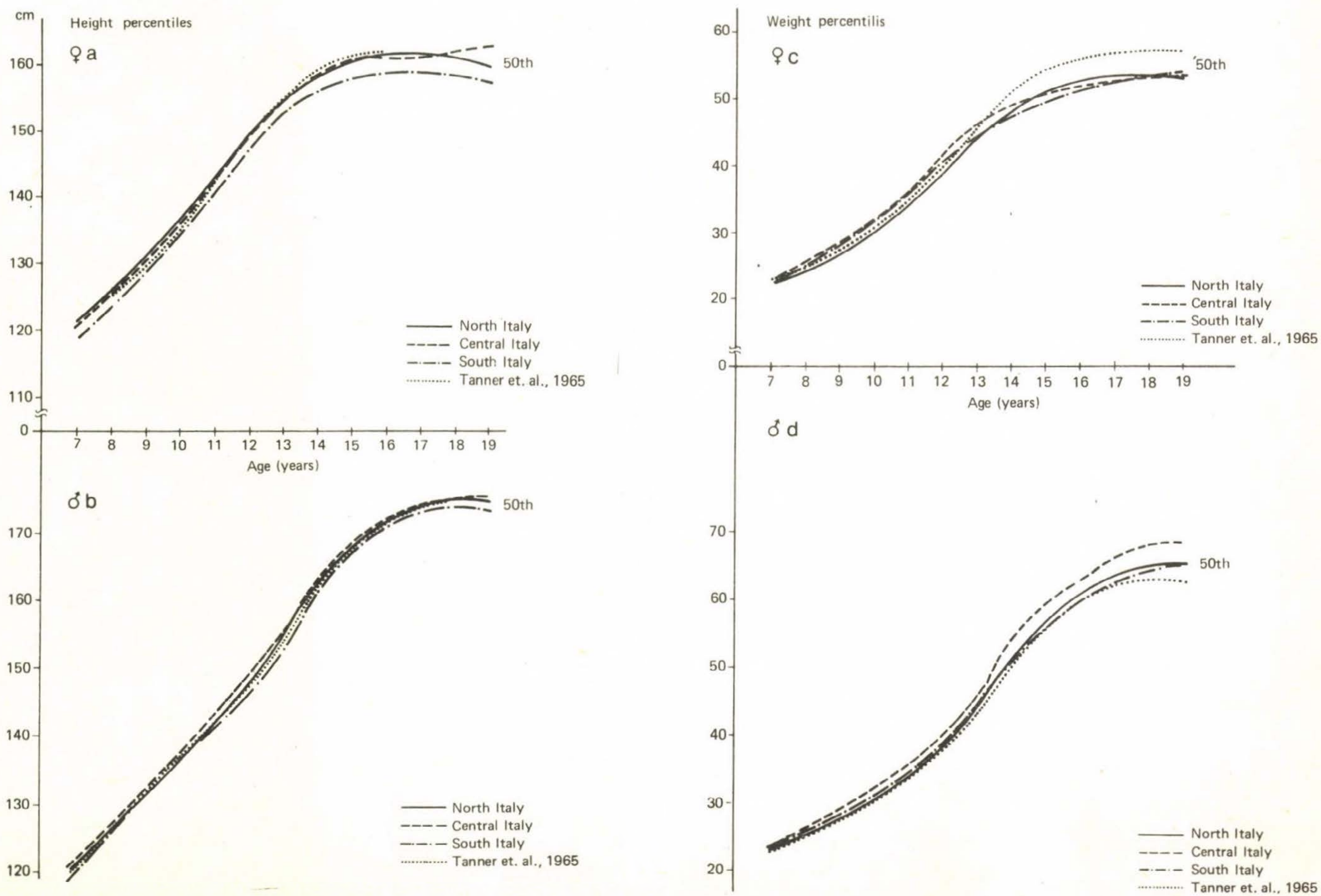

Fig. 7: Comparison of growth curves for height (a, b) and weight (c, d) in the 50th centile for females (a, c) and males (b, d)

but in the opposite direction, both males and females nearly constantly showing higher values than those in the other two regions. However, there is also a noteworthy difference between the Northern and the Central region, the latter, also tending towards higher values in weight and especially in males.

From these results the necessity of establishing different national standards, at least for the South of Italy, seems obvious. As national standard for Italy for several decades has been used mostly the English national standard (Tanner et al. 1966). A comparison of the 50th centiles of height and weight of these with our data (Fig. 7a–d) makes not only the North-Central-South gradients still more striking, but also demonstrates the need for appropriate growth surveys.

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SECULAR CHANGES OF BODY MEASUREMENTS IN HUNGARIAN UNIVERSITY STUDENTS BETWEEN 1976–1985

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Abstract: The body development of first year students of the Technical University, Budapest has been investigated yearly from the 1974/75 academic year. In this paper the decennial changes in body measurements of 20 year old male students between 1976–1985 are analysed. All the investigated body measurements show a tendency to increase, except that of biiliocristal diameter. But there appear different trends in secular changes of body measurements according to the students' socioeconomic status. The increase in the measurements of students with a father having a university or high school education level showed lower values than that of other students, and the changes in students born in Budapest also showed lower values than those who were born in the country.

Key words: Secular trend, Hungarian university students, Body measurements.

Introduction

The term of secular growth changes contains several phenomena. Among them the best known is the change of adult height, which is usually associated with increased growth maturity, earlier maturation and greater adult stature (Van Wieringen 1978).

The general trend of the secular changes can be well-represented by the data of military conscripts from different European countries, which show an increasing tendency of adult height during the last century (Tanner 1966, Van Wieringen 1978).

Among the factors determining body measurements the most important are the enviromental elements. Therefore the rate of the secular changes in different between social categories of the populations from these countries (Van Wieringen 1978).

One of the special strata of young adults is that of university student. They belong to an intellectually selected group, and they have usually grown up in better socioeconomic conditions, therefore, their average stature is higher than the conscripts' height, who represent the mean of the whole population of that age (Gyenis 1980, Olivier 1980).

The aim of this paper is to present data of decennial changes in body measurements of Hungarian students and the effects of two socioeconomic factors (place of birth and educational level of fathers) on it.

Material and Methods

In the Polyclinic of the Technical University, Budapest regular screening tests have been made for a long time on first and fifth year students to record their state of health and body development (Gyenis 1980, Till – Gyenis 1975). This paper is only concerned with first year students, who were measured in the second terms of the 1975/76–1984/85 academic years. More than ter thousand students were examined during this period, but only the data of the largest group, the 20 year old male students are analyzed here (N=6951). Among these students 39.8% were born in Budapest and 60.2% in other settlements and 44.4% of them had fathers with a high level of education (university or high school), which is more than 3 times higher than the national average in Hungary.

Results and Discussion

The majority of the measurements of the 20 year old male students show an increase, with the exception of the biiliocristal diameter and three skinfold measurements (Table 1). But there are some differences in the change of the measurements considering two socioeconomic factors: the birth place of the students and the educational level of their fathers.

Table 1. Mean and decennial changes (1976–1985) of measurements in total sample of Hungarian students and according to their birth-place

Body measurements	Total		Place of birth: Budapest		Place of birth: Country	
	$\bar{x}$	Changes	$\bar{x}$	Changes	$\bar{x}$	Changes
Height (cm)	176.9	2.1	177.3	1.1	176.6	2.7
Weight (kg)	68.9	3.2	69.5	2.3	68.5	3.8
Sitting height (cm)	92.8	1.5	93.0	1.2	92.7	1.6
Iliac spine height (cm)	100.1	0.9	100.4	0.3	99.8	1.3
Upper arm cf. (cm)	27.2	0.2	27.5	0.1	27.1	0.3
Chest cf. (cm)	91.5	0.7	91.8	0.6	91.4	0.7
Thigh cf. (cm)	54.1	0.1	54.5	−0.3	53.8	0.4
Calf cf. (cm)	36.4	0.5	36.6	0.4	36.3	0.6
Total arm length (cm)	78.8	1.1	78.8	0.9	78.7	1.3
Biacromial dm. (cm)	40.7	0.9	40.7	0.8	40.7	0.8
Transverse chest dm. (cm)	29.4	0.2	29.5	0.3	29.3	0.2
Biiliocristal dm. (cm)	28.6	−0.2	28.7	−0.3	28.6	−0.2
Skinfold biceps (mm)	4.4	−0.5	4.6	−0.8	4.2	−0.4
Skinfold triceps (mm)	10.8	0.7	11.2	0.1	10.4	1.1
Skinfold subscapula (mm)	12.6	−0.3	13.2	−0.8	12.2	0.1
Skinfold suprailiaca (mm)	17.3	−1.6	18.3	−2.5	16.7	−1.0

Students born in other settlements (in the country) show an „accelerated" trend as compared with those born in Budapest. The increase in their measurements is higher, or, at least, the decrease in some of them is smaller than in the other group, with the exception of the transverse chest diameter. It is remarkable, that the decrease of skinfold data is much greater among the students in Budapest than in the other group.

The same phenomenon was observed among the students in relation to the educational level of their fathers, as in the case of their birth-place (Table 2). An accelerated growth can also be seen in students with fathers of basic (primary), or middle (secondary) educational level. The students' measurements with fathers of high educational level have the lowest increase in value, moreover, in some measurements there is a decrease. The sum of the 4 skinfold measurements also show a tendency to decrease only among the students with fathers of high and middle educational level, while among the students with fathers of basic educational level, this value shows a slight increase.

In Table 3 the change in the average stature of 18–20 year old military conscripts from 11 Western-European countries is shown for the period between 1960–1980 (Chamla 1983) with the same data of 20 year old Hungarian students between 1976–1985. The highest increase appeared with the conscripts of Spain, Denmark and Holland, while Portugal showed the lowest value. The data of Hungarian students is close to the best developed group of western countries, but they do not represent the average population of the youth in Hungary, because the educational level of their fathers was higher than the national average in Hungary.

Table 2. Mean and decennial changes (1976–1985) of measurements in Hungarian students according to educational level of their fathers

Body measurements	Educational level of fathers					
	Basic		Middle		High	
	x̄	Changes	x̄	Changes	x̄	Changes
Height (cm)	175.9	2.3	176.8	2.4	177.6	1.1
Weight (kg)	68.5	3.5	69.0	4.2	69.1	2.3
Sitting height (cm)	92.3	1.6	92.7	1.4	93.2	1.2
Iliac spine height (cm)	99.6	1.1	100.1	1.0	100.4	0.2
Upper arm cf. (cm)	27.2	0.3	27.3	0.5	27.3	−0.1
Chest cf. (cm)	91.6	0.7	91.7	1.2	91.4	0.3
Thigh cf. (cm)	53.9	0.3	54.2	0.4	54.2	−0.3
Calf cf. (cm)	36.3	0.6	36.5	0.7	36.5	0.2
Total arm length (cm)	78.6	1.1	78.8	2.0	78.9	0.5
Biacromial dm. (cm)	40.7	0.9	40.7	0.9	40.7	0.8
Transverse chest dm. (cm)	29.4	0.2	29.4	0.2	29.3	0.3
Biiliocristal dm.	28.7	−0.2	28.6	0	28.6	−0.4
Skinfold biceps (mm)	4.3	−0.3	4.5	−0.4	4.4	−0.7
Skinfold triceps (mm)	10.5	1.1	10.9	0.6	10.9	0.4
Skinfold subscapula (mm)	12.3	0.2	12.7	−0.2	12.7	−0.8
Skinfold suprailiaca (mm)	17.0	−0.5	17.5	−0.9	17.4	−2.8

Table 3. Changes of stature of conscripts in some Western European countries (Chamla 1983), with same data of Hungarian students

Countries	Period	Stature Former	Recent	Difference
West-Germany	1960–1978	174.9	178.0	+3.1
Belgium	1960–1979	172.55	175.3	+2.75
Denmark	1960–1980	175.4	179.8	+4.4
Spain	1960–1980	166.7	171.3	+4.6
France	1960–1979	169.98	173.86	+3.88
Italy	1960–1977	168.47	172.19	+3.72
Norway	1960–1980	177.15	179.5	+2.35
The Netherland	1960–1978	176.0	180.3	+4.3
Sweden	1960–1979	176.7	179.17	+2.47
Switzerland	1962–1977	173.1	175.5	+2.4
Portugal	1970–1980	166.6	167.1	+0.5
Hungarian students	1976–1986	175.3	177.4	2.1

Summarizing our results, two alternative conclusions may be drawn. Either, as a consequence of the general increase of living standards in Hungary, the effects of factors causing, growth retardation among the offsrings of formarly poor social classes are being eliminated, or the living standards of families with fathers of high educational level is not increasing to the same level as for families with lower educational level.

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SECULAR CHANGE OF HEIGHT, WEIGHT AND AGE AT MENARCHE IN KAPOSVÁR CHILDREN AND YOUTHS DURING THE PAST 50 YEARS

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Abstract: Based on the observations of Véli in 1928–31 and in 1947–49, Bodzsár in 1975, Környei and co-workers in 1981 and in 1985, the authors established that body size and maturation of school children at Kaposvár changed in the last half-a-century.

Height: Each successive survey gives means higher than the previous one. The mean heights of 7 year-old boys in 1981 by 7.8 cm, the girls by 7.5 cm, of 12 year-old boys by 11.4 cm, and the girls by 12.2 cm and of 18 year-old boys by 10.5 cm were higher than 50 years earlier. The height of girls aged between 16–18 increased only by 2.0–2.6 cm. Between 1975 and 1981 the means of height were unchanged in the age group of 7–9 years, but the others increased by 0.3–3.3 cm. The increase in stature per decade did not decrease in the last decade in the 15–18 year-old groups.

Weight: In 1981 the mean weight of 7 year-old boys by 2.6 kg, the girls by 2.2 kg, 12 year-old boys by 8.5 kg and the girls by 11.9 kg were greater than 50 years earlier. During the past 40 years the mean body weights of 18 year-old boys increased by 4.4 kg but the girls' increased only by 0.6 kg.

Maximum increments between annual means for stature comes earlier. During the past 44 years it comes by one year earlier at the 13–14 year-old boys and by 2 years earlier at the 11–12 year-old girls.

The median ages at menarche estimated by probit analysis in 1947 was 13.9 year, in 1962 it was 12.98 year and in 1981 it was 12.69 year.

Therefore the socioeconomic factors which caused the gradual amelioration but not total subsidence of the earlier „retardation" need further investigation.

Key words: Secular trend, Height, Weight, Age at menarche, Kaposvár children.

Introduction

Changes such as an increase in height, weight and an earlier physical and sexual maturation have been observed during the past 50–100 years in most industrialized countries (Cameron 1979, Marshall 1981, Roche 1979, Vercauteren–Susanne 1985).

In this paper we consider the secular trend in height, weight and puberty (especially menarche) over the last years in Kaposvár. We wanted to find out whether any kinds of positive secular changes (acceleration) can still be revealed or as in certain developed countries (England, Norway, Japan, United States) have already ceased (Roche 1979).

Kaposvár is the country-town of Somogy (South-west Hungary), it is an agricultural-industrial town. In 1930 the number of residents was about 36900, in 1948 about 33500, in 1975 about 69400 and in 1985 about 74800. Over the last 50 years the increase in population was caused by settling from the surrounding agricultural villages. Migration wasn't from afar, there is little reason to believe that genetic changes – particularly heterosis or hybridization – took place.

György Véli, pediatrician and medical officer of schools lived and worked in this town and he was one of the eminent scientists of the Hungarian growth studies.

In our paper we made a comparison between the results of examinations by Véli from 1928–1931 (Véli 1936), and from 1947–1948 (Véli 1956), by Bodzsár in 1975 (Bodzsár–Véli 1980) and by our group of research workers in 1981 and in 1985 (Table 1). We examined 7–14 year-old children in 1981, and 15–18 year-old ones in 1985.

Table 1. Examinations of body-height and body-weight in Kaposvár

	Year	Authors	n	Boys	Girls
I.	1928–31	Véli	1819	986	833
II.	1947–48	Véli	3569	1958	1611
III.	1975	Bodzsár	6386	3099	3287
IV.	1981 (7–14 year-old) 1985 (15–18 year-old)	Környei Gyódi Gelencsér	4550	2524	2026

Secular Trend in Growth of Height

Each successive survey gives means higher than the previous one (Fig. 1). As it appears from the mean values by age groups included in this illustration an unambiguously demonstrable change in the height of the children took place during the past 50 years. The differences in mean stature between 1928 and 1981 of the 7–12 year old boys and girls vary between 7.5–12.2 cm. This secular increase is about 1.5–2.5 cm/decade. The upward tendency of the mean stature continued during the last 6–10 years. It is larger in the older age groups than in the group of young school-children. Our observations will show that the maximum increments between annual means for stature come earlier: during the past 44 years it come by one year earlier in boys and two years earlier in girls.

Secular Trend in Increase of Weight

As for height, a similar increase in weight has been observed (Fig. 2). In 1981 the mean weights of 7–12 year old boys and girls by an increase of 2.2–11.9 kg were greater than 50 years earlier. During the past 40 years the mean weights of 18 year old boys increased by 4.4 kg but the girls increased only by 0.6 kg. The results of our examinations show that the maximum increments between annual means of weights come earlier, similar to the growth of height: during the past 44 years it comes one year earlier in boys and two years earlier in girls.

Menarche

An acceleration of maturation has accompanied the secular increase in body size. The physiological sign of maturation is the menarche which follows the adolescent growth spurt. Age at menarche has been studied extensively for more than a century. Means and medians from various studies show that the age at menarche decrease of about 4 months/decade occurred in many developed countries (Roche 1979). The recent reduction in age at menarche has not been uniform, there has been some change (for example in Eskimos).

In our examination we obtained the dates of menarche from the girls with status quo method and the results were analysed by the probit method (Table 2).

The median age at menarche in 1947 was m = 13.9 years, in 1962: m = 12.98 years and in 1981: m = 12.69 years. It is interesting to mention that in 1982 at Nagyatád – a town about 70 km from Kaposvár – the median age at menarche was m = 12.63 years (Várhegyi 1985). We have found that – compared to the earlier medians at Kaposvár reported by Véli – the so-called „acceleration" of growth has become slower, however, it has not stopped. Therefore, the environmental factors which caused the gradual amelioration but not total subsidence of the earlier „retardation" (Eiben 1967, Véli 1972) need further investigation.

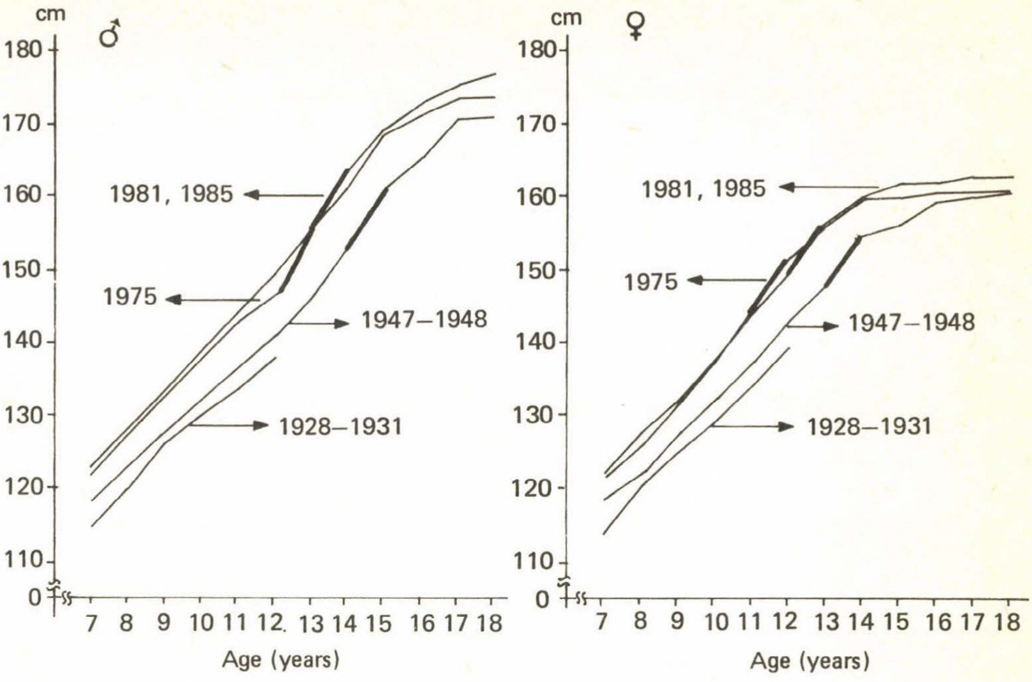

Fig. 1: Secular changes of height in Kaposvár boys and girls

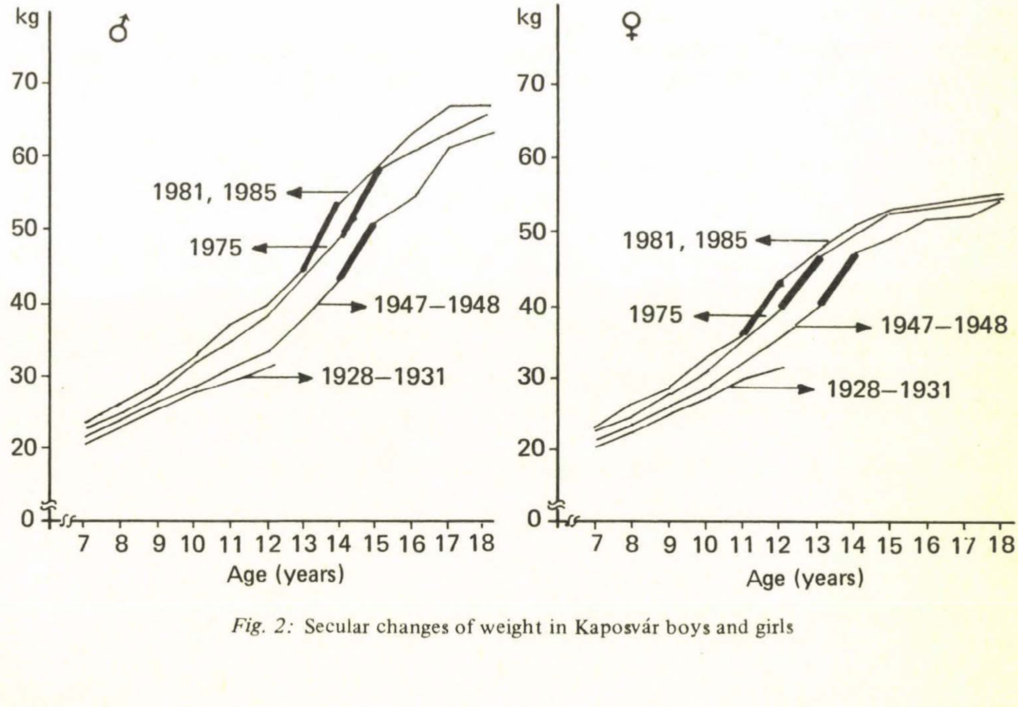

Fig. 2: Secular changes of weight in Kaposvár boys and girls

Table 2. Distribution of the menarcheal girls in Kaposvár

Age (year)	1947 (Véli 1971) n = 946 Menarcheal %	1962 (Véli 1971) n = 1342 Menarcheal %	1981 n = 550			
			Age (year)	n	Menarcheal n_1	Menarcheal %
10	0.00	0.00	10	74	–	0.00
11	0.00	0.00	10.5	53	2	3.70
12	3.10	23.20	11	66	4	6.70
13	20.57	54.10	11.5	59	10	17.00
14	61.90	83.00	12	51	9	17.60
15	84.68	91.30	12.5	56	22	40.00
16	94.60	98.66	13	55	37	66.40
			13.5	52	41	78.90
Median of the age at menarche			14	55	48	87.30
with probit analysis:			14.5	29	29	100.00
m = 13.9 year		m = 12.98 year	m = 12.69 ± 0.32 year			

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AN ANTHROPOMETRIC FOLLOW UP STUDY OF CHILDREN WITH VESICOURETERAL REFLUX AND COELIAC DISEASE

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Abstract: The growth and development of children with two different chronic pathological states, namely vesicoureteral reflux (VUR) and coeliac disease (CD), were studied and compared with the growth and development of normal children of similar age and sex by calculation of standard deviation score (SDS).

VUR: Over a 12 year period 33 children with VUR grades II–III were treated medically and followed throughout a period of an average 7.5 years. The mean SDS for both height and weight of children with VUR was far below the normal at the detection of the disease. The retardation in weight was greater than in height. At the conclusion of the follow up, values of SDS for both weight and height approached normal. The increasing weight and height velocity showed a close correlation with the improvement of renal function.

CD: Growth in height and weight were compared in 13 children with CD and 10 patients with transitoric glutensensitive enteropathy (TGE). At the start of a gluten free diet the mean SDS for weight was found to be far below the normal values in both diagnostic groups but became less negative as they progressed on an appropriate diet during the follow-up period. No significant difference between the two groups was observed. Although mean SDS for height was below normal, it turned out to be less negative than for weight. While the coeliac group responded with a marked increase in height velocity to the gluten free diet, in the children showing a TGE it remained practically unchanged. This unresponsiveness of linear growth to the gluten free diet points towards a cause of growth failure rather than that of transient gluten sensitivity.

Key words: Vesicoureteral reflux, Coeliac disease, Follow-up anthropometric study, Standard deviation score, Transitoric glutensensitive enteropathy.

Introduction

It is well-known that chronic diseases may be associated with growth retardation, sometimes the only predominant clinical feature pointing towards the possibility of an underlying chronic disease. The causal relationship is often shown by catch up growth following the proper treatment of the primary abnormality.

Material and Methods

The growth and development of children with two different chronic pathological states, namely vesicoureteral reflux (VUR) and coeliac disease were studied and compared with the growth and development of normal children of similar age and sex by calculation of standard deviation score (SDS). The SDS enabled a pooling of sex and age-groups (see Tanner et al. 1971). In this formula x represents the actually measured height or weight, the x means the idal height or weight for age, SD_x means the standard deviation of ideal height or weight for age. Means and SD-s for height and weight for age were taken from the data reported by Eiben (Eiben et al. 1971).

Results

Vesicoureteral reflux

Over the 12 year period 33 children with VUR grades II–III (Heikel–Parkkulainen 1966, Ducket–Bellinger 1982) were treated medically and followed up throughout a period of an average 7.5 years.

The following criteria were required in the study:

1. Age more than 12 months at the time of detection of vesicoureteral reflux;
2. Medical management without surgical intervention;
3. Two years follow-up;
4. Persistence of VUR after urinary tract infection had been abolished;
5. VUR with otherwise normal renal architecture;
6. No other chronic illness was present

The results of the study are shown in the Fig. 1. The mean SDS for both height and weight of children with VUR was far below that of the normal at the detection of the disease. Retardation in weight was greater than in height. At the conclusion of the follow-up, values of SDS for both weight and height did not differ from the normal values and velocity showed a close corellation with the improvement of renal function.

It is our assumption that anthropometric studies of patients with reflux should be sensitive parameters of the overall effect of reflux-nephropathy during long-term floow-up.

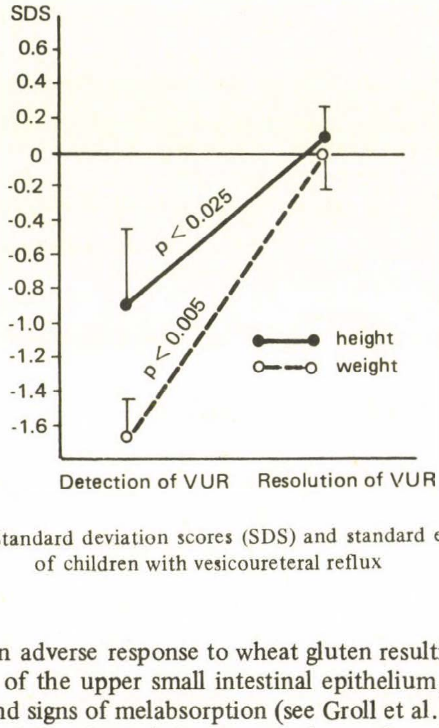

Fig. 1: Standard deviation scores (SDS) and standard errors (S) of children with vesicoureteral reflux

Coeliac disease

Coeliac disease is an adverse response to wheat gluten resulting in villous atrophy with hypoplastic flattening of the upper small intestinal epithelium, accompanied by the well-known consequence and signs of melabsorption (see Groll et al. 1980).

Clinical features and histological findings in the coeliac disease and the transitoric gluten sensitive enteropathy (TGE) at the early phase are the same. Only after a 3 year follow-up can the two disorders be differentiated from each other. By following the growth of children in height and weight, we attempted to find distinctive anthropometric characteristics for the two types of gluten-induced malabsorption.

Growth in height and weight were compared in 13 children with coeliac disease (CD) and 10 patients with transitoric gluten sensitive enteropathy. At the start of a gluten-free diet mean SDS for weight was found to be far below the normal values in both diagnostic groups, but became less negative as the time on an appropriate diet progressed (Fig. 2).

During the follow up period no significant difference was observed between the two groups. Although mean SDS for height was below normal it turned out to be lass negative than for weight (Fig. 3).

While the coeliac group responded by a marked increase in height velocity to the gluten free diet, in children showing a TGE it remained practically unchanged. This unresponsiveness of linear growth to the gluten free diet points towards a cause of growth failure rather than that of gluten sensitivity.

It is of interest – but difficult to explain – that while in this group of children linear growth did not respond to a gluten-free diet, weight for height showed an appreciable increase suggesting marked changes in body composition. It should be pointed out that the rapid catch up growth in response to a gluten-free diet convincingly shows that this group of children suffered from real a gluten sensitivity, that is, from coeliac disease.

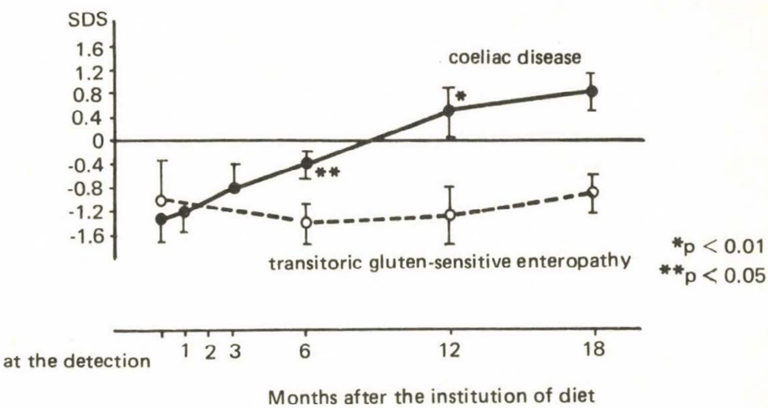

Fig. 2: Standard deviation scores (SDS) and standard errors (SE) for weight of children with coeliac disease and transitoric gluten-sensitive enteropathy.

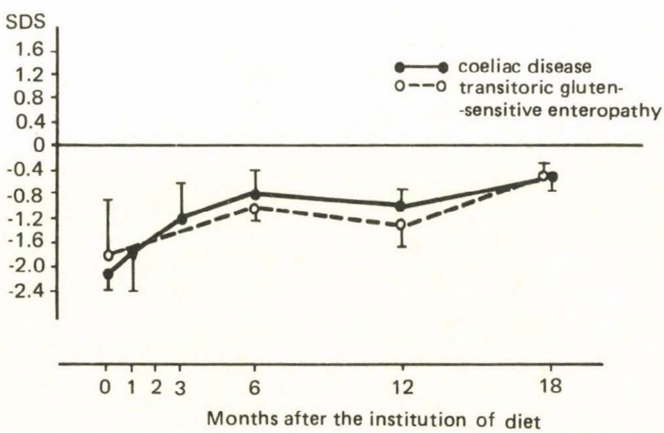

Fig. 3: Standard deviation scores (SDS) and standard errors (SE) for height of children with coeliac disease and transitoric glutensensitive enteropathy.

Finally the authors should like to point out that the patient sample in their study was rather small and further observations are already in progress to investigate the present conclusions on a larger number of children suffering of different chronic diseases.

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ANTHROPOMETRIC CHANGES IN OBESE CHILDREN DURING WEIGHT-REDUCING SUMMER CAMPS

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Abstract: Two groups of obese children (age: 8–16) were camped for two and three weeks, respectively (34 and 57 children). In this period they were on a 1000 kcal daily diet, taking intensive physical exercises twice a day. Fluid intake was limited to 1000 ml. Measurements were taken in a three week camp with a similar program, too, but without restriction of fluid intake (101 children) before and after the camp. The skinfold thickness on triceps, biceps, subscapular and suprailiac was measured. Depending on age, density was calculated by the equations of Brook or Durnin and Rahaman, and fat% and fat content were calculated by the Siri-formula. On the basis of the data measured and calculated the authors analyses the changes in body weight and composition due to the different duration and fluid intake in the camps. The reliability of equations is sought when comparing the data of the two age-groups.

The body weight loss is proportional to the duration of the camp and to the restriction of the diet; the majority of weight loss is derived from body fat loss. It may be supposed that the actual thickness of the skinfold depends on the hydrated status of the organism as well; this fact may modify the value of the fat% determined by the skinfolds.

Key words: Obese children, Weight-reducing camps, Weight-loss, Body fat loss.

Introduction

Obesity is a condition difficult to define; a sort of deviation from the normal body proportion that concerns almost all components, mostly the adipose tissue. Children's obesity cannot be determined by a simple or repeated weighing: a child's weightgain doesn't necessarily mean fatgain, and the improvement in the proportion of the composition does not necessarily mean weight loss. The most significant changes in the growing organism are being brought about at the expense of the total body water. The quantity of muscle and adipose tissue, respectively, increases from time to time more or less as a function of age and sex (Friis-Hansen 1971), and in compliance with it the specific gravity (density) is also determined (Pařízková 1961).

The specification of body composition can be done by several methods. However, the invasive character of these methods rises paralell with their reliability and they require laboratory or hospital background. In general medical practice an objective method is needed to quantitatively determine the fat content of obese children.

Several investigators examining adult population have found close correlation between fat content assessed by physico-chemical methods and subcutaneous fat quantity. Their finding is that skinfold thickness and density clearly reflect body fat.

Durnin and Rahaman (1967) extended their studies to adolescents of both sexes aged 12 to 16 years, and set up two equations for the description of body density (Density for boys = 1.1533–0643xlog sum of the four skinfold thicknesses; Density for girls = = 1.1369–0.0598xlog sum of the four skinfold thicknesses). Brook (1971) investigated prepuberal obese and short statured children between the age of 1 and 11 years. He has modified the previous equations according to the total body water assessed (Density$^+$ for boys = 1.690–0.0788xlog sum of the four skinfold thicknesses; Density$^+$ for girls = = 1.2063–0.0999xlog sum of the four skinfold thicknesses).

We therefore have methods for assessing changes in fat of obese children imperfect they may be. In evaluating the data we also sought the reliability of methods.

Patients and Methods

During the school holidays we camped obese children aged between 8 and 16 years for two (34 children) or three (57 children) weeks. They were on a daily 1000 calorie (4187 kJ) diet taking intensive physical exercise twice a day. Fluid intake was limited to 1000 ml per day. There was a three week camp with a similar program in Kőszeg (101 children), but without restriction of fluid intake. In these obese children's backgrounds there was no evidence of endocrine disease, their weight-for-hight deviated from that of the normal by +3 SD (Eiben et al. 1971).

Data were collected at the beginning and at the end of camp, precisely 10 and 18 days, respectively. In addition to weighing the children we measured skinfold thickness by Lange caliper. In order to reduce errors in measurement the same doctor measured thickness on triceps, biceps, subscapular and suprailiac. The density of children over 11 years was calculated by the equations of Durnin and Rahaman (D), and those under 11 by the equation of Brook (D^+). Fat% was calculated by the Siri-formula (Siri 1956): Fat(%) = = [(4.95/density)−4.5]x100. The multiplication of weight and the fat% made up the body fat content: Fat (kg) = fat%xbody weight/100.

The homogeneity of the pattern enabled us to concentrate on the degree of changes in weight, fat% and fat loss. The figures demonstrate the differences in data taken at the beginning and end of the camp, 10 and 18 days, respectively.

Results

According to the two different equations we illustrated (Fig. 1) our data separately (groups under 11 and over 11 years). The columns demonstrate the data of the camps. The first column shows the 10 days', the second one the 18 days' camp in the hospital and the third one the 18 days' camp in Kőszeg. By comparing the first two columns we can evaluate the effect of the duration, and by comparing the second and third columns the effect of the fluid restriction.

Looking at the outcome the long-lasting and more restricted fat-reducing diet yields the best result. Note, in the fat loss there is no significant difference ($p=0.54$) between these two groups: 18 days' > Kőszeg'.

Interestingly enough in the fat%-loss we discover significant difference ($p=0.03$) in the only group where the fat loss compared to the weight loss was not significant – remember the previous note (Fig. 2). And in addition, the value of the fluid restricted 18 days' group was lower than that of the liberal Kőszeg group: 18 days' < Kőszeg'.

This raises the suspicion that the mean values of fat loss are misleading. Therefore, we analysed the fat change individually, and compared the body fat loss to weight loss.

In the under 11 group we got relatively high values (Fig. 3). Twice as many children in a 10 days' period gained lean body mass than during a 18 days' period. It seems to be unrealistic. The value of about 40% of the Kőszeg camp seems rather unreal only in relation to the other age-group; in the second group there are only two children each per camp. Does the unbelievable fat loss calculated by the Brook equation show any relation to something?

In order to get an answer to the question raised we sought a connection with the other data available. The weight-for-height turned out to be indifferent. Definite correlation was discernible by the analysis of the fat%-change in fluid restricted camps (Fig. 4).

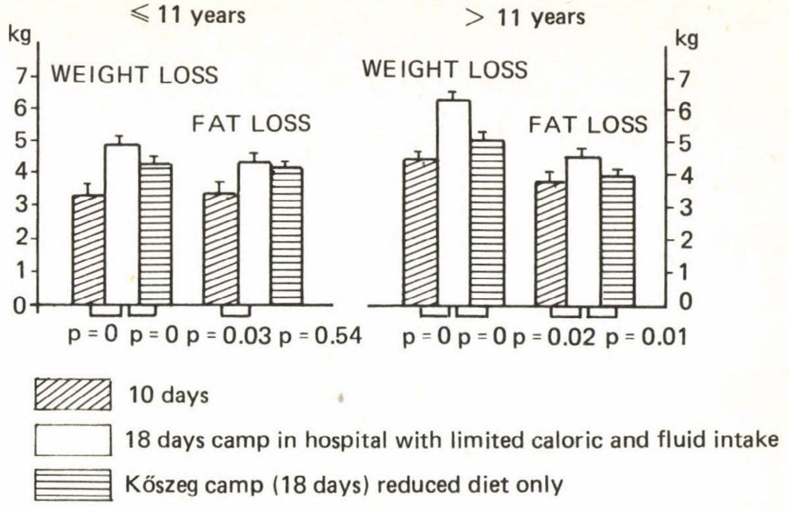

Fig. 1: The degree of the weight loss measured and that of the fat loss calculated at the end of the camps

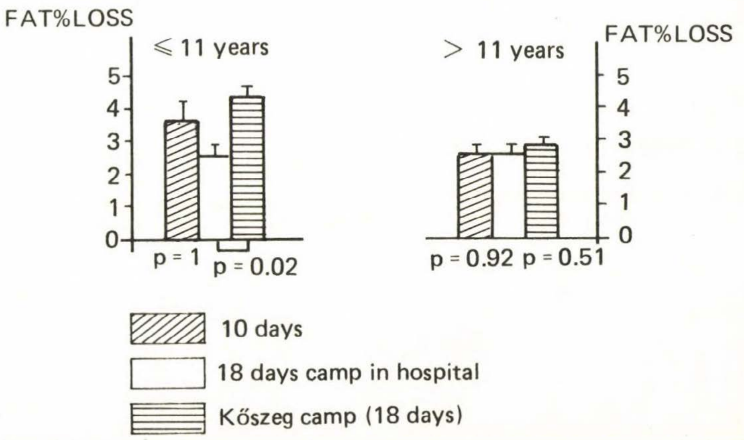

Fig. 2: The degree of fat%-loss at the end of the three different (see above) camps

Firstly we divided the children into two groups on the basis of the relation between body weight loss and fat loss. We than analysed the fat%-loss of the separated groups. We found that in the critical groups (fat loss > weight loss) of the 10 days' camp fat% values move between 3.3 and 8.0, and no cases belonging to the other group has 3.3 or higher value in fat%-loss. Similar correlation was found in the 18 days camp, but the limit is in the fat%-loss at 5.5 However, though the correlations seem to be similar, note that the distances from mean values are different.

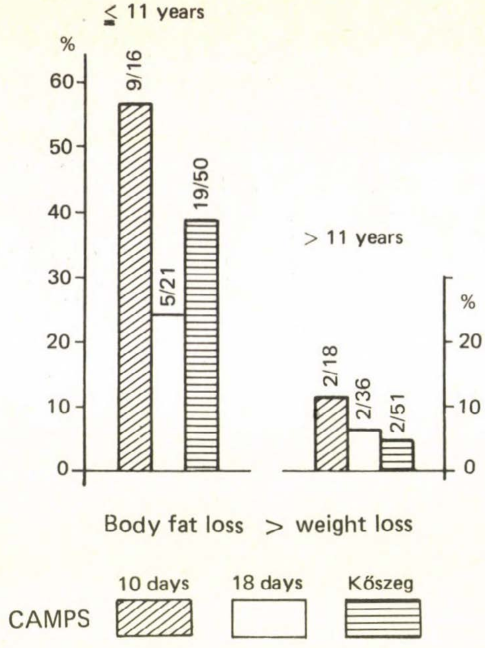

Fig. 3: The cases where fat loss exceeds weight loss compared to the total number of the children in the camps.

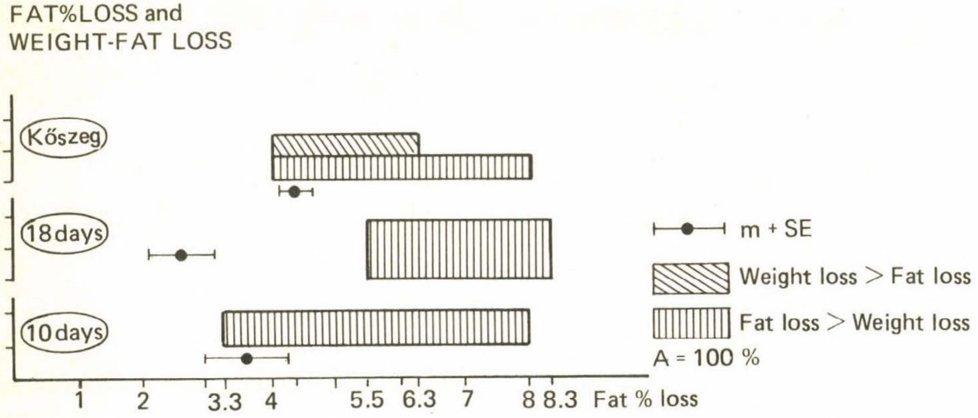

Fig. 4: The correlation between the fat%-loss and the fat loss compared to the weight loss

Conclusions

1. In summerising the weight changes we may state that the primary aim was achieved. The children lost weight depending on the time factor and on limitation of fluid intake. The majority of their body weight loss came from fat loss.

2. Concerning the skinfold change on the basis of fat%-loss (Kőszeg' > 10 days' >

> 18 days') we may admit: *(a)* the skinfold change is independent of fluid restriction (Kőszeg' > 18 days'), and *(b)* the skinfold of obese children contains some other material with a quicker turn over than fat (e.g. water).

3. Analysing the cases where fat loss exceeds body weight loss, and

4. comparing these to the fat%-loss raises the suspicion that unreal fat loss may perhaps derived from water loss.

The validity of the two equations of Durnin's and Brook's are different, which queries the reliability of the data calculated. We concluded that at the next investigation we have to extend our research over the water balance of obese children as well: The reason for this is that we suppose the thickness of skinfold is partly a result of the hydrated status of the organism. This will give a definite answer to the question in so far as the usefulness of the equations is concerned.

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ON VARIATIONS OF HEAD CIRCUMFERENCES IN VRŠAC CHILDREN AND ADOLESCENTS

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Abstract: The author studied variations of head circumference in 1503 children and adolescents aged 7–18 years, both sexes, in Vršac (Vojvodina). The head circumference is found to increase with age in both sexes. The difference between the means is statistically significant in favour of the males in all ages except for the 11 and 12 year-old groups. The head circumference of seven year-old boys is larger than in girls of the same age. The same is also true for 18 year-old age-groups. The greatest precent increase of the head circumference is in 14 year-old boys and in 11 year-old girls.

Key words: Head circumference, Adolescents, Vršac.

Two decades ago we pointed out the great importance of assessment of the head circumference both from the theoretical and practical aspects. Its variations are important as for human evolution as well as for the manufacture of caps, hats and berets. It is particularly important for the army needs paying a special attention to these examinations. This kind of studies is a constituent part of applied anthropology of which major goal is an application of the results obtained to everyday practice.

According to our earlier studies on the head circumference in children, adolescents and adults (Gavrilović and Štambuk 1966), this parameter increases until the age of 18 years, with a sexual difference before 10 and after 20 years of age.

The head circumference in schoolchildren in Vršac ranged between 52.9 and 56.0 cm in boys and between 52.2 and 56.7 cm in girls according to earlier studies (Štambuk 1937), and there was only one case with a too small size of 48 cm at the age of 11 years. Except for the age of 14 years, the head circumference on average was greater in boys than in girls.

Our study was aimed to establish the variations in the head circumference among children and adolescents within the period 7–18 years of age.

Material and Methods

The sample included 1503 children and adolescents of both sexes, aged 7–18 years. The head circumference was measured with a centimetre tape by Martin's anthropometrich technique (Martin–Saller 1956). The means and standard deviations were calculated for the data obtained on a Texas instrument digital computer TI–51–III. The differences between the means were tested by the t-test. The tempo of an increase represents the annual growth rate.

Results

In Table 1 the means of the head circumference by sex and age are presented.

As it is seen from Table 1, the means for the head circumference increase with advancing age, for its maximal value in male adolescents (57.11 cm) and female adolescents (54.82 cm) at the age of 18 years. The largest variability in this parameter is in 12 year old boys and 11 year old girls. In the age-troups studied the head circumference ranges be-

Table 1. Head circumference of children and adolescents according to age and sex

Age (year)	Boys				Girls				t
	N	x̄	s	Min-Max	N	x̄	s	Min-Max	
7	46	52,30	1.35	50–56	64	51.30	1.60	47–55	4.08
8	63	52.76	1.50	49–56	50	51.61	1.27	49–55	4.42
9	53	53.04	1.53	50–57	62	52.22	1.37	49–56	3.04
10	58	53.59	1.46	51–57	61	52.70	1.26	51–55	3.56
11	76	53.68	1.43	50–58	63	53.38	2.09	50–57	0.97
12	66	54.33	1.79	50–59	58	54.02	1.81	50–57	1.00
13	53	54.77	1.75	51--58	63	53.94	1.67	51–58	2.59
14	50	55.60	1.63	53–59	60	54.35	1.72	51–59	3.90
15	56	56.18	1.49	53–59	103	54.72	1.57	51–58	5.84
16	57	56.73	1.55	54–60	41	54.76	1.56	52–58	6.15
17	111	56.67	1.48	53–61	64	55.10	1.39	52–58	7.13
18	64	57.11	1.48	54–60	61	54.82	1.52	52–59	8.51
Total N	753				750				

tween 50–60 cm and 47–59 cm in boys and girls, respectively. The sex differences for the head circumference exist in all ages in the period studied except for 11 and 12 year-old individuals.

Fig. 1 illustrates the trend of the means for the head circumference by sex and age. In male adolescents the head circumference is larger at all ages in comparison with female adolescents. The smallest difference is observed at the age of 11 and 12 years and, as previously emphasized, it is not statistically significant. The highest growth intensity for the head circumference is in 14' year-old boys and 11 year-old girls (Fig. 2).

Discussion

In this study the author presented the variations of the head circumference in Vojvodina children and adolescents. Thus, he confirmed the earlier findings of Štambuk (1937) for that town, i.e. the means of the head circumference increase with advancing age in both sexes, and they are larger in male than in female individuals.

With regard to the data on the head circumference of adolescents in Belgrade, however, there are sex differences in dimorphism. In Belgrade we have found the differences by sex before the age of 10 and after the age of 18 years (Gavrilović–Štambuk 1966). In this study the differences observed between male and female children do not seem to be statistically significant except in 11 and 12 year-old persons.

The present study indicates that the head circumference in children and adolescents ranges similarly within the variants as they did 20 and 50 years ago.

We consider that a comparison of these data will be interesting after exchange of some generations.

The practical implication of the present investigation is to offer the percent variability of this parameter within the minimal and maximal value ranges.

Conclusion

Based on the data presented in this paper, the following conclusions can be drawn:

1. The head circumference increases with an advancing age in both sexes.

2. The differences in the means between male and female adolescents are statistically significant in favour of the males, except for 11 and 12 year-old individuals.

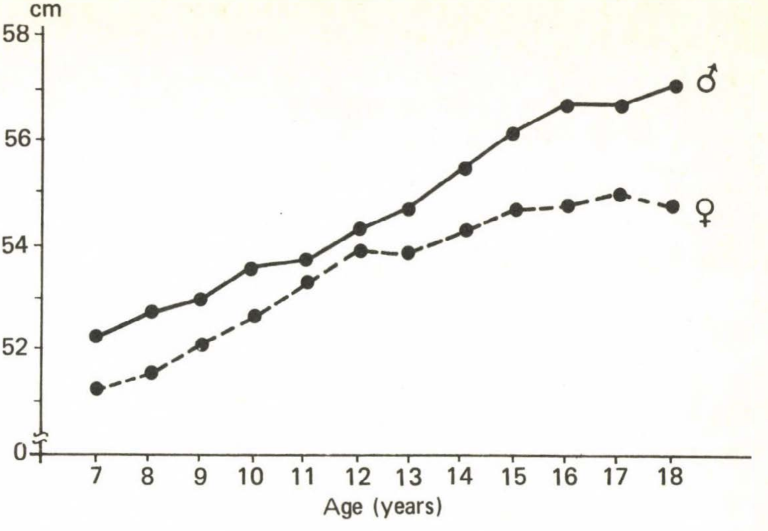

Fig. 1: Changes of head circumference according to sex and age

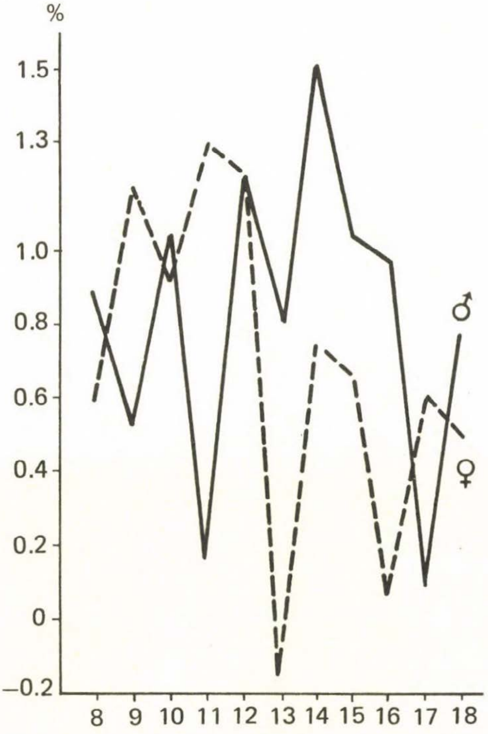

Fig. 2: Percent annual increase of head circumference

3. The highest growth intensity for the head circumference is in 14 year-old boys and 11 year-old girls.

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GROWTH AND DEVELOPMENT OF PUPILS IN DEBRECEN (EAST HUNGARY) BASED ON CROSS-SECTIONAL AND LONGITUDINAL STUDIES

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Abstract: The authors performed a cross-sectional growth study on nearly 8500 pupils aged 7–18 of primary and secondary schools in Debrecen between 1973–76. 524 of them were 7–8 year old, repeatedly measured until they became 18. The mean values of body measurements (height, weight, chest circumference in normal position, in inspiration and expiration, upper arm circumference, hand strength and vital capacity) of the longitudinal study were compared to those of the original cross-sectional study. The differences were described. Percentiles of the values characteristics of children growing up at the present time in Debrecen, obtained in the longitudinal study are reported.
Key words: Longitudinal growth study, Body measurements, Functional characteristics.

Introduction

Debrecen is a town with 200 000 inhabitants. We have been observing the pupils' growth with repeated cross-sectional and two longitudinal studies in this town. Our first cross-sectional examination (Cs1) was performed 20 years ago, between 1966–69 and it was carried out on over 6000 school children aged 7–16 years (Szöllősi et al. 1970, Szöllősi–Jókay 1978, Szöllősi 1981a). The 7–8 year-old pupils were then examined by being remeasured till their age of 18 (L1). Comparing the data obtained in such a way, a great acceleration of the growth was found. In the boys: stature +10 cm, weight +8 kg, chest circumference +8 cm at the age of 16. In the girls' stature and weight, significant differences formed only from the age of 13 and 14 and they represented only 1–3 cm and 1.5–1.8 kg, respectively. In their chest circumference, however, a remarkable shift forward in development could be observed already from the age of 9. The greatest difference was at the age of 12: nearly 6 cm. The results of the comparison were demonstrated at the EUSUHM Congresses held in Amsterdam (Szöllősi 1981b) and in Budapest (Szöllősi–Jókay 1985).

Having obtained these findings we were interested in how long the strong rise of growth lasts?

Material and Methods

Between 1973–76 we performed a second cross-sectional study (Cs2) on nearly 8500 pupils of Debrecen aged 7–18 by Martin's technics (Martin–Saller 1957–66). The 7–8 year-olds (259 girls and 265 boys) were then followed by being remeasured till the age of 18. Now we demonstrate the differences comparing the findings of these two studies.

Results and Discussion

The *boys* followed in our second longitudinal study (L2) got somewhat shorter *stature* at the age of 10 and 12 and taller for 17–18 than those in Cs2. Their *weight* is less

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($p < 5\%$) from 9 to 12, but from 15, it is more than that of the ones in Cs2 ($p < 1$ and 0.1%, respectively) (Fig. 1). The *chest circumference* hardly differs from the Cs2 till the age of 14 but from 15 it is significantly bigger except at the age of 17. The vital capacity is lower till the age of 14 and from 15 it is significantly higher than in Cs2 ($p < 5$, 1, and 0.1%) (Fig. 2). The chest circumference in maximal inspiration is larger between 12–16, finally, however, it is nearly identical with that of the Cs2. The reason for the vital capacity growing higher is that the chest circumference in expiration became smaller at 17–18 (Fig. 3). In such a way the breathing deviation of the chest grew larger and consequently their breathing technics improved (strengthening of the expiratory muscles).

In the *upper arm circumference* no significant change was brought about and the *hand strength* was measured only in the L2 study. Therefore only the L2 data are demonstrated in Fig. 4. The upper arm circumference grows at a strong rate between 8–17, however, the hand strength runs parallel with it only to the age of 14. From now on its growth rate is strongly left behind. Boys aged from 14–18 are secondary school pupils, most of whom give up regular sport activities during this time. Thus the muscles lack training. It is a functional cause of the lag of the hand strength since their body weight grows at a maximum intensity between 13–16 (see Fig. 1) and it should also mean the gain in the muscular mass of the body.

The *girls' height* is practically the same till the age of 14 then they have become significantly taller than the ones in Cs2 ($p < 2$ or 1%). The *weight* is less between 11–14, from 15, however, it became significantly greater than that of the ones in the Cs2 sample (Fig. 1). The *chest circumference* is significantly bigger between 14–16 but later on it hardly differs from the values observed in Cs2. Here the point is only the shifting of the intensive development of the chest to an earlier age. At the age of 13 the vital capacity is still lower but from 15 it increased to a much higher value ($p < 0.1\%$). It can be seen that it intensively rises after the decreased development of the chest, too (Fig. 2). A shifting forward of the development could be experienced in both the *inspiration* and *expiration* evaluations of the chest as well and similarly to the case of boys the breathing deviation grew here, too (Fig. 3). Till the age of 14, in the same manner as in the case of boys, the enhancement of the girls' *hand strength* follows the growth of the *upper arm circumference*. From this age on, however, a decrease is evident (Fig. 4). It is due to the lack of training as well as to the fact that during this period the increase of subcutaneous fat in girls plays a major role in the increase of the upper arm circumference (Jókay–Szöllősi 1985).

Our cross-sectional and longitudinal studies have produced a lot of information. From them, figures 1–4 manifest that in the case of the L2 study – in contradiction to the L1 – significant deviations were found only in the boys' latter years, in comparison to the Cs2 investigation, in both the body measurements and vital capacity. The differences are not so great at all, unlike those between the Cs1 and L1. In girls the process in the same except in the case of chest circumference, where the development occures at the earlier ages.

It is evident from the comparison of the above data as well as the results of our other observations that the intensified acceleration of the pupils' body development occurred in the period between the two Cs studies performed by us and this intensity has slowed down recently. Therefore it has become possible to state the regularities and norms of the development of the new generation. Tables 1 and 2 demonstrate the percentile values obtained.

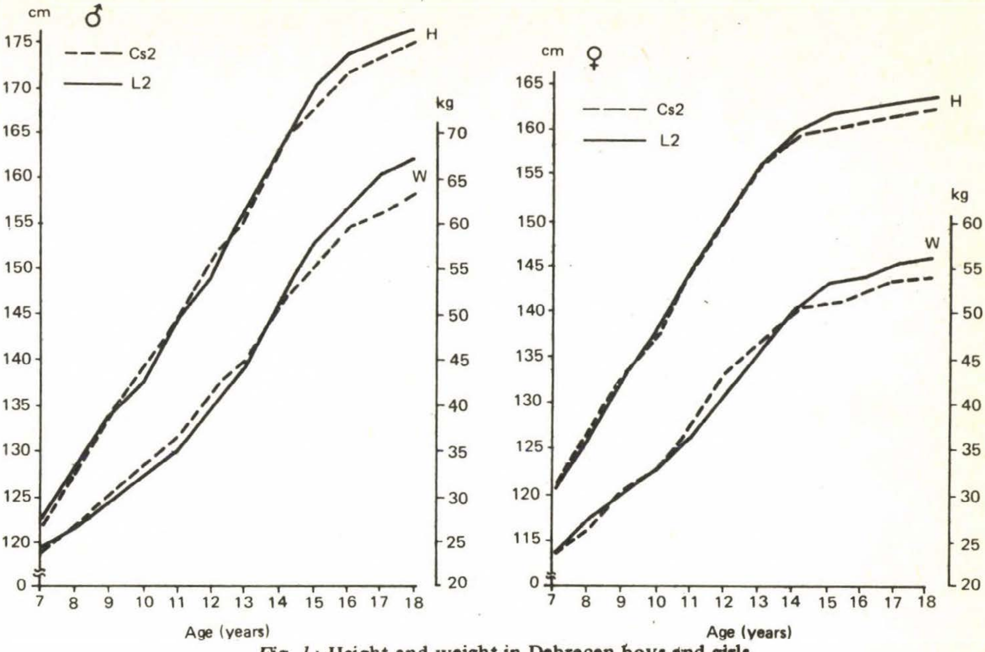

Fig. 1: Height and weight in Debrecen boys and girls

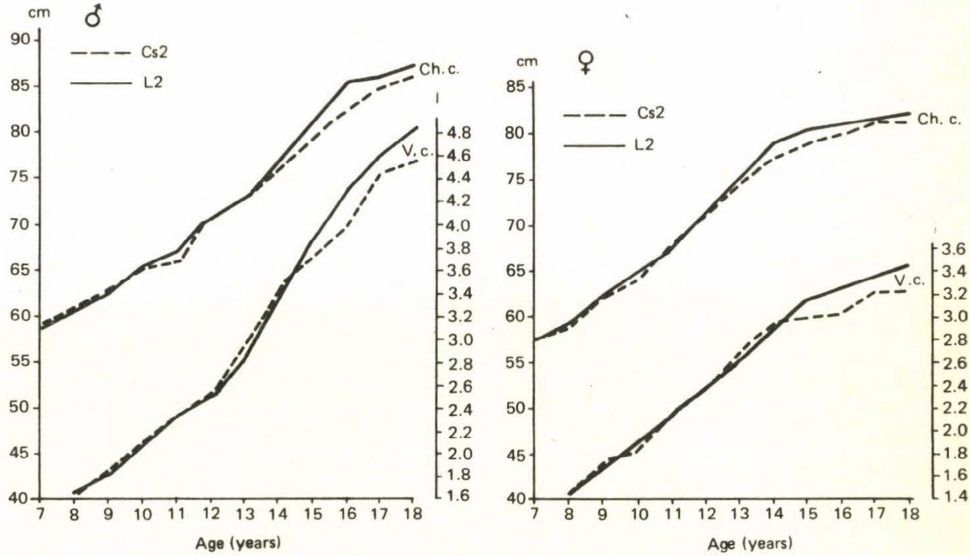

Fig. 2: Chest circumference and vital capacity in Debrecen boys and girls

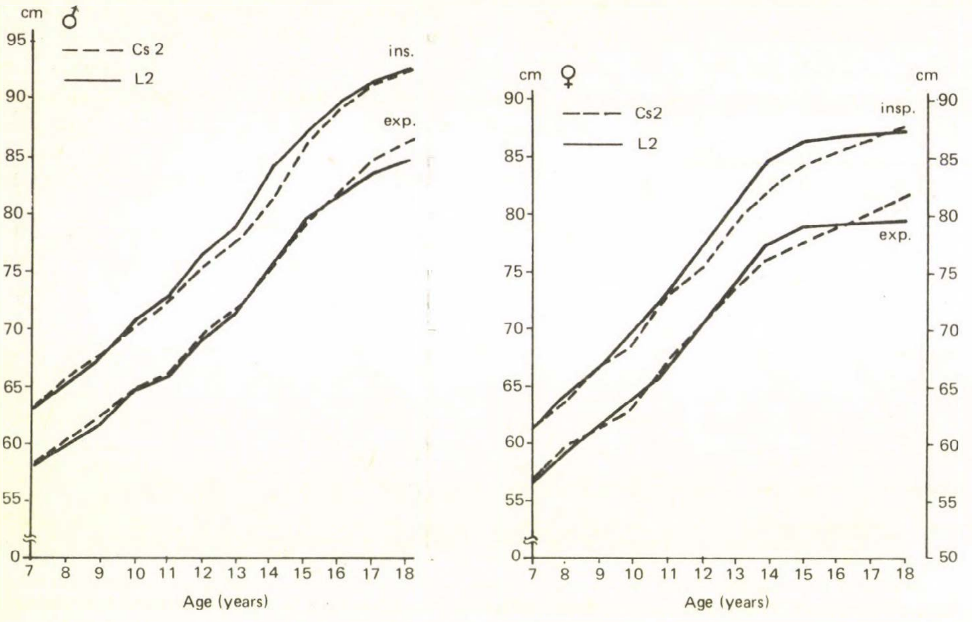

Fig. 3: Chest circumference in maximal inspiration and exspiration in Debrecen boys and girls

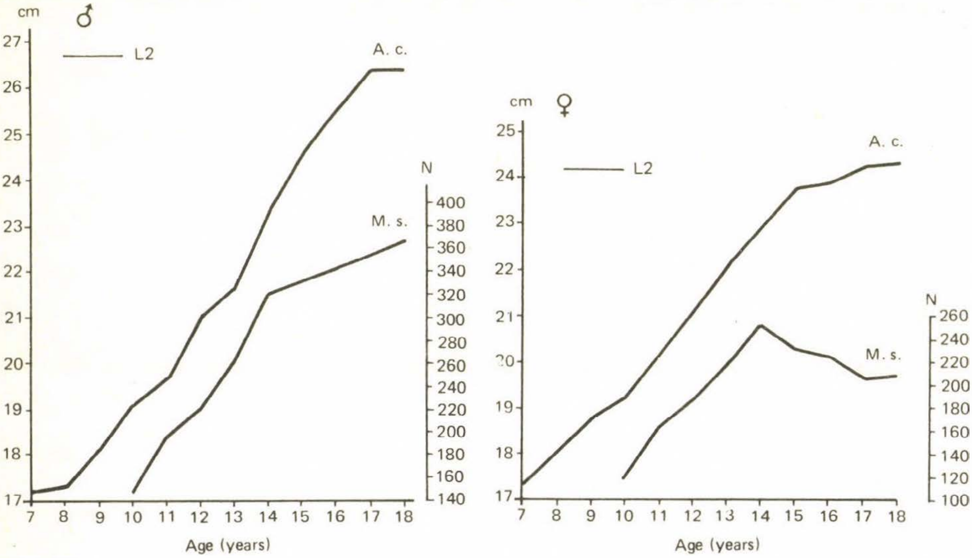

Fig. 4: Upper arm circumference and hand strength in Debrecen boys and girls

Table 1. Percentile values of height (cm) and weight (kg) of Debrecen boys and girls

Boys							Age (year)	Girls						
p3	p10	p25	p50	p75	p90	p97		p3	p10	p25	p50	p75	p90	p97
113.5	115.5	119.0	122.0	126.5	130.5	135.0	7	111.5	113.5	116.0	119.5	123.5	128.0	131.0
117.5	121.0	124.7	127.2	131.5	135.5	140.2	8	115.5	120.0	123.0	127.0	130.5	134.5	137.0
124.0	127.5	129.5	133.0	136.5	141.0	144.0	9	124.0	126.5	129.0	132.0	136.5	140.5	143.0
127.5	131.0	133.2	137.5	141.5	145.5	150.0	10	126.0	129.0	133.5	137.5	142.5	146.0	149.5
132.0	136.0	139.0	142.5	147.0	152.5	157.5	11	132.0	135.0	139.5	144.0	150.0	154.0	156.0
136.0	139.5	144.0	149.0	153.5	160.0	163.0	12	137.5	141.0	146.5	150.5	155.5	159.5	164.0
141.0	146.5	151.5	155.5	161.0	166.5	170.5	13	144.0	148.0	151.0	156.5	161.5	164.0	168.0
144.5	153.0	158.5	164.0	168.5	175.0	179.5	14	147.0	150.0	155.0	160.5	164.0	167.5	172.0
151.0	159.5	164.7	169.5	174.5	179.5	182.5	15	150.5	154.0	158.0	161.0	165.5	169.0	174.0
158.0	163.5	168.5	173.5	177.5	182.0	185.5	16	151.8	154.7	159.0	162.0	166.5	169.5	173.7
161.3	166.0	170.5	175.0	179.2	183.5	187.0	17	151.5	154.5	159.5	162.5	166.5	170.5	174.0
164.0	167.2	172.2	176.5	180.5	185.0	188.5	18	151.8	154.8	159.5	163.0	167.8	171.5	175.5
19.0	20.0	22.0	24.0	25.0	28.0	34.5	7	17.5	19.0	21.0	22.5	25.0	27.0	29.5
19.5	21.5	23.5	26.0	29.2	32.0	34.0	8	19.0	21.0	23.5	26.0	30.0	33.0	38.0
23.0	25.0	26.0	29.0	31.5	33.5	38.0	9	21.5	24.0	25.5	29.0	32.0	37.0	40.0
24.5	25.0	28.0	31.0	35.0	41.0	46.5	10	23.5	25.0	28.0	32.0	36.5	40.5	45.0
26.0	28.5	30.5	34.0	38.0	44.5	48.0	11	25.0	27.0	30.5	34.5	42.0	47.5	51.0
28.0	30.0	34.0	38.0	43.0	51.5	59.0	12	28.5	30.0	35.0	40.0	46.0	52.5	59.0
32.0	34.0	37.0	42.0	47.0	55.0	63.0	13	33.0	35.0	39.0	44.0	50.5	57.0	65.0
34.0	39.0	44.0	50.5	60.0	65.0	73.5	14	35.0	40.0	44.0	50.0	55.0	61.0	66.0
41.0	45.0	50.0	57.0	62.0	69.0	81.0	15	41.0	43.5	48.0	52.0	58.0	63.0	66.0
46.0	51.0	55.0	61.0	67.0	74.0	84.5	16	41.0	45.0	48.5	52.5	58.0	64.0	68.0
49.0	54.0	58.5	64.5	70.0	76.0	86.0	17	44.0	47.0	50.0	54.0	59.0	66.0	69.0
52.0	57.0	60.5	66.0	72.0	79.0	87.0	18	43.0	47.5	50.5	55.0	60.0	66.0	73.0

Table 2. Percentile values of chest circumference (cm) and vital capacity (lit.) of Debrecen boys and girls

Boys							Age	Girls						
p3	p10	p25	p50	p75	p90	p97	(year)	p3	p10	p25	p50	p75	p90	p97
54.0	55.0	56.0	58.0	60.0	62.0	69.0	7	52.0	54.0	55.0	57.0	59.0	61.0	66.0
54.0	56.0	58.0	60.0	63.0	65.0	66.0	8	53.0	55.0	57.0	59.0	62.0	67.0	72.0
57.0	58.0	60.0	62.0	65.0	67.0	69.0	9	55.0	57.0	59.0	61.0	64.0	69.0	71.0
58.5	60.0	62.0	65.0	68.0	72.0	80.0	10	57.0	58.0	60.0	64.0	67.0	72.0	79.0
60.0	62.0	64.0	66.2	69.5	73.0	77.0	11	58.5	60.0	63.0	66.0	70.5	76.0	80.0
62.0	63.0	67.0	69.0	74.0	80.0	86.0	12	61.0	64.0	67.0	71.0	75.0	80.0	85.0
63.0	66.0	69.0	71.0	75.0	81.0	87.0	13	64.0	67.0	71.0	74.0	79.0	83.0	91.0
65.0	69.0	73.0	76.0	81.0	88.0	91.0	14	68.0	71.0	75.0	78.5	82.0	86.0	93.0
69.0	72.0	77.0	80.5	85.0	89.0	96.0	15	72.0	74.0	77.0	80.0	83.0	87.0	94.0
73.5	76.0	80.0	83.0	87.0	91.0	97.0	16	72.0	75.0	77.0	80.0	84.0	89.0	96.0
75.0	79.5	81.0	86.0	89.0	93.0	99.0	17	73.0	76.0	78.0	81.0	84.0	88.0	92.0
77.0	80.0	83.0	86.0	90.5	94.0	100.0	18	73.0	76.0	78.0	81.0	84.0	89.0	94.0
1.13	1.27	1.46	1.60	1.83	2.03	2.30	8	1.00	1.07	1.29	1.44	1.70	1.84	1.93
1.20	1.45	1.62	1.79	2.02	2.23	2.48	9	1.27	1.36	1.54	1.71	1.86	2.07	2.22
1.51	1.66	1.87	2.05	2.30	2.50	2.71	10	1.33	1.43	1.64	1.88	2.02	2.21	2.55
1.74	1.89	2.06	2.29	2.51	2.78	3.06	11	1.38	1.75	1.93	2.11	2.41	2.66	2.84
1.69	1.96	2.19	2.47	2.83	3.10	3.33	12	1.40	1.68	2.07	2.31	2.69	2.98	3.22
2.06	2.28	2.48	2.72	3.18	3.57	4.02	13	1.79	2.01	2.29	2.55	2.82	3.23	3.39
2.16	2.41	2.83	3.26	3.84	4.43	4.68	14	1.96	2.15	2.50	2.94	3.26	3.48	3.67
2.48	2.96	3.39	3.83	4.37	4.88	5.29	15	2.31	2.51	2.84	3.12	3.46	3.72	4.16
3.02	3.39	3.90	4.26	4.69	5.26	5.70	16	2.49	2.68	2.97	3.26	3.60	3.86	4.16
3.16	3.70	4.09	4.59	5.04	5.51	6.03	17	2.50	2.80	3.02	3.36	3.70	4.03	4.46
3.51	3.94	4.30	4.78	5.27	5.70	6.36	18	2.57	2.80	3.11	3.44	3.81	4.10	4.50

Summary

In their former investigations of the Debrecen children, the authors had found that the pupils' growth had accelerated at a great rate. They therefore performed a new corss-sectional study on more than 6000 pupils from the town aged 7–18 years in 1973–76. They then investigated the 7–8 year-old boys and girls (524 pupils) by remeasurings till their age of 18. Comparing the data of the pupils followed longitudinally to those of the ones in the latter cross-sectional study they observed a decrease of the highly accelerated development.

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DESCRIPTION OF THE RESEARCH PROJECT „HEALTH AND DEMOGRAPHIC STUDY OF PREGNANT WOMEN AND INFANTS"

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Abstract: The authors report on the effectuation of comprehensive longitudinal survey. In the first stage of the survey, by means of regularly visiting the sample of a 2 per cent national representative of pregnant women, information was collected on the exogenous and endogenous factors which may affect the condition of the pregnant women and the outcome of pregnancy. In the second stage, the longitudinal survey concerning the growth of the live-born children of the observed pregnant women took into consideration the children's health condition, social circumstances as well as the factors exerting an influence during pregnancy and the conditions of confinement.
Key words: Prenatal care, Health, Socio-economic factors, Affecting the course, Outcome of pregnancy, Longitudinal survey of children, Diseases influencing the growth, Nutrition.

Introduction

The first scholarly study of growth connected with the name of Stöller, J. A. was published in 1729 and the first study of bodily development containing the first data on body measurements by Jambert, Ch. F. appeared in 1754 (Tanner 1985). Thus, it is more than two hundred years that man has been trying to acquire a more profound knowledge of the dimensional changes of human ontogenesis and its relationships with physiological and environmental factors.

The significance of the study to be described now may be highlighted by its two important features:

– the study is being carried out on a 2 percent representative national sample;

– the longitudinal study begins not at the newborn-age but at the earliest possible time of the pregnancy with the continuous monitoring of the pregnant woman.

The Preliminaries of the Study

Following the idea of the study formulated by J. Nemeskéri, in 1970 the group of the cooperating institutions which even now work jointly in order to realize the research project was outlined in 1971. These institutions are as follows: the Demographic Research Institute of the Central Statistical Office, the Department of Population Statistics of the Central Statistical Office, the National Institute of Infants' and Children's Health and the Section of maternal, child and youth welfare of the Ministry of Health.

The measuring instruments necessary for the countrywide study – and meeting also international standards – were prepared on the basis of the experiences obtained from the pilot study that had been carried out in 1975.

The first stage of the study began in November 1979 by including pregnant women into the sample and then, in June 1980, the second phase of the study, the study of the development of infants and children was started with the examination of the first live-born babies of those pregnant women who had been included into the sample. The duration of the inclusion of the pregnant women was 3 years.

The Aim of the Research Program
„Health and Demographic Study of Pregnant Women and Infants"

The aim of the research program, because of its interdisciplinary character, is manifolded. According to its structure the aim of the study can be formulated in three sets of relationships:

Questions related to the preliminaries, course and outcome of the pregnancy

– The relationship between the disease medication, x-ray examination and other radiation burden on the woman examined during the preconception and periconception period, the number and outcome of her previous pregnancies, the time which has elapsed since the previous obstetrical event, the quantity of alcohol consumed, smoking, the diseases of the husband, the quality of the relationship between the spouses,etc. on the one hand and the course and outcome of the pregnancy on the other.

– The investigation into the relationship between exogenous influences on the pregnant women during the various periods of the prenancy (physical and nervous burdens at the place work, at home, and during commuting,etc.), endogenous causes and impacts (the effect of possible genetic damage, diseases, medicaments, chemicals, radiation, immune reactions,etc.), the degree of smoking and alcohol consumption, changes in the relationship with the human and physical environment on the one hand and the course and outcome of the pregnancy (perinatal complications, live births, foetal deaths, low birth weight and/or premature birth,etc.) on the other.

The investigation results obtained from the many-sided analysis of the above relationships are expected primarily to provide a more reliable basis to specify these ones of certain diseases, environmental and social factors, harmful effects which make it probable, by themselves alone or jointly, that pregnancies do not end in live births, and to outline the degree of the respective probabilities. It is important discover during which prenatal periods the appearance of the above harmful effects is the most dangerous.

The investigation into infant and child development and into the diseases, environmental etc. circumstances having an impact on it

The body development and growth of liveborn children of observed women are studies from the birth on wards with a longitudinal method.

Our aim is to work out and publish standards worthy of being used as references on the basis of the investigated data of body measurements for a better and more accurate evaluation of the rate and extent of growth characteristics of the various ages.

For establishing of standards to be used in practice, only the data of those children are used who were born with a weight of 2 500 to 4 500 g, and who are not suffering from diseases with a duration of more than 60 days (e.g. from acute diseases having become chronic) or from diseases having an impact on the rate and extent of the growth and development.

In the case of groups excluded from the above standard we investigate the retardation in development, as compared to the development of the so-called physiologicals, due to low birth weight or disease or to the joint impact of these two factors.

We investigate the problem of what joint or individual impact more frequent diseases or groups of diseases, what family and social environmental factors have on the rate and extent of the growth and development.

Our aim is also to investigate the relationship between nourishment, and primarily feeding with and without the mother's milk on the one hand, and the extent of development and growth as well as the incidence of diseases on the other.

The relationship between the course and outcome of the pregnancy and the delivery process on the one hand and the newborn condition of the child and its development at the infant age on the other

In this set of relationships we essentially study which factors among those mentioned under item 1 have an effect on the development and growth of the child at the newborn age and then at the infant age, and to what extent. Further, we investigate the conditions and the duration among and, respectively, during which harmful influences appearing during the foetal period or at birth have an impact on the rate and extent of the development.

Do the above-mentioned harmful influences effect they way the infant is being fed (feeding with and without mother's milk) on the evolution of its general health condition?

The System of the Repeated Data Collection

One of the preconditions of the realization of longitudinal studies is the collection – repeated by specific periods – of data and information related to the same individual.

At the stage of the collection of data on pregnancy the first data collection was performed simultaneously with the inclusion of the pregnant woman into the care-provision, during about the 9th week of the pregnancy.

The dates set for the repeated data collections: during the 20th, the 27th and 34th week of the pregnancy (as of the first day of the last menses) as well as subsequent to the end of the pregnancy.

The repeated examinations of the stage of the study of infant and child development follow one another according to the following: Examination at the newborn age: at the age of 24 to 48 hours. After that: at the age of 30, 60, 90, 120, 150, 180, 240, 300 and 365 days, respectively. Between the ages of 1 to 2 years: at the age of 15, 18, 21 and 24 months, respectively. From the age of three years, once a year on the child's birthday.

Questionnaires and Data Sheets of the Study

The questionnaires of the data survey (data sheets) must be constructed in a way that as far as it is possible all the information could be obtained which presumably contribute to the realization of the set aim.

The questionnaire „Data sheet on pregnancy" breaks down into six chapters. Chapters 1 includes basic data, the questions regarding the state of health and conditions of the pregnant woman and possible damaging influences; chapters II to V include the repeated questions. Chapter VI gives information on the outcome of the pregnancy.

The questionnaires and data sheets regarding the child are as follows: „Data sheet on the infant „A I" and „A/2" contain the data regarding the state of health of the newborn after birth and the antrometrical data.

The „Data sheet on the infant" „B" and „C" include general data on the infant as well as the anthrometrical data measured at the repeated examinations, the diseases diagnosed, medicaments taken and the data on nourishment, etc.

The data sheet on the infant signed „D" has the title „Demographical and environmental data and the state of health of the parents and of the child between the age 1 to 2 years ".

The title of the data sheet „E": „The examination of the child's development and state of health at its age of 3, 4, 5 and 6 years, respectively".

As to their contents the data sheets „D" and „E" are essentially identical with the data sheets „B" and „C" except for the chapter on nourishment which is lacking in the first.

The Present State of Research

The stage of data collection dealing with the study of pregnant women ended in August 1983. Then the preparation of the data for processing by computers began, which followed by the fixation of data, and at present computer table designs are under preparation for a comprehensive paper. In 1982 a preliminary paper was issued on the basis of part figures (Gárdos 1982).

Of the 8800 completed pregnancies included in the sample 8333 ended with live births. With the study of the liveborn children at the age of newborn the second stage of the project began: the study of the growth of the children which has been in process since that time.

The data of the growth study is processed by phases. We first intend to prepare the growth standards of infancy. It will be published presumably in 1986.

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CHANGES OF TOTAL BODY WATER DURING ADOLESCENT GROWTH

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Abstract: Total body water was determined on 26 boys and 21 girls and on 40 boys and 45 girls attending Junior and Senior High Schools, resp. The same volunteers were studied for a period of 3 years. Approximately 10 ml of D_2O (99.8%) was given orally and urine samples taken 3 and 4 hours after equilibration period were used for determination of the ratio of heavy hydrogen to normal hydrogen by mass spectrometry according to the procedure described by Solomon et al. (1950). Total body water was calculated as proposed by Schloerb et al. (1950).

The height of boys aged 12 to 13 years increased from 159.1 cm to 177.7 cm at age 17 and 18 years. The girls' height changed from 158.5 cm to 165.7 cm, resp. Similarly, the weight of boys increased concomitantly from 49.4 kg to 66.1 kg whereas the girls' weight increased from 49.0 kg to 58.3 kg, resp.

Total body water of boys aged 12 to 13 years and expressed in absolute values increased from 31.9 liters to 43.3 liters determined in boys 17 to 18 years old. Similar changes of smaller magnitude occurred in girls where TBW of 29.0 liters to 31.9 liters was determined during the same period of time. In relative terms, TBW of boys increased slightly from 62.1% to 65.9% which was reached at the age of 15 to 16 years and then a slight decrease to 64.2% was found in boys 17 to 18 years old. The girls showed continuous decrease in relative values of TBW from 60.3% to 53.6% during the same period of time.

Regression equations with correlation coefficients provided evidence about linear relationship of TBW with weight in boys (r=0.92) and similarly in girls (r=0.77) with the smallest standard deviations of 2.7 liters and 2.1 liters in boys and girls, resp.

Key words: Total body water, Height, Weight, Adolescent boys and girls.

Introduction

During the past three decades, studies of body composition have enhanced greatly the understanding of tissue changes which occur during human growth. Most particularly, the periods of growth, during which the growth velocity changes rapidly, are holding specific attention of most researchers. The first two years of postnatal life and the adolescent period are the prime examples of major growth changes which, under influences of various hormones, provide fascinating scenario for investigations into the intricate maze of body tissue variations.

Total body water is the largest compartment of the body. Fat-free mass seems to hold 73% of water approximately while body fat is practically anhydrous (Brožek 1963). Consequently, the changes of fat-free body and body fat will be reflected in changes to total body water. This relationship has been documented in adults of both sexes (Steele et al. 1950, Edelman et al. 1952, Moore et al. 1963). However, changes of total body water in children and in adolescents have been documented sparingly (Friis-Hansen 1956, Novak 1966, Mellits and Cheek 1968).

This study was designed to enhance understanding of adolescent period as far as lean tissues are concerned in both sexes, using total body water as the variable which would demonstrate variations in the ratio of lean to fat tissue with advancing years during adolescent growth spurt.

Subjects and Methods

The subjects for this study included 59 twelve year old boys and 59 twelve year old girls from junior high school and 40 fifteen year old boys and 45 fifteen year old girls from senior high school. The ages are as of the beginning of the study. All subjects were studied for three consecutive years. They were healthy and of a middle-class socio-economic background. The subjects were given orally one gram of D_2O (99.8%) per kg of body weight, with an additional 100 ml of tap water. After the equilibration period of D_2O to normal water elapsed (±two hours), the subjects emptied their bladders. Then two urine samples at three and four hours were collected and aliquots analyzed for the ratio of hydrogen from D_2O to hydrogen of the H_2O by mass spectrometry. The calculations of volume distribution of total body water was done according to the procedure suggested by Schloerb et al. (1950).

Results

The means for heights of the boys and girls are presented in Table 1. These mean values for both sexes correspond well, to the 50th percentile, of the standards compiled by Stewart and Meredith (1946) for American children. The velocity curve for height of boys provided us with the usual magnitude of height increase as the boys advanced in age, i.e. an increase of 7.3 cm, 5.3 cm, 3.4 cm and 1.4 cm, respectively. Thus, the possible maximal increase in height or peak velocity between ages 12 to 13 years was documented. Decrease in height velocity thereafter occurred.

Table 1. Heights and Weights of Adolescent Boys and Girls

Age		Height (cm)		Weight (kg)	
(years)	N	Mean	S.D.	Mean	S.D.
		BOYS			
12–13	59	159.1	±8.2	49.4	±10.8
13–14	59	166.8	±8.7	55.2	±11.3
14–15	54	172.1	±8.0	60.1	±11.0
15–16	40	172.9	±8.7	59.4	±9.8
16–17	40	176.3	±7.3	62.8	±8.7
17–18	40	177.7	±7.0	66.1	±9.0
		GIRLS			
12–13	59	159.6	±5.1	49.0	±8.3
13–14	59	162.5	±5.0	52.7	±8.4
14–15	57	164.4	±5.3	55.2	±8.4
15–16	45	164.6	±5.5	56.3	±8.2
16–17	44	165.5	±5.7	56.7	±8.3
17–18	43	165.7	±5.7	58.3	±8.3

On the other hand, in the girls the end of peak height velocity was demonstrated with the height increase of 2.9 cm between ages 12 to 13 years and smaller height additions of 1.9 cm, 0.9 cm, and 0.2 cm, which occurred as the girls advanced in age.

Another interesting and well-known fact was documented when the mean heights of 12 to 13 year old boys and girls were compared. The heights of both sexes at that age were nearly identical. However, after that age, the later spurts in height of boys in subsequent years showed much greater gains as compared to girls.

As far as the weights of boys and girls are concerned, practically the same weights in both sexes were obtained at the age of 12 to 13 years. From that age onwards. the velocity weight curve showed that boys gained 5.8 kg, 4.9 kg, 3.4 kg, and 3.3 kg respectively, as they grew older. On the other hand, the girls showed less of an increase in their weights by 3.7 kg, 3.5 kg, 0.4 kg, and 1.6 kg in subsequent years. The means of vital signs of adolescent boys and girls are shown in Table 2. The heart rates showed a decreasing trend from age 12 to 13 years in both sexes. The heart rate of boys decreased from 74 beats/minute to 62 beats/minute and that of girls from 81 beats/minute to 66 beats/minute, respectively. The slightly higher heart rates of females as compared to males are well-known. Similarly, when the means of the respiratory rates were compared, the girls seemed to have slightly higher breathing rates throughout the age groups.

Table 2. Vital Signs of Adolescent Boys and Girls

Age (years)	N	Pulse Rate/min.		Resp. Rate/min.		Systolic B.P.		Diastolic B.P.	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
				BOYS					
12–13	59	73.8 ±	9.6	15	±2.9	108	±11.1	58	±9.2
13–14	59	68.1 ±	9.0	14	±3.4	109	±12.0	63	±7.1
14–15	54	64.8 ±	8.8	14	±3.3	109	±9.8	63	±7.1
15–16	40	66.2 ±	10.5	14	±2.9	110	±10.4	64	±8.4
16–17	40	63.7 ±	8.6	14	±2.4	109	±8.8	63	±6.3
17–18	40	62.3 ±	9.0	13	±2.3	112	±9.9	67	±9.1
				GIRLS					
12–13	59	80.9 ±	10.2	16	±2.7	107	±10.3	61	±9.9
13–14	59	76.1 ±	10.1	16	±2.7	105	±9.1	62	±7.3
14–15	57	70.7 ±	10.3	15	±3.0	105	±9.0	62	±7.3
15–16	45	73.2 ±	11.4	15	±2.4	108	±8.9	64	±7.6
16–17	44	68.1 ±	10.7	15	±2.5	104	±7.8	64	±7.1
17–18	43	65.9 ±	8.6	15	±2.4	106	±7.9	64	±8.4

The means of blood pressure in boys indicated the well-known trend of continuously increasing blood pressure with age, both in systolic and diastolic blood pressure. Conversely, the blood pressure of girls remained practically unchanged between the ages of 12 to 18 years.

The mean values of total body water in absolute and relative terms are presented in Table 3. The velocity curve for total body water of boys showed the magnitude of increases corresponding to height increases. Thus, the gain in total body water from the age of 12 to 18 years amounted to 4.4 liters, 3.1 liters, 1.8 liters, and 1.5 liters, respectively. Again, the peak velocity of total body water seemed to occur in boys between ages 12 to 13 years and decreasing velocity occurred thereafter.

As far as the girls were concerned, the only increases in total body water of 2.2 liters was noted between ages 12 to 13 years. From that age onwards the mean values of total body water of girls remained unchanged with advanced age.

Sex differences of total body water expressed in absolute values were observed in all age groups. Boys had significantly higher amounts of total body water which varied from 2.9 liters difference at age 12 to 13 years which increased to 5.1 liters, 7.8 liters, 9.6 liters and eventually to 11.3 liters difference between the oldest group of boys and girls.

Table 3. Total Body Water of Adolescent Boys and Girls

Age		Liters		Percent	
(years)	N	Mean	S.D.	Mean	S.D.
		BOYS			
12–13	59	31.9	±5.9	62.1	±6.0
13–14	59	36.3	±5.9	63.5	±6.4
14–15	54	39.4	±5.6	64.0	±5.2
15–16	40	39.0	±5.9	65.9	±3.4
16–17	40	40.8	±5.3	65.1	±3.1
17–18	40	42.3	±5.2	64.2	±3.1
		GIRLS			
12–13	59	29.0	±3.5	60.3	±6.1
13–14	59	31.2	±4.1	59.4	±4.9
14–15	57	31.6	±3.8	58.1	±4.7
15–16	45	31.3	±3.8	56.0	±4.5
16–17	44	31.2	±3.6	55.2	±4.1
17–18	43	31.0	±3.3	53.6	±4.0

The relative mean values of total body water provides an indication about tissue changes which affect the percentage of water as growth advances through adolescent years. At the age group 12 to 13 years the deuterium oxide space – TBW – reached 62.1% and increased up to 64.0% in boys aged 14 to 15 years. Slightly higher percentages around 65.0% were noted in the Senior High School boys and a small decrease to 64.2% was observed in the boys 17 to 18 years. This decrease in total body water coincides with known slight increase in body fat during this age as boys advance towards biological maturity.

The relative mean values of total body water of adolescent girls provided evidence about continuous decreasing trend with age from 60.3% observed at age 12 to 13 years to 53.6% of total body water of girls 17 to 18 years old.

The relationship between total body water in liters and age, height, weight was examined for both sexes using quadratic, cubic, and straight-line approach. The results of appropriate regression equations and correlation coefficients are presented in Table 4.

Table 4. Relationship of Total Body Water to Age, Height, Weight

Regression Equation	Mean	TBW, L	Sy.x	r	P-Value
	BOYS				
TBW, L = 12.008 + 1.65 (Age)	15.85	38.4	6.14	0.43	<.001
TBW, L = –67.819 + 0.616 (Height)	172.5	38.4	3.86	0.82	<.001
TBW, L = 4.264 + 0.572 (Weight)	59.68	38.4	2.73	0.92	<.001
	GIRLS				
TBW, L = 30.40 + 0.023 (Age)	15.96	30.8	3.28	0.01	N.S.
TBW, L = –19.401 + 0.308 (Height)	162.8	30.8	2.85	0.49	<.001
TBW, L = 15.276 + 0.283 (Weight)	54.74	30.8	2.09	0.77	<.001

The best relationship between total body water with highest coefficients of correlation and the smallest standard error of estimate was reached with weight in both sexes, namely r equal to 0.92 and standard error of 2.73 liters for boys and r equal to 0.77 with standard error of 2.09 liters for girls, respectively. Significant differences of total body water with respect to the slopes of the boys' and girls' regression lines were determined by analysis of covariance.

Discussion

According to the results of this study, adolescent boys showed higher hydration of the body as compared to girls of the same age group. Only in the early adolescent years, namely those between 12 to 13 years, did the relative amount of total body water approach that of the boys, i.e. 60.3% compared to 62.1%, respectively. From that age onwards, the boys increased their relative body water content continuously to over 65.5% as they progressed toward maturity. The opposite trend was noticed in girls, namely a decrease in total body water from 60.3% to 53.6%. These changes seem to coincide with growth spurts of various tissues which differ in their hydration. As testosterone triggers accelerated growth of skeletal muscle mass in boys and estrogens stimulate deposits of fat in girls, invariably, body water starts changing because lean tissues hold approximately 73% of water while body fat seems to be nearly anhydrous. Therefore, a spurt of muscle mass in adolescent boys was reflected in an increase of body water in boys and a decrease in body water percentage-wise in girls reflected increased body fat.

The absolute as well as the relative values of total body water obtained from this study correspond well with those of Friis-Hansen (1956). The cited denterium oxide spaces of boys aged 12 to 15 years ranged from 54.8 to 63.2%. Hunt and Heald (1963) reported relative water contents of boys 12 to 17 years which ranged from 61.4% to 64.9%. And last but not least, Mellits and Check (1968) applied profound statistical analysis of two intersecting regression lines to combined data of investigators mentioned previously. Their statistical technique provided evidence that a spurt of lean tissues of different magnitudes is revealed when body water is plotted against height. The point of intersection in boys (137.2 cm) and in girls (113.0 cm) indicates that within 95% of confidence limits around these height values, changes in hydration occur due to a spurt of fat-free mass and, in particular, that of muscle mass. In this study, the velocity of the lean tissues spurt was demonstrated well in boys, while in girls, only the end of lean tissues spurt was detected. It would be necessary to include younger groups of girls to be able to provide the entire velocity curve of body water coinciding with growth spurt during adolescent period. Such study is in progress.

These changes of body tissues during adolescent years were also demonstrated previously by Novak (1963), Hunt and Heald (1963), or by Pařízková (1961). Densitometric, biochemical and/or anthropometric approaches to document profound changes in body composition during this interesting period of human growth were used. All these methods, applied to adolescent boys and girls, yielded information about increasing body density, creatinine excretion and corrected diameters of lean tissue in boys while the opposite trends were documented in girls of the same age. Thus, the results of this study elucidated further changes in body compartments which occurred during adolescence and, in particular, new knowledge of hydration of adolescent body in both sexes was obtained in this semilongitudinal study.

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AGE AND SEX VARIATIONS OF SOMATOTYPE

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Abstract: The author gives an overview on somatotype of 6924 7–14 year-old children based on her Bakony Growth Study. Within the framework of the cross-sectional growth study carried out in 23 villages in the Bakony Hills, Western Hungary, she examined differences of age and sex among the somatotype of children of this region. The changes of somatotype with age were demonstrated by somatoplots on Sheldon's somatochart. The differences between the means of somatoplots in the age-groups were tested by Hotelling's T^2-test. To analyze homogeneity of the children's somatotype in different age-groups the author calculated several indices: SDI, SAM, SASD and sex differences were characterized by SDD and I-index.

Key words: Bakony Growth Study, Cross-sectional growth study, Somatotype, Somatoplot, SAM, SASD, SDI, SDD, I-index.

Introduction

The Bakony Growth Study, a cross-sectional anthropometric examination has been carried out on 6924 children of between 7 and 14 years, living in 23 settlements of the Bakony Hills, which is one of the ethnic regions of Hungary. The sample represents rural children living in a very industrialized environment.

In the anthropometric examination 23 body measurements were taken following the recommendation of the IBP. The secondary sex characteristics of the girls were also studied. Besides the anthropometric examination, data were collected about the social and economic factors influencing the children's biological status.

The sample was analyzed from a number of aspects such as:

- the sex differences in body measurements,
- the proportional differences of age and sex for the trunk, trunk–extremity and extremities,
- the variations of the somatotype and body composition with age and sex,
- the changes of the secondary sex characteristics of the girls with age as well as the relationship of the secondary sex characteristics with each other and with the menarcheal age,
- the influence of socio-economic factors on the growth process (B. Bodzsár 1982a, b, c, d, 1984).

In the present study the author wish to summarize the results referring to the dispersion of the somatotype of children belonging to the same age-group and the sex differences of the somatotype.

Material and Methods

The somatotype of 6924 7–14 year-old children was determined by the Heath–Carter's anthropometric somatotype method (Carter 1971, Hebbelinck et al. 1973). The deviation of the individual somatotypes from the mean somatotype was, respectively, the distance of the somatoplots of the children in the same age-group from the mean somatoplot were estimated by the SAM, SASD (Duquet–Hebbelinck 1977) and SDI (Ross–

Wilson 1973). The values of the SDD and the I-index (Ross et al. 1977) were calculated to describe the sex differences. The differences between the somatoplots of boys and girls of the same age were tested by Hotteling's T^2-test.

Results and Discussion

Analyzing the variations of the somatotype components with age it was found that the second component had the most stable value both in boys and girls in the studied age-interval. The changes with age in the first and third components had an opposite tendency in the two sexes. The first component increased with age in girls, while in boys it was the third component that increased (Table 1).

Regarding of the sex differences of the somatotype components the values of the first component were found to be significantly higher in all the age-groups of the girls, whereas in the boys the values of the second component are significantly higher. Significant differences in the mean values of the third component can be detected only from age 11 on, in favour of the boys (Table 1).

The somatoplots reflect very well the age-dependent differences between the somatotype of boys and girls, as well as the tendency of the changes in their somatotype. The somatoplots of the boys shifted with age from the field of ectomorphic-mesomorphy to the field of mesomorphic-ectomorphy. The somatoplots of the prepubertal girls are also located in the field of ectomorphic-mesomorphy, but nearer to the central field. In puberty a shift of the somatoplots can be observed throughout the central field to the area of endomorphy (Fig. 1).

The homogeneity of the groups, i.e. the relationship between the somatotypes, respectively the somatoplots of the individuals and the mean of the group was tested by SAM and SASD as well as SDI (Table 2). The tendency of the change of SDI and SAM with age seems to be similar. Both parameters are nearly the same till the age of 9 in the girls and till the age of 10 in the boys. This is the age-interval in which they have the smallest value. The highest SAM and SDI values can be observed in the girls from 11 to 13 years, and in the boys from 12 to 14. The highest value of SASD, expressing the dispersion of the deviations from the mean somatotype and also showing their homogeneity could be found in the group of girls aged 12 and in the group of boys aged 13. The dispersion of children's somatotype belonging to the same age-group varies in the different age intervals. The age-groups are most homogeneous in prepuberty and the children aged 11–13 are least homogeneous. The most likely reasons for this may be the fact that the greatest differences in the children's growth-rate can be observed in this age-interval, the differences become more marked in their body proportions, too, and the physique is manifesting itself step by step.

The differences of the somatoplots of boys and girls of the same age are significant as shown by the results of Hotteling's T^2-test, in every age-group (Table 2).

The values of SDD showing the distance between the somatoplots representing the mean somatotype of boys and girls in the same age-group are the same till the age of 9. In the subsequent age-groups its value gradually increases. The facts that the mean somatotypes are changing with age in both boys and girls and that the distance between the somatoplots of the two sexes remains constant indicate that the tendency of the changes in the somatotype of boys and girls is the same. This means that the differences between the somatotypes of the two sexes do not increase between 7 and 9 years of age. But from 10 years of age the differences become more and more marked, because there is an opposite tendency in the changes of the first and third components in the boys and girls. The grad-

Table 1. Statistical parameters of the somatotype components

Age	1st component							2nd component					3rd component				
	Boys			Girls				Boys		Girls			Boys		Girls		
	n	$\bar{x}$	s	n	$\bar{x}$	s	p <	$\bar{x}$	s	$\bar{x}$	s	p <	$\bar{x}$	s	$\bar{x}$	s	p < (t)
7	387	1.61	0.99	388	2.41	1.15	0.001	4.21	0.74	3.90	0.75	0.050	3.18	0.91	3.20	0.96	–
8	478	1.78	1.09	457	2.82	1.27	0.001	4.20	0.72	3.82	0.81	0.050	3.45	0.94	3.57	0.97	–
9	485	2.23	1.27	369	3.13	1.45	0.001	4.21	0.94	3.80	1.01	0.050	3.42	0.99	3.49	1.08	–
10	471	2.57	1.30	419	3.59	1.51	0.001	3.99	1.02	3.65	0.98	0.001	3.80	1.10	3.74	1.18	–
11	433	2.71	1.48	454	3.61	1.56	0.001	3.86	1.05	3.44	0.97	0.001	4.73	1.28	3.69	1.27	0.001
12	439	2.87	1.50	455	3.98	1.61	0.001	3.75	1.03	3.40	1.11	0.001	4.83	1.19	3.70	1.23	0.001
13	461	2.83	1.66	428	4.49	1.63	0.001	3.83	1.06	3.29	1.14	0.001	5.13	1.15	3.68	1.21	0.001
14	399	2.81	1.52	401	5.35	1.59	0.001	3.78	1.03	3.17	1.12	0.001	5.11	1.14	3.57	1.24	0.001

Table 2. Parameters of the distribution of the somatotypes in age-group

Boys				Girls					
SAM	SASD	SDI	Age	SAM	SASD	SDI	SDP	I-index	p < (T^2)
1.40	0.64	3.29	7	1.51	0.81	1.68	1.89	50.63	0.01
1.42	0.79	3.34	8	1.54	0.85	1.61	1.90	55.73	0.05
1.45	0.81	3.34	9	1.60	0.90	1.69	1.87	57.03	0.05
1.57	0.90	3.31	10	1.77	0.98	2.07	2.26	56.34	0.01
1.82	1.01	4.22	11	1.94	0.99	2.05	2.18	54.41	0.01
2.07	1.07	4.59	12	2.19	1.07	2.18	2.54	46.66	0.01
1.99	1.11	4.64	13	2.13	0.99	2.02	2.60	36.40	0.01
1.91	1.00	4.29	14	1.95	1.01	2.01	3.32	20.17	0.01

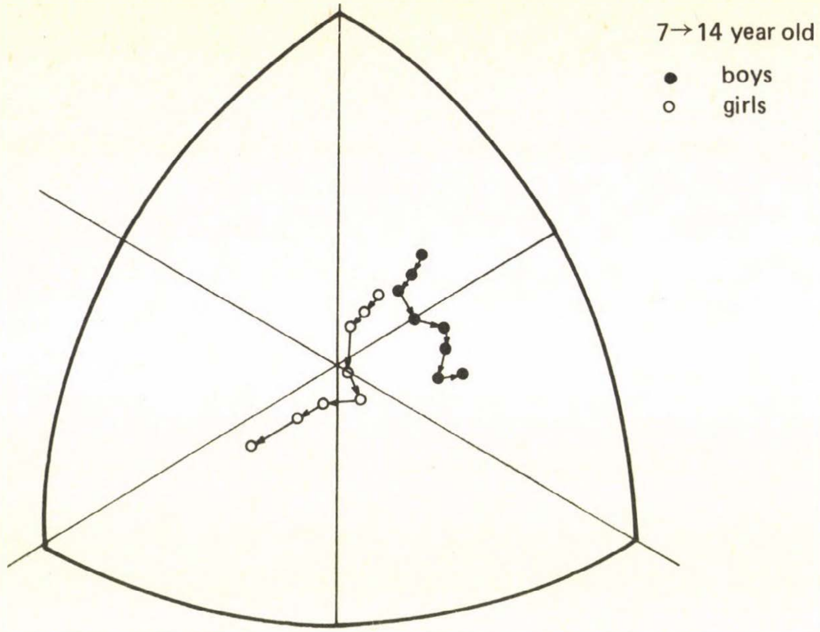

Fig. 1: Mean somatotypes of age groups

ual decrease of the value of the I-index after the age of 10 also indicates the manifestation of sexual dimorphism in the somatotype during the puberty.

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HEIGHT-DEPENDENT DISTRIBUTION OF SOMATOTYPE COMPONENTS IN YOUNG ADULTS

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Abstract: The purpose of the present work was to get some insight into the problem of whether or not somatotype components depended on stature in young adults of an above average level of habitual physical activity. The subjects of the study were 669 females and 710 males who applied for admission to the Budapest University of Physical Education (Magyar Testnevelési Főiskola) between 1977 and 1983 inclusive. Stature strata were selected to include approximately similar numbers of subjects (dissimilar intervals).

Somatotype component distribution in the respective strata of stature was studied by histograms and correlation coefficients. Both criteria evidenced that somatotype components were essentially independent of body height. An additional result of the distribution analysis was that mesomorphy and ectomorphy were distributed approximately normally in every stratum of stature and in both sexes while the distribution of endomorphy in every height stratum was skewed slightly towards the Larger values in this material.

Key words: Height-dependent distribution, Somatotype, Young adults.

Introduction

Stature is recognized to be among the most important dimensions of the body. It is often a basis of reference for derived measures and several of the methods of describing human physique or types of physique use it either on its own or imbedded into complex indices. Somatotyping is no exception to this rule: stature is used as an entry for both the second and third components (Carter and Heath 1971).

The purpose of the present study was to find out whether or not tall and short people could display the same variability of physique, or – in other words – whether the individuals' stature restricted the range of possible somatotypes.

Material and Methods

The young women and men whose data are summarized in Table 1 were students applying for admission to the Testnevelési Főiskola, the Hungarian university of physical education, between the years 1977 and 1983 inclusively. Since data for 1978 were excluded for technical reasons, seven cohorts in all were studied, none of which were statistically different in mean stature, body mass or in the rest of the dimensions used to produce somatotype components. Note, please, that the subpopulation from which this

Table 1. The number of applicants per year

Females	Year	Males
116	1977	95
92	1979	120
121	1980	150
119	1981	118
112	1982	114
109	1983	113
669		710

sample was drawn has been habitually more active physically than the common peer population in Hungary, though relatively few of the applicants have been athletes of really outstanding performance. Most of the investigators were the same.

Methodically, the idea was that by splitting the subject material into strata, or classes, of stature and studying the distribution of the somatotype components class by class, and by looking at the correlations with height, somatotype variability could be assessed. In order to avoid very low class frequencies at either end of the scale, the tallest and the shortest statures were cumulated until acceptable case numbers were achieved. Consequently, the end classes became broader than the intermediate intervals of 2.5 cm. The unorthodox height class boundaries of the males equally served the goal of comparability. Table 2 shows the employed intervals of stature and the respective numbers of subjects.

To see if somatotype components were related to stature, correlations were calculated, both before and after stratifying the material.

Table 2. Frequencies in the height classes

Females				Males
Height (m)	N	Class	N	Height (m)
1.500 .... 1.574	52	1	83	1.596 .... 1.689
1.575 .... 1.599	66	2	81	1.690 .... 1.714
1.600 .... 1.624	92	3	90	1.715 .... 1.739
1.625 .... 1.649	93	4	101	1.740 .... 1.764
1.650 .... 1.674	112	5	108	1.765 .... 1.789
1.675 .... 1.699	100	6	96	1.790 .... 1.814
1.700 .... 1.724	72	7	52	1.815 .... 1.839
1.725 .... 1.819	82	8	99	1.840 .... 1.987

Results and Discussion

The five year long period of sampling ensured against diverse biases, thus the results are believed to be very reliable. Stratification and subsequent histogrammatic appraisal provided a markedly broader base of assessing the relationships with stature than merely correlations. As shown in Table 3, the correlations were nonsignificant in the respective height classes expect for a few. It may be argued that the narrow class intervals of stature contributed to the nonsignificance by restricting variability. The fact, however, that none of the significant coefficients exceeded. 50, either in the respective strata or in the material as a whole, rather supports the opposite.

Table 3. Correlations between somatotype components and stature

Females				Males		
Endo	Meso	Ecto	Height class	Endo	Meso	Ecto
+.36	–.31	n.s.	1	n.s.	n.s.	+.26
n.s.	n.s.	n.s.	2	n.s.	n.s.	n.s.
n.s.	n.s.	n.s.	3	n.s.	–.30	n.s.
n.s.	n.s.	n.s.	4	n.s.	n.s.	+.20
n.s.	n.s.	n.s.	5	n.s.	n.s.	n.s.
n.s.	n.s.	n.s.	6	n.s.	n.s.	n.s.
n.s.	n.s.	n.s.	7	n.s.	n.s.	n.s.
n.s.	n.s.	n.s.	8	n.s.	–.35	+.43
n.s.	–.34	+.39	Total	n.s.	–.32	+.48

Abbreviations: Endo = 1st component; Meso = 2nd component; Ecto = 3rd component; n.s. = non-significant coefficient

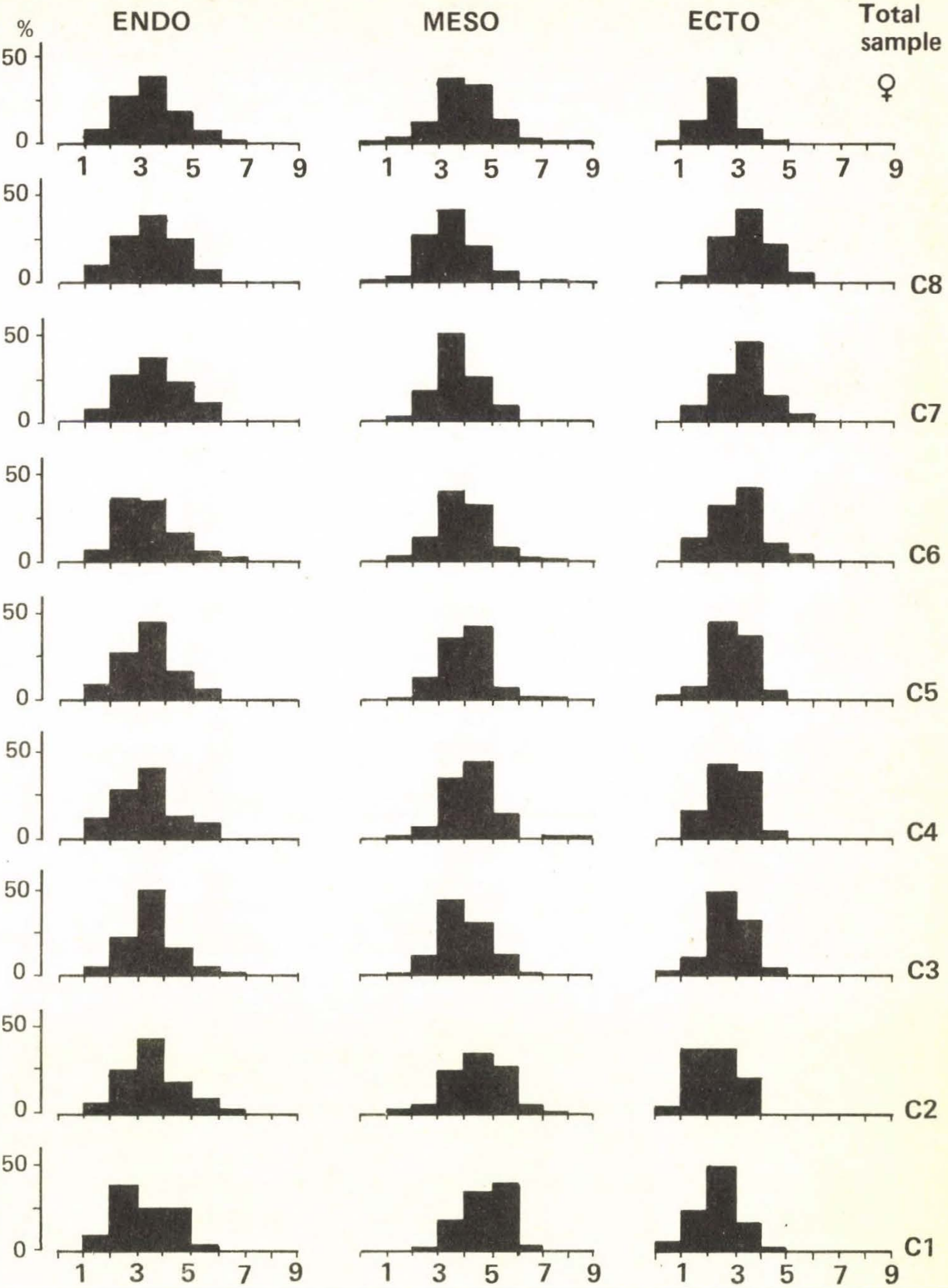

Fig. 1: Height-related histograms of the somatotype components, females. Endo = 1st component, meso = 2nd component, ecto = 3rd component; C1 ... C8 = height classes. Frequencies are shown in per cent for somatoscores rounded to integers.

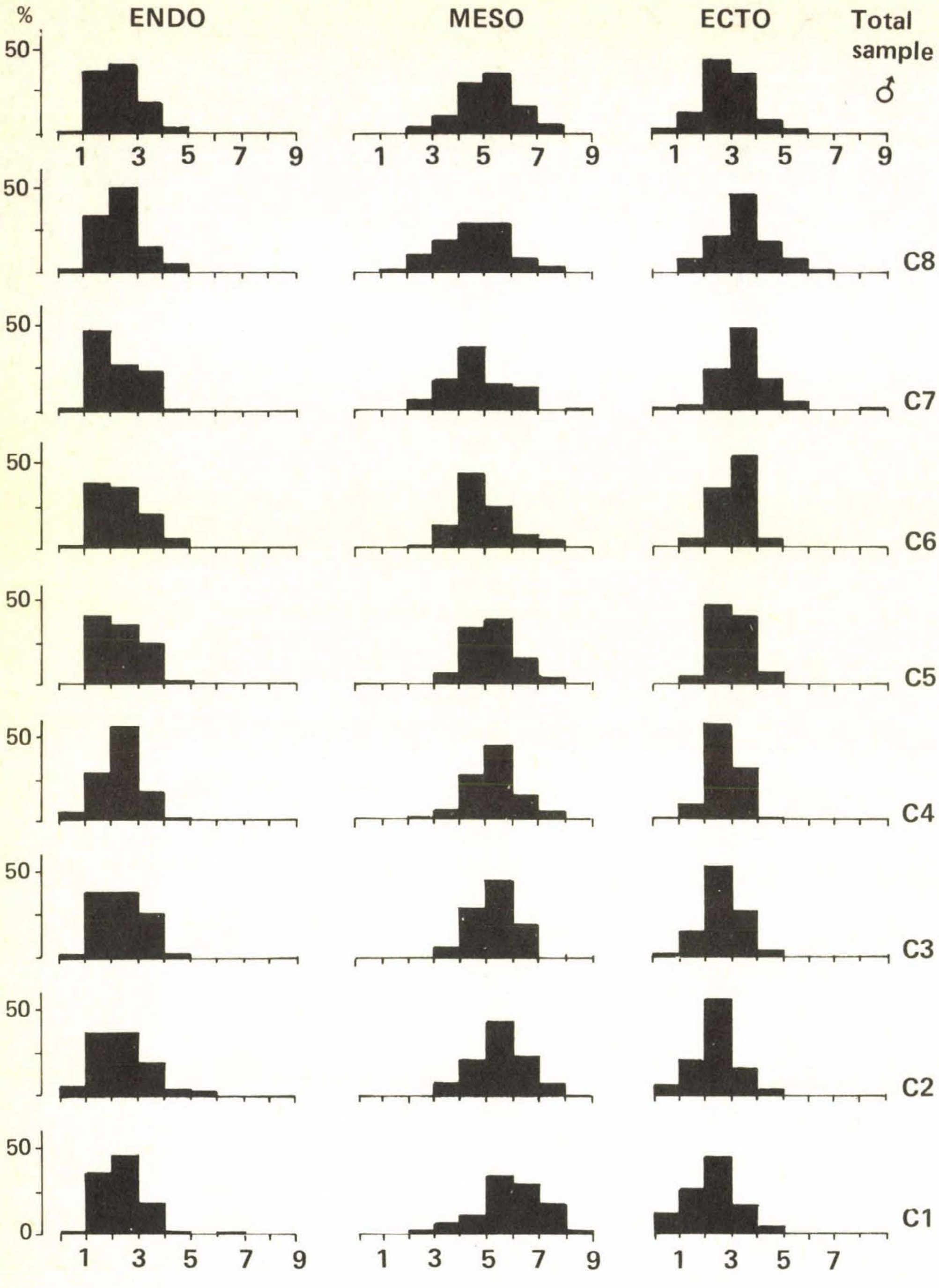

Fig. 2: Height-related histograms of the somatotype components, males. Abbreviations are the same as in Fig. 1.

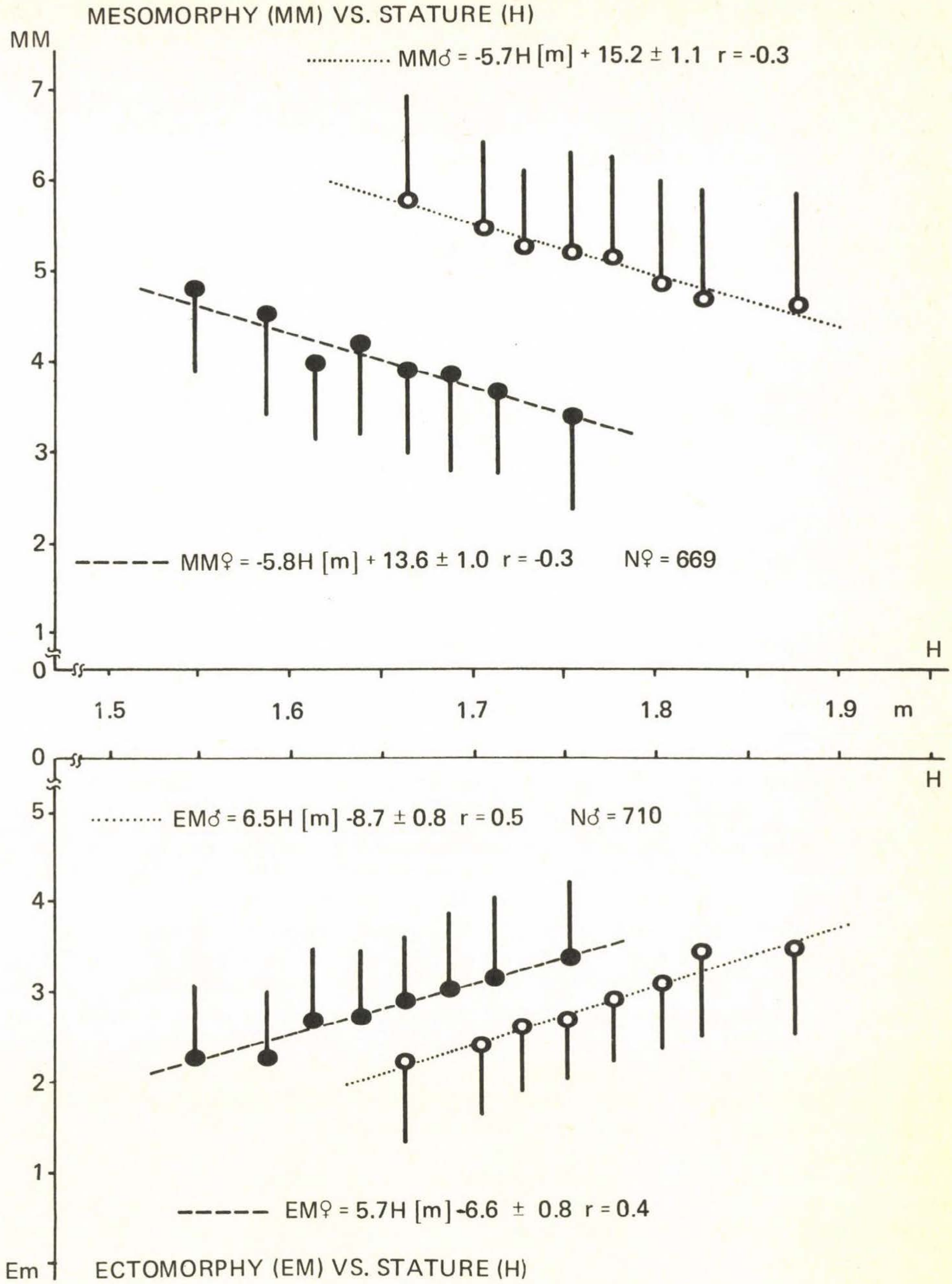

Fig. 3: Top: Regression of mesomorphy (MM) on height (H). Bottom: Regression of ectomorphy (EM) on height. The equations are of the type: b.x + a ± syx. Open circles refer to the males, bold dots refer to the females. Variability shown on the means are standard deviations. Means for the last and first height classes are placed proportionally along the horizontal axis.

The exceptional few of the correlations also aroused our interest, naturally. Thus, endomorphy in the shortest group of the girls was positively related to height, an observation which appeared rather startling at first. Then it was found that it could be attributed to the dominance of skinny gymnasts at the bottom of the scale. In the male and female samples as a whole a low negative coefficient was found for mesomorphy and a slightly greater positive one for ectomorphy.

These tendencies were found in the respective histograms as well, though with greater detail of information (Figs 1 and 2). The classes of height are ordered in increasing order from the bottom to the top. As shown, mesomorphy and ectomorphy were distributed almost symmetrically and normally. The direct comparison of the histogrammatic patterns was made feasible by expressing case frequencies as percentages of the respective sample numbers.

Endomorphy was distributed with a slight positive skewness: even among the females there were fewer above 4 than below 3. This positive skewing was even more marked in the males.

A glimpse at the comprehensive topmost histograms reveals that ectomorphy in these young women was rather subordinate and narrowly distributed. Though the tallest girl was above 181 cm and altogether 82 girls were above 172 cm, the highest score for ectomorphy was below 6. In contrast, five girls were found to be above 6 in mesomorphy, and one was above seven in this material.

In the males, mesomorphy was the dominant trait, as expected. In the shortest group mesomorphy had a slight negative skew, but its range was much broader than in the females. As already mentioned, the skew of endomorphy was more marked.

On the evidence of the histograms it can be stated that the variation of physique in the physically active subjects has approximately the same range independently from the height interval to which the individual belongs. A broader generalization of this observation, namely for the whole of the peer population, needs additional evidence.

The slight but consistent trend in mesomorphy to decrease with stature, and – as shown by the constants – the almost identical trend in ectomorphy to increase with stature is shown in the linear regressions of Fig. 3. Though analysis of variance unambiguously supported the linearity of the trend, the scatter around the means was considerable. This reduces total common variance which can be explained by the slopes, i.e. by the dependence on stature. The inference concerning the problem posed is, then, that in a physically active young population the same variability of body build can be expected in tall and short males and females alike. The negative linear relationship between mesomorphy and stature as well as the positive linear relationship between ectomorphy and stature do exist, but explain a negligible part of the total common variance of somatotype and stature. Even in this small part it is very likely that the role of stature observed in the components of the somatotype is attributable to the part height plays in calculating the component scores rather than to a direct dependence.

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PHYSIQUE OF COAL-MINERS

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Abstract: The authors intended to answer the question whether the predisposition of physique has any role in development of silicosis. They carried out a detailed anthropometric investigation on 150 coal-miners suffering from silicosis and on their 97 healthy counterparts who formed the control group. The persons investigated worked 15–25 years under the surface.

To estimate the somatotype of the coal-miners, the Healt–Carter somatotyping method was used. The mean somatotype of coal-miners suffering from silicosis is 3.78–6.07–1.16, and that of healthy coal-miners is 5.46–6.44–0.93, respectively. The mesomorphy component dominates in both groups. It is connected with the heavy physical work done permanently under the surface, but, on the other hand, these coal-miners were chosen from among the strong, corpulent shifts of the population. The value of endomorphy component in the coal-miners suffering from silicosis is significantly lower than in their counterparts. The total body fat of the former group is 21.9%, significantly lower than that of the healthy group (27.1%) which is qualified as obese. The ectomorphy component shows a very low value in both groups, the body build of coal-miners is very little linear.

It is conspicuous that in both groups the overwhelming majority of the subjects is endo-mesomorph, and both groups are very homogeneous in physique. This phenomenon rarely appears in such an extent in other professional groups. It seems to be that in coal-miners the physique has no primary role in development of silicosis.

Key words: Physique, Somatotype, Coal-miners, Silicosis.

Introduction

In the literature of constitutional biology it is well-known that a certain type of physique predispose to several different diseases. The term „type" needs to be, at the same time further clarified. On the other hand,it is also known that the same illness can appear in patients with different types of physique.

Before going into details we must draw attention to the fact that the type of physique, as all types, is an abstraction and individuals can only very rarely embody it. As Kretschmer (1921) stated, we all are alloys of physiques.

By *physique* we mean the morphological constitution of an individual which is formed by the manifestation of genetic endowment and the result of adaptation to environmental effects (Eiben 1972).

In the 1940s when clinical constitution researches described the above-mentioned statements it was already known that genetic and environmental factors have an effect on the physique. The question had risen whether it is the fundamental type of physique which predisposes to a certain disease or only a difference of the constitution which appears only in a particular part of the body. Some inherited deseases belong to this group which are based on a local difference taking place only in one of the germ layers or in one of the organ systems. The idea that the predisposition of the physique can be found in all diseases and moreover that each individual has his/her own susceptibility to certain diseases, was generally accepted. So the constitutional diagnostics were not concentrated on typing, but rather on the detailed recognition of constitutional predisposition.

The above-mentioned fact that the same illness apprears in different types of physique raised the question: What is the incidence frequency of the different types of physique in certain diseases? According to clinical constitutional biology a disease is predisposed by one of the extreme types of physique, for instance the pyknic. The disease, however, can be found in quite a great number of people among those of mixed type of physique and in a small number also among people with the opposite type of physique which in this case is leptosomic. Experiments verify that in the width development of the body a characteristic variational sequence can be followed in each group of the different diseases.

From constitutional viewpoints, the causes of the diseases are environmental factors, and local or general predisposition of the physique.

A Selected Overview of Literature on the Subject

It is a significant observation that although the pyknic constitution does not predispose to pulmonary tuberculosis, environmental factors can also stimulate the development of the disease in these people. Beneke (1881) noted that he often found miners with strong physiques suffering from pulmonary tuberculosis due to the inhalation of dust. Clinical diagnoses of these people usually show cirrhotic peribronchial bronchiectasia whereas mostly phthisis and dystrophy appears among miners with weak constitutions.

It is not possible to exclude that the constitutional differences in the structure and tissue of the lung have some role in predisposition to these diseases (Orsós 1928, 1933).

Only very little data are available concerning the clinical parameters and even less about the physique of miners suffering from inhalation of dust.

It is well-known that the permeation of silicosis all over the world demonstrates that the individuals of each race and groups of peoples are susceptible to this damage, namely, the longer and the more intensive they inhale the dust in great concentration, the more susceptible they are.

Ickert (1931) investigated the harmful effects of dust-inhalation among copper miners in Mansfeld. In leptosome miners he found serious silicosis combined with pulmonary tuberculosis while the miners with pyknic and athletic constitution showed only a very slight susceptibility. In the same mining district Geisler (1937) did not find any correlation between copper miners' physiques and silicosis.

Beckmann (1951), based on his vast investigation, published that people of pyknic constitution are especially suitable as miners, because in their case the silicosis develops much more slower than in those having athletic or asthenic constitutions. Leptosoms were found to be relatively suitable from the viewpoint of susceptibility to silicosis because they were found to be in between the pyknic and athletic and asthenic constitutions. (In his publication Beckmann drew attention to the difficulties of typing, to the differences derived from the age and to the necessity of further physiological and psychological investigations.)

In spite of these, Cochrane (1951) found that in people with asthenic constitutions, tuberculosis breaks out with great probability after a few years of mining. Lassere (1941) investigating Austrian coal miners also stated that people with asthenic constitutions are especially unsuitable as miners.

Ceelen (1951) raised the question whether the different behaviour toward silicosis can be explained by the stronger resistance of pyknics or by the congenital disposition of asthenics. It should also be taken into consideration that hypoplasia of the heart and blood vessels, which appears almost always in asthenic people, causes the insufficient blood supply to the lungs and can be connected with the disposition to infections, especially to silicosis.

On the basis of the investigations of Krüger and Schlomka (1954) the question arose whether it would be worth investigating the dependence of silicosis on the physique with the help of the methods of constitutional biology, because people belonging to the pyknic constitutional type show a greater susceptibility to the 2nd and 3rd phase of silicosis than the leptosoms (incidence frequency is 2–3 times greater).

Cochrane (1951) studying miners, drew attention to the importance of constitutional indices. Although in an index which is the ratio of height and one of the width measurements he did not gain significant differences between the groups of miners being in various stages of lung diseases caused by dust-inhalation, he emphasized the prognostic importance of constitutional indices. It is well-known that in athletes, especially those having a great stamina for example long-distance-runners, the chest depth is apparently large (Eiben 1972).

There are remarkable data available on the appearance of silicosis from studies carried out in families and twins. In certain mining families silicosis did not appear through generations, on the other hand, in other families its serious form appeared fairly soon (Lochtkemper 1935, 1951, Worth–Schiller (1954). This observation suggests the hereditary disposition.

Rasche and co-workers (1982) recite epydemiological observations carried out on coal-miners, which with help of comparable dust pollution unanimously proved that there are individual differences in appearance and development of different pulmonary diseases (pneumoconiosis) caused by dust-inhalation. Several miners show radiologically observable lung deformations after the inhalation of a relatively small amount of dust. For the special protection of these susceptible miners the knowledge of the individual factors, characteristic of those partly predisposed to pneumoconiosis, is needed. In the course of their investigations they found no significant differences in laboratory-parameters (apart from differences in HLA type). So they could not decide whether the difference they had found were the causes or the results of the development of pneumoconiosis. They did not published any data on physique.

The occupation usually has an early effect on physique, especially in young people (Buday 1943). Among the coal-miners in Mecsek hills we often met corpulent variations, similar to the „brachy" type of Viola (1933). This type of physique can be characterized by domination of the trunk, which is the centre of the vegetative life. The extremities, especially the lower limbs are short. Since the productivity of the body is proportional to the volume of the trunk, if all the other conditions are standard, people with this type of physique are able to perform strenuous activity, but they are slow. Their most important advantage is that they don't tire easily. Their musculature is not fatigable, in this respect it is similar to the smooth muscle. They are suitable for slow tonic contraction and as a consequence of this they will be hypertrophic.

Data on the somatotype of miners could not be found in the literature.

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The aim of our study was to clarify whether the constitutional predisposition has any role in the development of silicosis in the coal-miners in Mecsek hills.

Material and Methods

A detailed anthropometric programme was carried out on 150 coal-miners (mean age: 47 year; from 27 to 63 years of age) suffering from silicosis and on a normal healthy group of 97 coal-miners (mean age: also 47 year; from 35 to 55 years of age). The members of both groups worked for 15–25 years under the surface.

The anthropometric technique of Martin (Martin–Saller 1957) was used, taking into consideration the recommandation of the International Biological Programme (Tanner et al. 1969).

The physique was estimated according to the Heath–Carter anthropometric somatotyping method (Carter 1975).

Results

The values of height in the two groups are almost the same. The ill coal-miners are 169.3 cm tall and their healthy counterparts are 168.3 cm. Regarding the weight no significant difference can be found between them. The body weight of the coal-miners suffering from silicosis and that of the healthy coal-miners are 77.1 kg and 80.9 kg, respectively. The latter value is 5 per cent more. The epicondylar widths of the humerus and femur show that the developmental level of the skeleton is similar in both groups although the coal-miners suffering from silicosis seem to be in a minimal degree leaner. The extremities of the latter group are relatively more muscled while in the healthy coal-miners the higher values of subcutaneous fat are obvious (Table 1).

Apart from the latter measurements the two groups of the investigated coal-miners do not differ significantly in their body measurements from each other and also the values of standard deviation show that on the basis of their body build the coal-miners form a fairly homogeneous group.

The mean of the somatotypes in silicotic coal-miners is 3.78–6.07–1.16, while in healthy coal-miners: 5.46–6.44–0.93. Compared these values with Student's test, the differences in every component are significant, in endomorphy $t=12.2616$, $P<0.001$, in mesomorphy and in ectomorphy $t=2.2904$, and $t=2.2986$, resp., and in both cases $P<0.05$.

The *mesomorphic* component is dominant in both groups and this can be brought into

Table 1. Body measurements and other characteristics of physique of Mecsek coal-miners

Body measurements	Coal-miners suffering from silicosis N=150		Coal-miners, healthy (control group) N=97	
	$\bar{x}$	s	$\bar{x}$	s
Stature (cm)	169.31	5.89	168.55	6.67
Weight (kg)	77.06	12.57	80.90	12.80
Bicondylar humerus (mm)	73.06	4.19	74.19	4.02
Bicondylar femur (mm)	97.90	5.16	100.54	5.09
Upper arm circumference, relaxed (cm)	30.58	2.56	31.26	2.87
Upper arm circumference, contracted (cm)	32.01	2.65	32.55	2.96
Middle arm muscle circumference (cm)	28.06		27.69	
Middle arm area (cm^2)	74.98		78.45	
Middle arm muscle area (cm^2)	63.09		61.42	
Calf circumference (cm)	36.67	2.80	36.93	2.69
Calf muscle circumference (cm)	34.33		33.46	
Calf area (cm^2)	107.67		109.14	
Calf muscle area (cm^2)	94.30		89.47	
Subcutan fat (skinfold thicknesses)				
over triceps (mm)	8.06	2.54	11.40	4.57
subscapular (mm)	13.21	4.55	19.78	6.15
supra-iliac (mm)	15.61	5.45	25.76	8.93
medial calf (mm)	7.46	2.76	11.07	4.83
Fat mass (kg)	17.18		22.39	
Fat%	21.89		27.10	
Lean body mass (kg)	59.88		58.52	
Density	1.049		1.038	
Endomorphy	3.78	1.12	5.46	1.40
Mesomorphy	6.07	1.16	6.44	1.35
Ectomorphy	1.16	0.79	0.93	0.73
SDI	3.49		3.58	

connection with the hard physical work that they had done under the surface for a long period of time. It should also be taken into account that these men were chosen from the strong, well-muscled strata of the population because of their suitability for mining. The domination of mesomorphy is certainly a selectional factor. The *endomorphic* component shows a significantly lower value in silicotic coal-miners. Their total body fat is only 21.9%. The subcutaneous fat of healthy miners is 1.5 times greater than that of their silicotic counterparts. The total body fat of healthy coal-miners is 27.1% so therefore they are qualified as obese. The lean body mass and density of coal-miners suffering from silicosis are greater than those of their healthy counterparts. The *ectomorphic* component shows a low value in both groups; the body build of the coal-miners is only slightly linear (Fig. 1).

It is obvious that both groups are mostly endomorphic-mesomorph and also very homogeneous in their somatotype. Their SDI values hardly differ from each other (3.49 and 3.58, resp.). This phenomenon in such a degree can rarely be seen in groups of other occupations.

Somatotype of the coal-miners suffered from silicosis was investigated also in connection with their career in mines, as well as connection with severity of their illness.

Taken as a function of length of time what the coal-miners worked underneath the

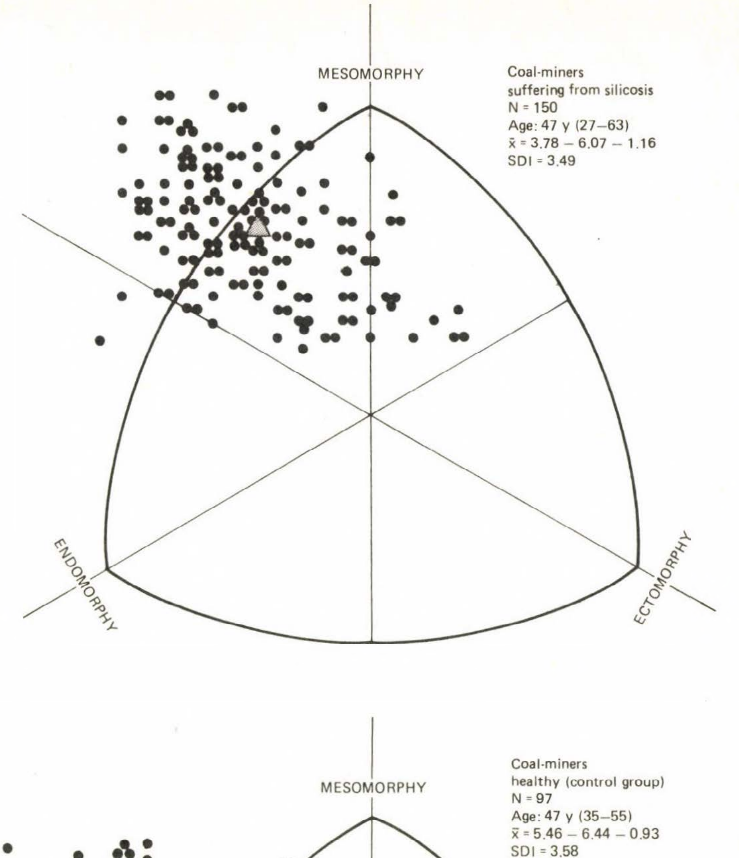

Fig. 1: Somatotyps of too groups of coal-miners

surface, there is no significant differences in their somatotype. The subgroups of coal-miners worked 5–10, 11–15, ... 36–40 years underneath the surface, have 5.4–6.5 units in their first component, 3.0–4.2 units in their second one and 0.8–1.7 units in their third one.

In respect to the illness, the coal-miners suffered from silicosis were reduced into two groups: (1) with mild form of silicosis in which case small shadows and/or emphysema appeared on their lung (N=140), and (2) with serious form of silicosis with extended hilus-lesions (N=10). Mean somatotypes of these groups were (1) 3.90–5.95–0.90 and (2) 3.70–6.06–1.20, resp. The differences between the somatotype components of the two groups are not significant.

From our initial examinations we may not draw final conclusions. Actually it seems so that physique has *no primary role* in the development of silicosis. We assume that the above presented characteristics of the physique are also in connection with the hard physical work of the miners, which is required in the mines of the Mecsek hills, because the area's geological structure renders mechanization impossible.

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IMPACT OF HIGH ALTITUDE ON BODY SHAPE

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Abstract: A somatotype compresses a lot of information into a reliable form that can be comprehended as compared to isolated values of lengths, girths, breadths and skinfold thicknesses. It provides one of the simplest and the most economical descriptions of the human form. To study body shape changes 274 children from the high altitude (3.534 m) ranges of Ladakh (India) and 121 ethnically similar children from the lowland (Kulu Valley), in the age range of 11 to 19 years, were anthropometrically somatotyped, using Heath and Cater's method.

Salient features of the study are that highlanders are more mesomorphic, more ectomorphic and less endomorphic than the lowlanders, at all ages. In view of the difficult terrain and increase workload, greater mesomorphy among high altitude boys is quite expected. Lower endomorphy and greater ectomorphy among highlander boys, however, seems to be the result of number of interacting, perhaps in the opposite direction, forces, such as, hypoxia, cold, difficult terrain, work-load and undernourishment. More than the cold environment, the conditions of hypoxia, heavy work-load and undernourishment seem to maintain this kind of somatotype among the highlanders.

Key words: Body shape, High altitude, Somatotype, India.

Introduction

Adaptation of a population to its environment may be measured at least in two ways. Firstly, by examining growth and development of individuals and secondly by studying population growth in relation to reproductive performance. Studies of human growth and development have been quite popular in measuring the overall health status and adaptive fitness of population at high altitude (HA). Our earlier researches on high altitude Bods have demonstrated that Bods were well-adapted to high altitude stresses in terms of cardio-respiratory functions. Nonetheless their growth patterns were affected in number of ways (Malik 1976, 1984, Malik and Singh 1978, 1984). In particular high altitude male Bods showed slower and prolonged growth, and a non-clear adolescent spurt in stature.

The present study elucidates the impact of high altitude stresses on the anthropometric somatotype, i.e. body shape. The aims of the study are the following: (1) To study changes in the anthropometric somatotypes with age among high (HA) and low altitude (LA) Bods in the age range of 12 to 18 years. (2) To make age groupwise comparison of individual somatotype component viz., endomorphy, mesomorphy and ectomorphy, and (3) To make comparison of somatotypes with other reported Indian Populations in this age range.

Material and Methods

Leh (34°09'N–77°34'E), where the present study was conducted, is the headquarter of Ladakh distict of Jammu and Kashmir. It is one of the highest parts of the globe with permanent human habitation (3514 m). The climate of Leh is characterised by a number of complex and interlinked stresses, such as reduced atmospheric and oxygen pressure, increased cold, difficult terrain, elevated atmospheric aridity and solar radiation.

Although a detailed survey in the area is still lacking, but scanty vegetation, that too along the river Indus, suggests that the population must be living under poor nutritional condition. This condition is accentuated in those parts of the district where transport/ communication is poor. As only a few can be supported under such poor economical and harsh environmental conditions therefore the population density is very low (approx. 2 persons/sq km).

Compared to Leh(Ladakh), the Kullu valley, where a section of Bods have migrated centuries ago, is lashy green. Its pleasant environment, abundance of fruits and scenic beauty attracts thousands of tourists every year. Unlike high altitude there is plenty of rainfall and the climate, in general, is not that harsh. Although this migrant group still maintains the old traditions but it is likely that they have better nutritional conditions and the workload is not as much as in the high altitude. For comparison a sample from this population was extracted.

Anthropometric measurements, viz., stature, weight, skinfolds at triceps, subscapular, suprailiac and calf, bicondylar humerus, bicondylar femur, upper arm and calf circumference were taken following the standard techniques (Tanner et al. 1969, Carter 1975). Subjects were somatotyped using the above measurements following the method of Heath and Carter applicable for children (Heath and Carter 1967, Carter 1975). Somatotype dispersion distance (SDD) was calculated using the formula of Ross and Wilson (1973) and migratory distance was calculated as per the formula of Pařízková and Carter (1976). Heath and Carter have advocated the use of photographs, along with the anthropometric somatotyping, specially for children but at the same time maintain that anthropometric somatotypes under special circumstances serve the purpose efficiently even in absence of photographs.

A total sample of 233 male Bods in the age range of 12 to 18 years were measured and somatotyped from the high altitude ranges of Leh, Ladakh (3514 m). For comparison, 121 boys were sampled, in the same age range, from the migrant Bods settled in Kullu valley.

Results and Discussion

A somatotype compresses a lot of information into a reliable form that can be comprehended extensively as compared to isolated values of lengths, girths, breadths, and skinfold thicknesses. It provides one of the simplest and the most economical description of human form, particularly the body shape. Numerous researchers have used the method of anthropometric somatotype given by Heath and Carter to analyse body shape changes in various situations (Araujo 1977, Slaughter et al. 1977, Guimaraes and De Rose 1980), and in various ages (Eiben 1985, and others).

It is evident from the mean migratory distance (HA=19.26, LA=18.70) that the body shape changes are slightly more at high altitude than at the low altitude, in the age range of 12 to 18 years. Average somatotype distance from the mean somatotype of their respective age group is more in the high altitude than in the low altitude for the age groups 12, 13, 16, and 18 (Figs 1–2, Table 1). Dispersion in somatotype distance is, however, more in all the age groups at high altitude than at the low altitude (Fig. 1). This reflects that individuals at high altitude differ much more from each other in the same age group. Whether high altitude environment is responsible for this, is not clear. One of the reasons could be that the lowlanders are represented by a relatively more homogeneous group as one would expect that a relatively more homogeneous group would segregate during onset of migration.

In the mean somatotypes, however, both the highlander and lowlander Bods in their all age groups are in the mesomorph-ectomorph channel, generally on the lower side of

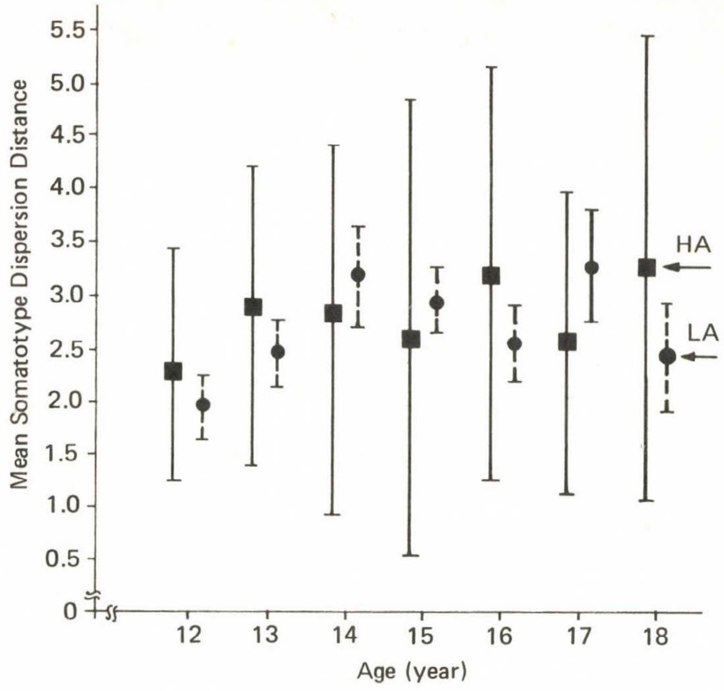

Fig. 1: Mean Somatotype Dispersion Distance among high and low altitude male Bods, in the age range of 12 to 18 years.

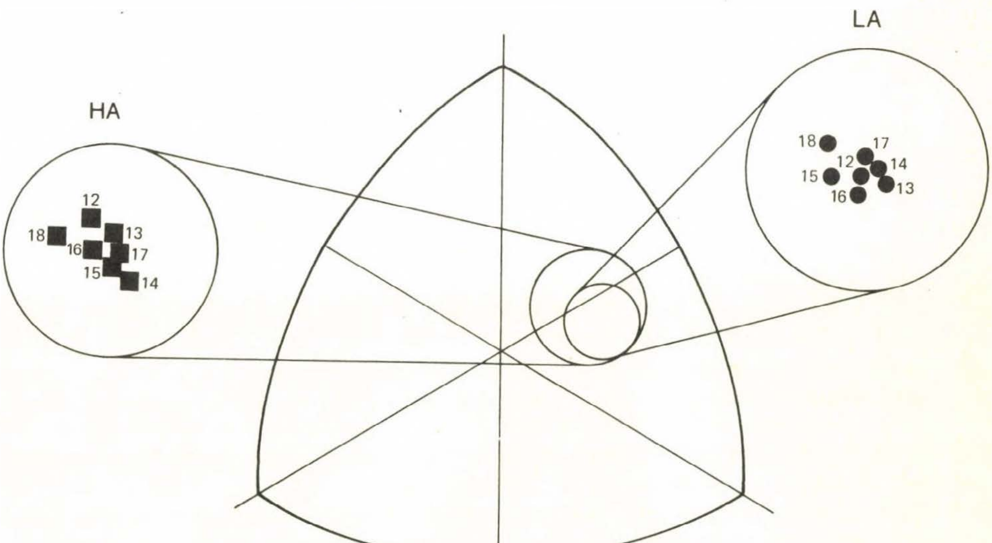

Fig. 2: Migratory distances from 12 to 18 year among high and low altitude male Bods

Table 1. Mean values of Somatotype Dispersion Distance along with their Standard Error and Variance among the High Altitude and Low Altitude male Bods

Age Group	High Altitude Mean	S.E.	DSD	Low Altitude Mean	S.E.	DSD
12	2.34	0.22	1.09	1.95	0.28	1.10
13	2.80	0.29	1.41	2.49	0.28	1.27
14	2.67	0.31	1.78	3.14	0.44	1.96
15	2.51	0.32	2.02	2.94	0.33	1.40
16	3.17	0.25	1.95	2.49	0.29	1.33
17	2.53	0.25	1.41	3.25	0.52	2.02
18	3.24	0.47	2.16	2.44	0.46	1.52

the endomorphy axis. As a comparison, the authors cite the results of the somatotype analysis of the Körmend Growth Study (K–78 investigation; Eiben 1985). The mean somatotypes of the Körmend boys in the same age groups are in the central region of the somatochart. The Körmend boys are much endomorphic (the values of their first component in age groups in question vary between 3.02 and 3.44), somewhat less mesomorphic (the values of their second component are 3.31–3.75), and less ectomorphic (3.21–3.90). These values are closer to lowlander Bod boys than the highlander ones, and the differences of somatotype components in Körmend boys compared to Bods are parts of the general differences in Asian and European boys' physique.

An analysis of individual somatotype components reveals that highlanders are less endomorphic than the lowlander Bods (Table 2). In view of the fact that fat and more endomorphic people are better adapted to cold, it is paradoxical to observe lower endomorphy among the highlanders. Štěpnička (1972, 1974, 1976) observed that more endomorphic people require greater amount of energy, to conduct same amount of work, resulting in a negative relationship between endomorphy and physical activity requiring strength and stamina. Conditions of undernutrition and low oxygen pressure limit the release of energy, on one hand, while on the other, workload is enhanced due to difficult terrain at high altitude. Succinctly all these stresses collectively outweigh the stress of cold and result into lower endomorphy. Adaptation to cold, however, takes place by cultural factors, rather than the biological ones, by utilising and conservating heat efficiently (Malik 1984).

Greater mesomorphy at high altitude, as compared to low altitude, is as expected under the conditions of difficult terrain and increased workload (Table 2) in view of positive association between mesomorphic component and physical activity (DeGaray et al. 1974, Štěpnička et al. 1976).

Highlander Bods are more ectomorphic than the lowlander Bods (Table 2). Better living conditions, specially better nutritional intake and lesser physical activity could be some of the factors responsible for the reduction of ectomorphy at low altitude.

Only limited number of studies have been conducted in India on somatotypes of children (Singh and Sidhu 1980, Parkash et al. 1986). Compared to Gaddis (Singh and Sidhu 1980) and Santhals (Parkash et al. 1986), Bods at high altitude have markedly greater ectomorphy. In endomorphy, however, they are closer to Gaddis as compared to Santhals who are living under extremely poor nutritional and hygienic conditions and as such have lower endomorphy. Greater mesomorphy and ectomorphy among highlander Bods, as compared to other Indian populations seem to be largely adaptive in nature and a result of various interlinked stresses at high altitude.

Table 2. Age groupwise comparison in endomorphy, mesomorphy, and ectomorphy between High Altitude and Low Altitude male Bods

Age (year)	N	High Altitude (□)						N	Low Altitude (o)					
		Endomorphy		Mesomorphy		Ectomorphy			Endomorphy		Mesomorphy		Ectomorphy	
		Mean	S.E.	Mean	S.E.	Mean	S.E..		Mean	S.E.	Mean	S.E.	Mean	S.E.
12	24	1.51	0.08	4.27	0.13	4.09	0.14	16	1.76	0.12	3.87	0.14	4.08	0.14
13	24	1.46	0.10	4.31	0.13	4.31	0.19	20	1.74	0.09	3.64	0.16	4.26	0.19
14	33	1.55	0.06	3.74	0.14	4.51	0.17	20	1.82	0.09	3.73	0.25	4.24	0.21
15	41	1.58	0.06	4.15	0.15	4.39	0.12	18	2.23	0.17	3.91	0.16	3.93	0.21
16	59	1.62	0.07	4.09	0.12	4.26	0.14	21	1.81	0.09	3.56	0.18	4.04	0.19
17	31	1.51	0.06	4.05	0.11	4.28	0.16	15	1.75	0.11	3.87	0.25	3.99	0.29
18	21	1.66	0.09	3.99	0.23	3.73	0.25	11	1.94	0.13	3.87	0.28	3.65	0.16

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PHYSIQUE OF YOUNG FEMALE GYMNASTS

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Abstract: The authors studied 132 young female gymnasts in Hungary. The age of these girls varied between 9 and 19 years. Based on a detailed anthropometric survey the authors analysed the physical development status (body measurements) and sexual maturity (age at menarche: „status quo" method; probit analysis) as well as the skeletal age (TW2 method) of the subjects.

The data of body measurements compared with the very recent Hungarian National Growth Standards show that the young female gymnasts are smaller by 3–10 cm and lighter by 3–9 kg than their „normal" counterparts. Other body measurements – except subcutan fat – show the same trend. Their somatotype was 2.54–4.05–3.39. The age at menarche was m=15.04 ± 0.62 year, which is later by 2–2.5 years than the recent Hungarian medians (12.6–13.0 y). The skeletal age of the girls was found to be behind their chronological age, i.e. their skeletal maturity delayed.

The retardation in growth and development process of young female gymnasts could be explained by the enormous heavy training and a cruel diet, but also a selection for the sport event can play a special role.

Key words: Physique, Somatotype, Body measurements, Menarche, Skeletal age, Female gymnasts.

Introduction

The relationship between physiques and sport achievements is the centre of interest of physical training and sport sciences. Philostratos Flavius (3rd century B. C.) stated what is the most suitable physique of a contestant in the different olympic games and encouraged the right physical education in his „Gymnastikos". In his study, which is already a standard work, Godin (1901) demonstrated that apparatus work has an advantageous effect on the width development of the trunk and on the muscle development of the extremities. Since the 1928 Olympic Games investigations on physique of athletes were carried out at almost every Olympic Game and also at several World Competitions. Unfortunately most of these examinations referred only to men. Since the 1960s perfectly reliable data on female athletes's physique, moreover of female gymnasts, have been available and comes from investigations of scientific value. From among the latter we mention the following investigations:

In 1968 De Garay – Levine – Carter (1974) investigated 115 female gymnasts at the Mexico Olympic Games. Their mean somatotype was 2.7–4.2–2.8; 62% of them was found to be in the central field and 29% in the mesomorphic fields.

Hirata (1979) based mostly on his own investigations carried out on female gymnasts at the Tokyo Olympic Games, stated that the female gymnasts were the youngest, the shortest and the most linear among the female athletes.

Carter et al. (1982), among others, investigated 15 female gymnasts at the Montreal Olympic Games. The mean of their somatotypes was: 2.1–4.0–3.4

Although gymnastics has a long history in Hungary, there were no scientific reports on physique characteristics of elite Hungarian female gymnasts. The Hungarian Gymnastics Federation in its concern for the optimal growth and development of participants in the sport expressed a need for a scientific appraisement to determine: (1) the somatic and physique characteristics of elite young Hungarian female gymnasts and (2) make preliminary assessment of the possible effects of intensive training on the normal pattern of growth and development.

Material and Methods

The investigation was carried out in January, 1983 and involved 132 young female gymnasts, all Hungarian, Caucasian between the ages 8.5 and 21.0 years. The majority of them had been actively engaged in the sport for 5 years and all were rated in the elite class. Although all of the data were useful in appraising individual characteristics, the numbers in the total sample were insufficient for groups analysis other than for those between the ages 11 and 14 years old (N=91).

The measurement protocol contained data of birth, height, weight and 15 other anthropometric items consistent with the technique of Martin (Martin and Saller 1957) in accord with the general plan proposed for the International Biological Programme (Tanner et al. 1969). Somatotype photographs in accord with the technique described by Carter (1975) and hand and wrist X-rays as specified by Tanner et al. (1975) were obtained in all the subjects.

Concurrently, data on whether the subjects had experienced menarche and auxillary data from gynaecological and psychological examinations were obtained.

The anthropometric data were summarized by conventional descriptive statistics, somatotypes calculated by Heath–Carter method (Carter 1975) with sample homogeneity described by somatotype dispersion distances as described by Ross and Wilson (1973). The estimation of age at menarche was made from the „status quo" data by probit analysis (Weber 1957). Radiographs were rated by one of the authors, by an experienced investigator (G. G.) who had established reliability with original ratings of the Tanner-Laboratory (made by R. H. Whitehouse) in the Department of Anthropogenetics, Vrije Universiteit Brussel, Brussels.

The above data were compared to individual age-matched samples of girls from the Hungarian National Growth Study (Eiben–Pantó 1981, 1986, Pantó–Eiben 1984).

Results and Discussion

Body measurements

The body measurements of the female gymnasts compared to the Hungarian national reference values (Eiben–Pantó 1986) are presented in Table 1. The gymnasts were significantly shorter than the girls in the reference group ranging from 3.5–9.8 cm less than Hungarian girls. They were also shorter in sitting height, and upper and lower extremity length. One possible explanation of the short stature is that the gymnasts came from families with short parents. This was not the case in this study since the fathers' height of 172.7 (SD 6.0) cm and mothers' height of 160.1 (SD 6.0) cm were not appreciatively different from the Hungarian population 172.0 cm and 162.0 cm for adult males and females.

Compared to the Hungarian national height standards (Eiben–Pantó 1986) the mean height values of the female gymnasts were below the 25th percentile, except the 10 year-old ones, however, even the 11–14 year-old female gymnasts investigated intensively were at the 10th percentile (Fig. 1).

The female gymnasts were significantly lighter 3.3–9.4 kg than the respective Hungarian girls. Compared to the Hungarian national weight standards (Eiben–Pantó 1986) the mean weight values of the female gymnasts were below the 50th percentile, however, the 11–14 age groups of them were between the 10th and 25th percentiles (Fig. 2).

The weight-for-height data of the female gymnasts compared to the Hungarian national reference values were more reassuring than their height and weight data in this comparison.

Table 1. Body measurements of the 10–15 year-old females gymnasts compared to the Hungarian national reference values

Age (year)	Female gymnasts N	$\bar{x}$	SD	W	Hungarian national reference values N	$\bar{x}$	SD	W
				Height (cm)				
10	9	134.8	5.5	124.7–141.3	1286	138.29	6.65	113.8–166.3
11	26	136.3	5.3	124.8–148.5	1355	144.68	7.18	120.0–168.0
12	18	140.9	6.3	127.3–156.8	1374	150.66	7.57	127.0–174.2
13	18	147.4	6.2	133.4–156.8	1373	156.03	6.89	126.5–181.0
14	29	150.9	6.5	135.7–164.0	1325	159.31	6.43	134.5–180.3
15	11	156.8	4.4	145.1–162.9	1563	161.16	6.34	137.4–191.9
				Weight (kg)				
10		28.3	1.7	25.2–30.5		31.616	6.85	20.0–63.0
11		29.9	4.3	22.4–39.7		36.062	8.03	20.0–78.0
12		32.3	3.8	25.6–41.3		40.860	9.21	20.0–89.5
13		37.2	4.3	27.5–42.9		46.615	9.61	21.0–93.0
14		42.2	5.8	30.3–55.2		49.830	9.06	27.5–94.0
15		47.7	6.0	33.7–55.5		53.000	8.80	26.5–98.0
				Sitting height (cm)				
10		70.7	2.3	65.8–74.4		73.026	3.48	57.5–88.0
11		71.4	2.9	63.4–78.0		75.804	3.75	62.8–87.8
12		73.5	3.3	67.3–81.2		78.885	4.16	59.9–91.0
13		76.2	3.6	69.7–81.2		81.860	3.94	64.2–92.6
14		79.1	3.7	70.1–87.7		83.990	3.64	66.3–96.6
15		81.7	3.2	73.9–85.6		85.327	3.46	61.7–96.6
				Length of the upper extremity (cm)				
10		58.1	2.6	54.4–62.4		58.84	3.69	43.4–84.8
11		59.1	2.4	54.9–63.6		61.85	3.85	44.8–75.4
12		60.6	3.4	54.0–65.7		64.70	4.14	42.3–80.2
13		65.3	3.5	57.1–71.9		67.27	3.92	47.8–83.8
14		66.1	3.9	57.8–74.0		68.65	3.70	51.9–82.3
15		69.1	2.4	65.1–73.7		69.34	3.75	44.5–83.8
				Length of the lower extremity (Height of the anterior superior iliac spine, cm)				
10		76.4	3.7	70.8–81.2		77.21	4.57	54.8– 92.0
11		78.1	3.3	71.6–85.4		81.39	4.96	57.4– 96.2
12		80.2	4.1	71.2–89.4		85.05	4.92	70.4– 99.8
13		84.2	3.8	75.3–90.6		87.91	4.61	63.1–102.5
14		85.5	3.8	78.7–92.9		89.37	4.55	64.0–105.6
15		88.7	3.1	82.7–93.3		89.99	4.58	69.3–106.6

Table 1 cont.

Age (year)	Female gymnasts $\bar{x}$	SD	W	Hungarian national reference values $\bar{x}$	SD	W
			Biacromial diameter (cm)			
10	29.8	1.2	28.1–31.7	30.24	1.88	23.5– 39.6
11	30.1	1.5	27.4–33.2	31.57	1.99	24.0– 39.0
12	31.2	1.6	27.3–33.6	32.92	2.11	25.7– 40.4
13	32.8	2.0	28.7–36.0	34.26	1.90	26.1– 40.3
14	33.9	2.0	29.3–38.7	35.08	1.82	28.7– 41.5
15	35.4	1.4	32.5–37.3	35.57	1.75	29.3– 40.6
			Biilocristal diameter (cm)			
10	19.5	0.6	18.8–20.4	21.45	1.86	16.7– 30.0
11	20.0	1.0	17.9–22.1	22.58	1.98	17.9– 31.5
12	20.5	1.3	18.3–23.0	23.73	2.14	17.1– 34.0
13	22.1	1.4	20.0–24.1	25.03	1.98	17.6– 34.0
14	23.0	1.4	20.1–26.1	25.72	1.91	20.2– 33.1
15	23.4	1.1	21.3–25.1	26.34	1.92	20.7– 34.8
			Bicondylar width of humerus (cm)			
10	53.9	2.2	50–58	54.13	3.66	42– 69
11	54.8	2.8	51–62	56.57	3.61	45– 73
12	56.1	2.9	50–62	57.98	3.68	45– 73
13	58.4	2.4	54–63	59.39	3.52	49– 73
14	59.3	2.1	56–66	60.15	3.41	48– 73
15	60.9	2.9	56–65	60.71	3.46	51– 74
			Bicondylar width of femur (mm)			
10	77.6	2.4	74–82	81.77	5.43	66–105
11	79.4	3.7	73–87	84.81	5.59	65–109
12	81.6	3.4	76–89	86.74	5.65	66–110
13	82.5	3.3	76–87	88.79	5.70	67–117
14	84.5	3.2	78–92	89.83	5.52	77–116
15	86.4	3.7	77–93	91.12	5.57	72–118
			Chest circumference (cm)			
10	63.6	1.7	61.2–66.5	65.18	6.19	52.0– 93.0
11	65.7	2.7	59.8–71.2	68.85	6.61	54.5– 99.2
12	68.3	3.8	62.8–76.4	72.07	6.80	53.2–103.5
13	72.5	3.4	64.5–76.8	76.38	6.72	55.3–107.3
14	78.4	5.3	64.7–89.0	78.29	6.06	60.8–111.0
15	81.6	3.9	73.9–88.4	80.28	5.69	61.2–109.0

Table 1 cont.

Age (year)	Female gymnasts $\bar{x}$	SD	W	Hungarian national reference values $\bar{x}$	SD	W
			Upper arm circumference, relaxed (cm)			
10	19.5	1.0	17.4–21.1	19.84	2.59	13.8– 31.5
11	19.5	1.2	17.0–22.5	20.67	2.74	14.1– 32.0
12	20.3	1.5	17.7–23.2	21.52	2.77	14.6– 32.8
13	21.4	1.2	18.0–23.8	22.68	2.92	16.1– 37.2
14	22.8	1.6	19.3–26.0	23.37	2.72	16.3– 35.5
15	24.1	2.0	19.5–26.8	24.24	2.63	16.1– 35.0
			Upper arm circumference, contracted (cm)			
10	20.2	1.0	17.9–21.8	20.54	2.60	14.1– 31.7
11	20.4	1.4	17.3–23.6	21.42	2.77	15.2– 33.6
12	21.1	1.5	18.2–23.8	22.27	2.80	15.8– 34.2
13	21.9	1.3	18.2–24.6	23.45	2.93	17.0– 37.8
14	23.5	1.6	19.8–26.5	24.16	2.70	17.8– 35.7
15	24.9	2.0	20.2–27.4	24.99	2.64	17.0– 35.8
			Calf circumference (cm)			
10	27.2	0.8	25.7–28.6	28.01	2.75	16.5– 39.2
11	27.6	1.6	24.3–31.5	29.46	3.15	17.7– 43.0
12	28.7	1.5	25.8–31.0	30.81	3.23	22.3– 45.5
13	30.4	1.7	26.0–33.0	32.47	3.23	18.0– 45.1
14	31.7	2.1	26.5–34.8	33.25	3.03	22.8– 47.1
15	33.5	1.9	29.5–36.3	34.34	2.90	23.2– 46.5
			Skinfold over triceps (mm)			
10	8.1	1.7	5–10	14.27	5.33	2–38
11	7.8	1.6	5–12	14.97	5.62	2–38
12	8.3	2.7	5–14	15.39	5.61	4–47
13	8.7	2.6	5–13	16.26	5.95	5–43
14	8.7	2.2	5–14	17.27	5.66	6–38
15	10.3	2.4	7–15	18.85	5.68	4–41
			Skinfold subscapular (mm)			
10	4.8	0.8	4– 6	9.25	5.50	3–40
11	5.0	0.8	4– 7	10.17	5.80	2–40
12	5.3	1.2	3– 8	11.02	5.82	3–43
13	5.8	1.3	3– 8	12.28	6.15	4–43
14	7.3	2.8	4–18	13.14	5.85	3–47
15	8.0	2.0	5–12	14.04	5.86	4–48

Table 1 cont.

Age (year)	Female gymnasts x̄	SD	W	Hungarian national reference values x̄	SD	W
			Skinfold suprailiac (mm)			
10	6.9	2.8	3–11	16.39	9.49	2–52
11	7.0	1.9	3–11	18.44	9.67	3–53
12	8.7	3.9	4–17	19.38	9.47	3–57
13	9.2	3.1	3–14	21.39	9.39	5–54
14	11.7	4.3	4–25	22.61	8.90	3–55
15	12.2	4.0	7–20	23.84	8.71	6–53
			Skinfold medial calf (mm)			
10	8.6	2.3	5–13	16.14	6.10	3–46
11	8.5	1.8	6–14	17.59	6.74	3–43
12	9.2	2.6	6–14	18.44	6.85	5–56
13	10.0	3.1	4–15	19.67	7.03	6–52
14	9.0	2.6	5–17	20.75	6.76	5–53
15	10.2	2.8	6–14	21.92	6.86	3–52

The majority of the gymnasts were in the channels between the 25th and 75th percentiles, i.e. their body build is more or less shapely (Fig. 3).

The female gymnasts were also smaller than their counterparts in width measurements of the trunk, less so in the biacromial width (0.2–1.5 cm) than the bicristal width (2.0–3.2 cm) indicating a slightly more robust shoulder girdle. The female gymnasts were only slightly smaller in bicondylar humerus width (0.2–1.9 mm) whereas the differences in bicondylar femur width were larger in the range of 4.2–6.3 mm. The gymnasts were smaller than the reference national sample in girths, however, in upper arm circumference the differences were negligible and presumably if corrected for subcutaneous adiposity they would be significantly larger than the other girths perhaps reflecting muscularity in the arms. The subcutaneous adiposity values of gymnasts estimated by skinfolds were smaller than those of the reference national sample.

Somatotype

As a group the female gymnasts were primarily ectomorphic-mesomorph with Heath–Carter somatotype rating of 2.54–4.05–3.39. Figure 4 shows that female gymnasts ranged from mesomorphic-endomorph through mesomorph-endomorph, endomorphic-mesomorph, balanced mesomorph, ectomorphic-mesomorph, mesomorph-ectomorph to mesomorphic-ectomorph and balanced ectomorp as well as the central category.

The Hungarian female gymnasts' sample had mean somatotypes which were somewhere between those of the Mexico Olympic Games female gymnasts of 2.7–4.2–2.8 reported by de Garay et al. (1974) and the Montreal Olympic Games female gymnasts of 2.1–4.0–3.4 reported by Carter et al. (1982). In one of his papers Carter (1981, page 92) gave an overview on some characteristics of young female gymnasts who represented different age-groups, nations, races, physical maturity, etc. In Carter's table mean values of endomorphy, mesomorphy and ectomorphy varied between 1.4 and 3.8, than 3.3 and 5.2, than 1.6 and 4.1, respectively. The Hungarian sample is at about the middle of these ranges in endomorphy and mesomorphy, however, in ectomorphy it is above of it.

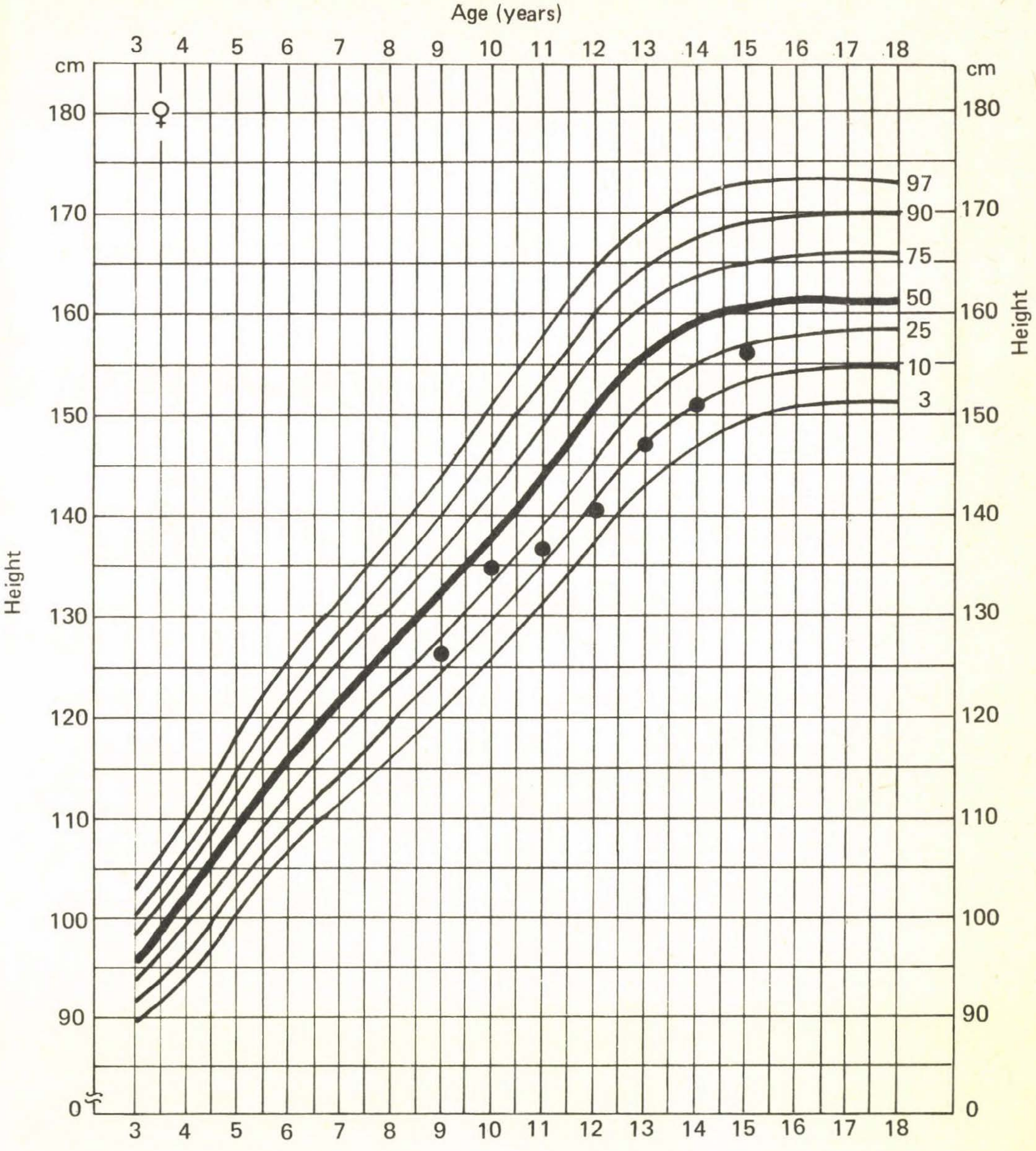

Fig. 1: Mean heights of the female gymnasts plotted on the Hungarian National Height Standards' percentile curves

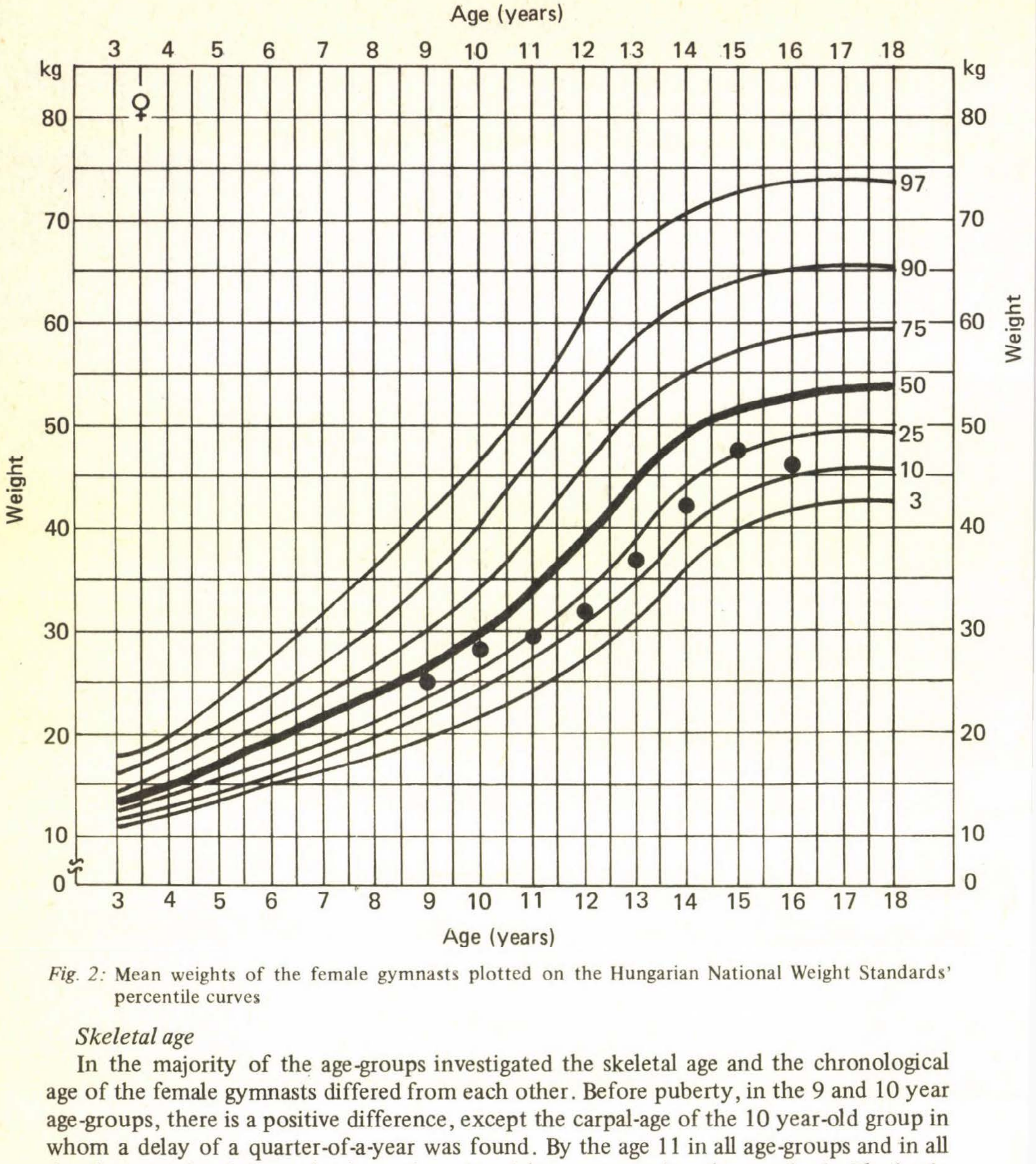

Fig. 2: Mean weights of the female gymnasts plotted on the Hungarian National Weight Standards' percentile curves

Skeletal age

In the majority of the age-groups investigated the skeletal age and the chronological age of the female gymnasts differed from each other. Before puberty, in the 9 and 10 year age-groups, there is a positive difference, except the carpal-age of the 10 year-old group in whom a delay of a quarter-of-a-year was found. By the age 11 in all age-groups and in all the three kinds of the skeletal age there is a delay, compared to the standards. The backwardness in skeletal age in the 15 and 16 year-old gymnasts is the most remarkable, e.g. in 20TW2 it is about one-and-a-half year. Based on these data it can be stated that in the skeletal maturation in female gymnasts there is a remarkable retardation, especially at puberty (Table 2., Fig. 5)

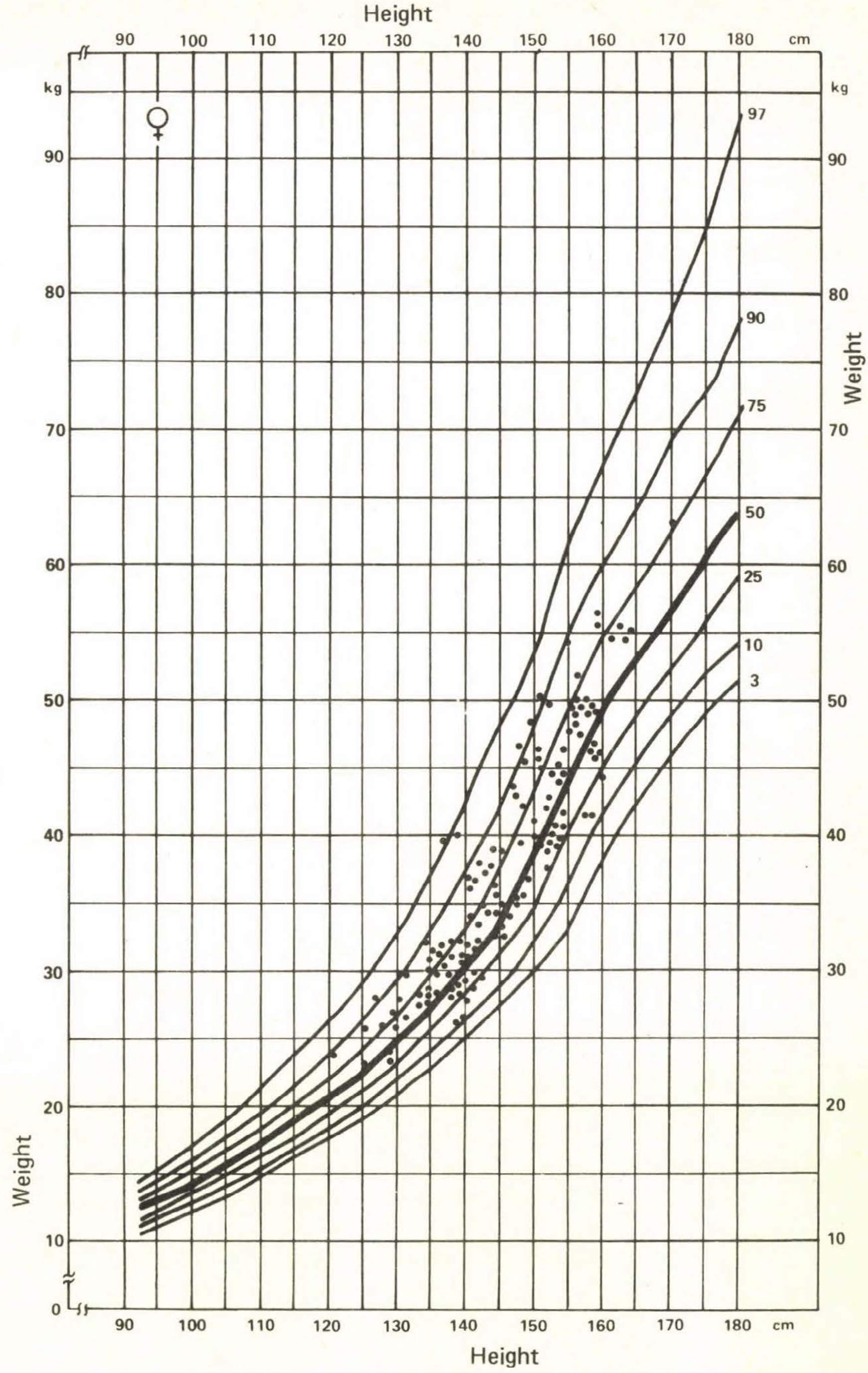

Fig. 3: Female gymnasts on the Hungarian National Growth Standards' weight-for-height percentile curves

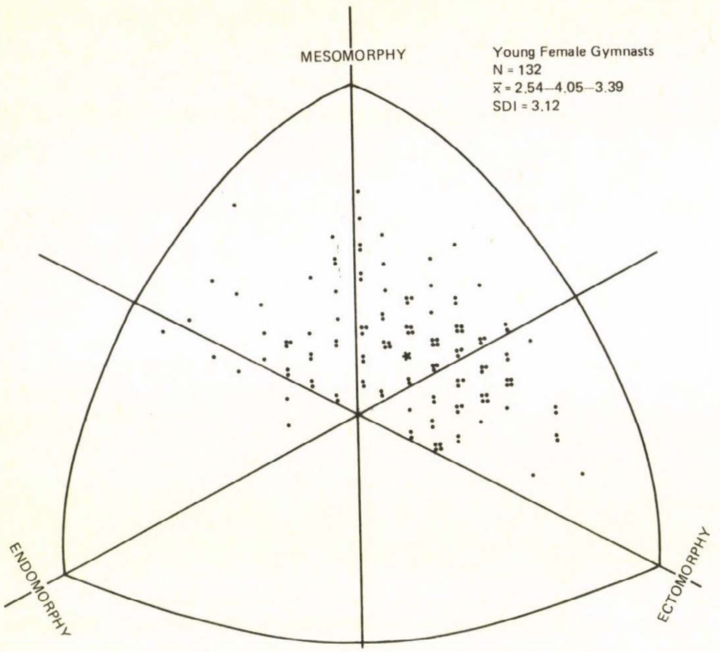

Fig. 4: Somatotypes of the female gymnasts

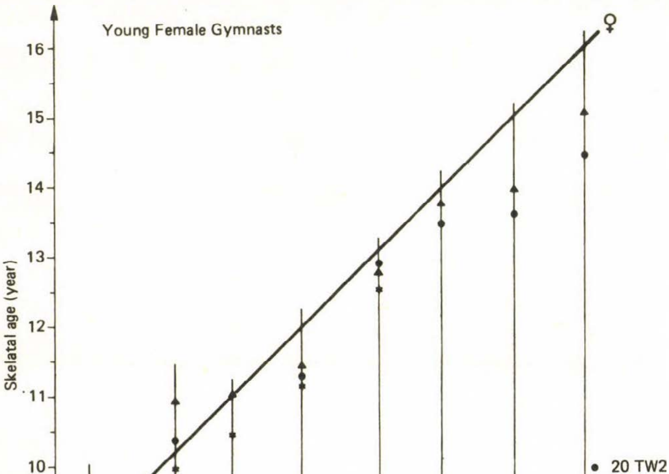

Fig. 5: Skeletal age of the female gymnasts compared to their chronological age

Table 2. Chronological age and skeletal age of the female gymnasts

Age (year)	N	Chronological age		Skeletal age 20TW2		RUS		Carpal	
		$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
9	4	8.97	0.45	9.65	0.28	9.70	0.59	9.20	1.33
10	9	10.19	0.33	10.35	0.91	10.94	0.98	9.94	0.67
11	21	11.03	0.22	10.76	1.11	11.06	1.34	10.44	1.10
12	18	12.00	0.21	11.30	1.44	11.40	1.22	11.19	1.58
13	18	13.13	0.34	12.93	0.94	12.82	0.82	12.52	0.10
14	26	14.01	0.28	13.50	1.10	13.79	1.13	–	–
15	11	15.05	0.27	13.61	1.11	13.99	1.11	–	–
16	9	16.06	0.26	14.48	0.41	15.17	0.53	–	–

Menarche

The physiological maturation of the female gymnasts can be characterized among others also with age at menarche. The median of the investigated group is m=15.04±0.62 year which is extraordinarily late. The investigations carried out in the last decades in Europe and also in Hungary resulted in much earlier menarche medians of 12.6–13.0 year (Pantó 1980, Danker-Hopfe 1986a, 1986b). The Hungarian National Growth Study's female sample gave a median of m=12.89±0.10 year. Comparing the female gymnasts' median to these, they showed a late maturation by about 2.0–2.5 years.

It is also obvious that in the gymnasts the first onset of the menstruation was among the 13.5 year-old girls, while in an average population it usually appears at the age of 10.0–10.5 years. As it is well-known, menarche appears as the result of a certain developmental level of the cortex–hypophysis–ovarium system. R. E. Frisch observed that appearence of menarche postulated a body weight of 46–47 kg. Although her theory was thought to be controversial it is true that a critical weight and a certain developmental level of the neuroendocrine system are preliminary conditions of onset of menarche. The question is: whether the sport achievements are in proportion to the deleterious effect of the small body weight which can only be produced by a special diet. In the prepubertal and pubertal age where the investigated female gymnasts should belong on the basis of their chronological age, normally a significant growth spurt is detectable. This phenomenon usually appears in the means of height and weight. The intensive phase of growth needs a certain amount of food and especially the sufficient protein intake. One must suppose that the young female gymnasts did not accept all these. The great physical load of an especially hard training and the reduced protein intake as a part of a very strict diet (alimentary insufficiency?) hinder their biological maturation.

It is a well-known fact that menarche occurs during the descending branch of the height velocity curve, at the moment when the velocity dropping fastest. The female gymnasts investigated, because of their late maturation, produced a late and long-lasting pubertal growth spurt. This probably had an advantegeous effect on the load of their training and on their achievements.

When we adopt the old question: „Are athletes born or being made?" (Eiben 1972), in reference to our case we think that the intentional choice has an important role. We should suppose that trainers prefer children retarded in their growth who are supposed to have a late maturation. These children because of their rigorous training and special diet would be much more retarded than the normal children at the same age.

Summary

(1) The young Hungarian female gymnasts were less developed than their counterparts in their lenght, width and girth measurements. This retardation was undoubtedly caused by environmental and not by genetic factors.

(2) Their somatotype was mostly ectomorphic-mesomorph and in a minority meomorphic-ectomorph and balanced mesomorph.

(3) Their pubertal growth spurt and sexual maturation occurred 2.0–2.5 years later than those of their normal counterparts, and their skeletal maturation was also remarkably retarded.

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THE PHYSIQUE OF URBAN GIRLS

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Abstract: Changes in stature, body mass and somatotype of urban girls was observed in a longitudinal study. The 85 girls were divided into subgroups according to the time of their menarche. The individual somatotypes were estimated by the Health-Carter anthropometric method, the somatotype components were obtained by using regression formulae.

The differences in stature and weight between early and late maturers were found to diminish in the studied age-interval. There were differences in the somatotype and in the pattern of somatotype migration. Endomorphy was more evident in the early maturers and ectomorphy in the late ones. The somatochart shows the early maturers moving towards the endomorphic field while retaining their mesomorphic level, and the late maturers demonstrated a reduction of the second component.

Key words: Body mass, Stature, Somatotype, Maturation

Introduction

There are several studies dealing with the body dimensions of girls maturing early or late (Bodzsár 1975, Prokopec 1982, Tanner 1961, 1962, Tanner et al. 1966). There are only a few available reports on the change or variation of the somatotype during maturation (Acheson–Dupertuis 1957, Bodzsár 1980, 1984, Hunt et al. 1958).

Accordingly, the first purpose of the present study was to report on the age-dependent changes that occurred in the stature, body mass and somatotype in a group of urban girls during pubescence. The second aim was to discover whether differences existed between the subgroups of these girls classified according to the time of their menarche.

Material and Methods

All the 85 girls reported here were born in the first half of the year and belonged to a sample of children observed longitudinally in Jászberény, an average-sized town in the middle of Hungary, central to the region called Jászság.

A prospective method of collecting menarcheal age data was used, as this yielded accurate dates for every girl, and enabled us to classify them into groups of half a year.

Of the body dimensions measured at yearly intervals between 1979 and 1982, stature and body mass will be discussed.

Individual somatotypes were estimated by the Heath–Carter anthropometric method (Carter 1975), somatotype components were obtained by using regression formulae (Szmodis 1977). Stature, body mass and somatotype of successive age groups were tested for significant differences by t-tests for dependent samples Parameters of the respective menarcheal age subgroups were compared by t-tests for independent samples.

Results

Figure 1 shows the successive means for stature in the whole sample. The menarcheal subgroups are designated by letters. It can be clearly seen that at the age of 10.5 the girls who would mature early, were the tallest. At a later age, however, the intergroup differences tended to diminish. These findings agree with other reports which have found no difference in the final stature between groups maturing early and late (Malinowski–Pawlaczky 1967–68). The curves also illustrate that the rate of growth began to decrease after

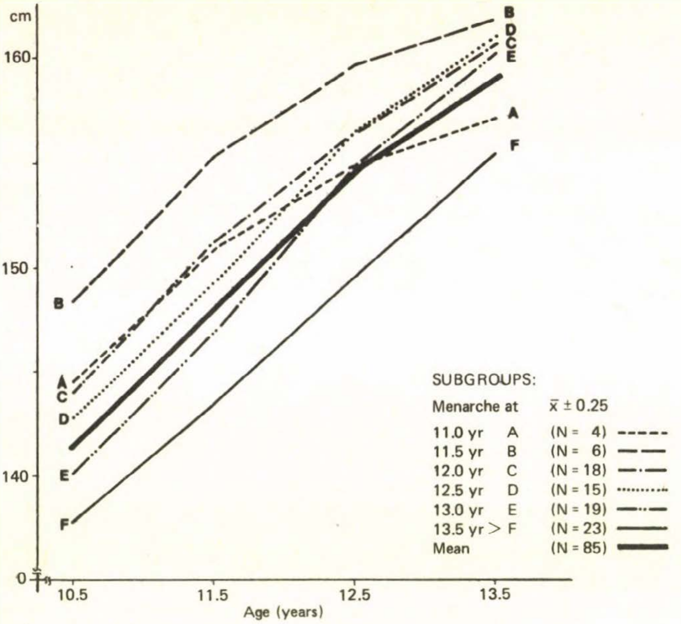

Fig. 1: The stature of Jászberény girls

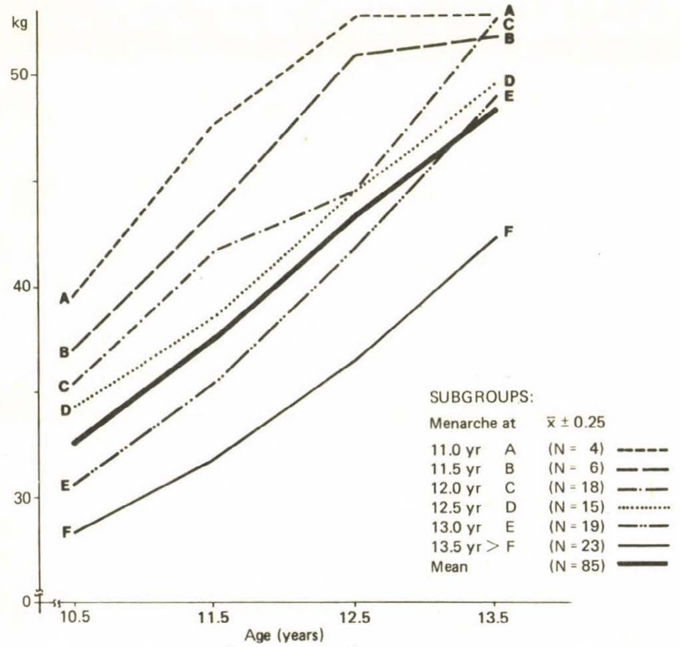

Fig. 2: The body mass of Jászberény girls

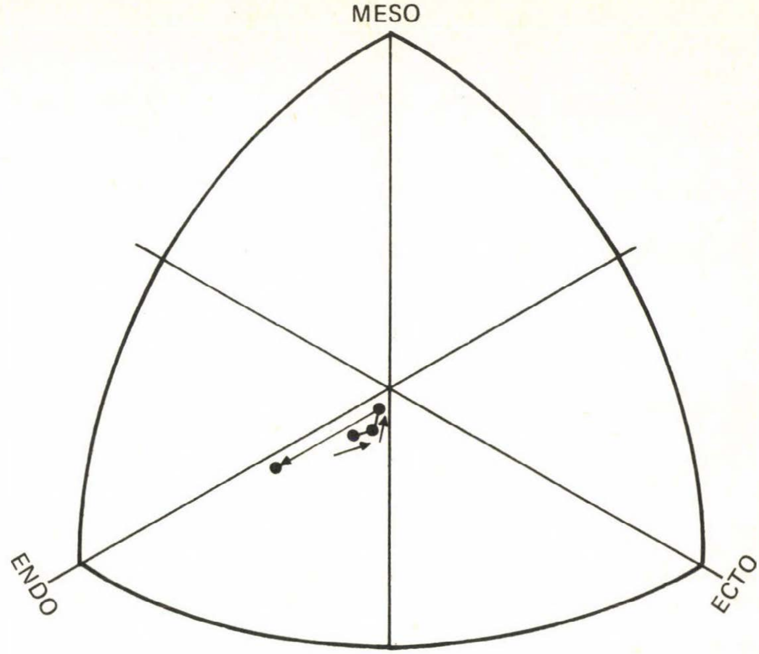

Fig. 3: Somatotype migration of the total group

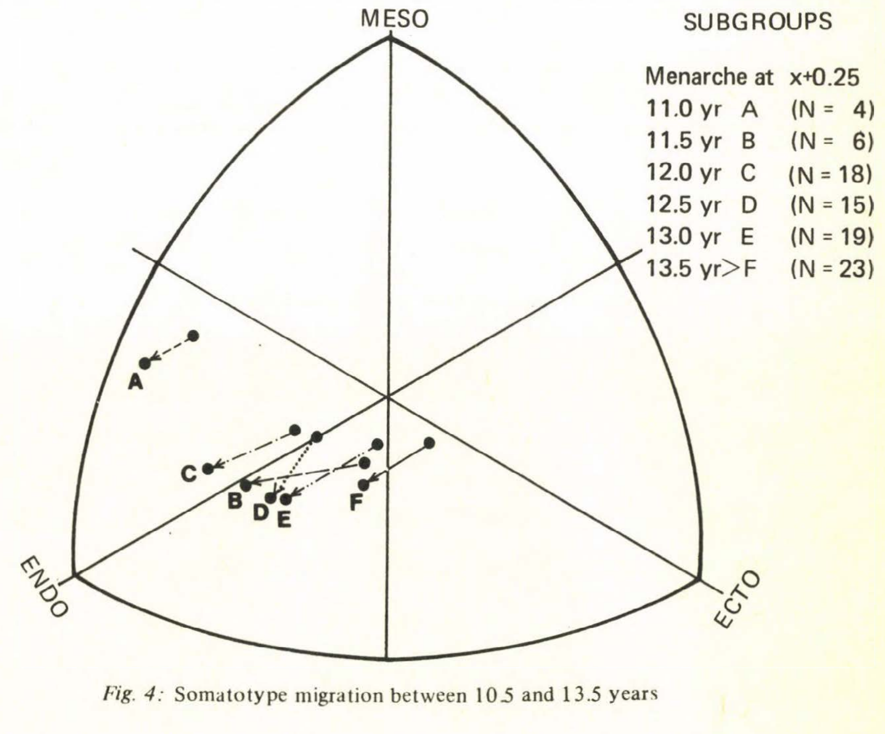

Fig. 4: Somatotype migration between 10.5 and 13.5 years

menarche had set in. The diversity in the body mass of the menarcheal subgroups also decreased with age (Fig. 2). At 13.5 years, the girls who had qualified as mature had nearly the same weight.

In summarising the means and standard deviations of the somatotype components, the Table 1 displays a tendency common to all the three components: a constancy with age. In endomorphy, however, this constancy was replaced by a marked rise after 12.5 years of age. When plotted on the somatochart (Fig. 1, 3), the first three somatopoints of the whole sample were found to reside in the central hexagon. Then, between 12.5 and 13.5 years of age, the mean was abruptly moved to the field of balanced endomorphy.

Table 1. Statistical parameters of somatotype in Jászberény girls

Age (year)	Endomorphy		Mesomorphy		Ectomorphy	
	$\bar{x}$ $s_{\bar{x}}$	s	$\bar{x}$ $s_{\bar{x}}$	s	$\bar{x}$ $s_{\bar{x}}$	s
10.5	4.63 ± 0.22	2.00	3.62 ± 0.11	1.06	4.06 ± 0.16	1.45
11.5	4.40 ± 0.19	1.76	3.54 ± 0.12	1.11	4.04 ± 0.17	1.60
12.5	3.92 ± 0.19	1.75	3.45 ± 0.13	1.22	3.82 ± 0.17	1.61
13.5	5.58 ± 0.16	1.45	3.12 ± 0.14	1.26	3.52 ± 0.16	1.45

In comparison with the very gradual decrease of endomorphy in the first two years, the last year of the observation showed a quite considerable change in fatness which was not at all apparent in the curve of body mass. Considering the not very high level of standard deviations in the table shown earlier and the apparently simple pattern of somatotype migration of the whole sample, the complexity of the second somatochart is striking (Fig. 4). These are the migration traces of the menarcheal age subgroups, but only the start and end points are shown, from 10.5 to 13.5 years of age. Group A, those mature at the age of 11, can be found in the field of mesomorphic endomorphy, distinctly separated from the rest other groups with little change. The girls with an averaga age at menarche start and finish as balanced endomorphs. Only the endpoint of the girls with menarche at age at 13 is shown because they start from the central field. The starting point of those who failed to reach menarche until the end of the observation period was within the balanced ectomorphy field and they ended up as endomorphic ectomorphs. Thus, endomorphy was dominant in all the girls who matured early, and ectomorphy was dominant in the relatively belated ones. Group B, a relatively early group, was interesting in that they retained their level of mesomorphy while moving towards endomorphy. All the other groups showed a further reduction of the second component.

Late maturation is a kind of younger biological age. The somatotype pattern of the menarche groups extending from ectomorphy to mesoendomorphy raises the question whether the groups would retain or change their direction of migration. If the course of development is regular, the late ones also would move towards increasing mesoendomorphy, as exemplified by groups C, B and A.

When, however, every subgroup retains its former direction of migration, this would mean that basically dissimilar patterns of growth and development can exist for the early and late maturers.

This point could not be settled from the present material and is worth pursuing.

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BODY STRUCTURE, SOMATOTYPE, AND MOTOR FITNESS OF YOUNG BELGIAN BASKETBALL PLAYERS OF DIFFERENT COMPETITIVE LEVELS

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Abstract: The purpose of this study is to compare bodily characteristics, somatotype and motor fitness of young Belgian basketball players competing at national (N=16) and regional (N=14) level. The mean chronological age of the national and regional groups varied between 15.3 ± 0.6 years and 15.1 ± 0.4 years, respectively. The following anthropometric dimensions were taken: weight, height, reaching height, humerus and femur widths, biceps and calf girths and the triceps, scapula, suprailliac and calf skinfolds. Somatotype was estimated according to the anthropometric Heath–Carter technique and motor fitness was evaluated by means of the Leuven Motor Ability Test Battery (Renson et al. 1980). Mean values and standard deviations were calculated for all variables. Because a difference for skeletal age was observed between both groups, differences between the variable means were tested by an analysis of co-variance with skeletal age as covariate. When skeletal age was held constant, the results indicate that in the national group significant (p < 0.05) higher values were found for weight, height and biceps and calf girths. Although the somatotype analysis revealed that the national group could be described as more endomorphic, more mesomorphic and less ectomorphic in comparison with the regional group, no significant differences between the component means could be observed (mean somatotypes of 2.8–4.1–3.9 and 2.3–3.7–4.5, respectively, were noted). For the motor characteristics the national group performed significantly better for speed of limb movement (test: plate tapping), static strength (test: arm pull), functional strength (test: bent arm hang) and running speed (test: shuttle run 50 m).

Key words: Basketball-players, Somatic development, Motor fitness.

Introduction

The relation between body structure and function has already been stressed in a number of studies. Apart from technical and other factors (e.g. tactical, psychological, physiological), the bodily constitution also plays a determining role in the achievement of top sporting performance. It is also indicated that for different types of physical activities different types of physique are required, and even so, that such bodily characteristics play a major role in the success of the athlete at all levels of competition. Already various researchers have carried out studies on basketball players to investigate the somatic structure, body type and body composition of these sportsmen, most of these studies are dealing with the observation of senior basketball players, competing at Olympic or high national level (e.g. Bláha 1981, Brown el al. 1974, Laska-Mierzejewska 1980, Lewis 1966, Mathur 1982, Muthiah and Sodhi 1980, Novotný 1963, Soares et al. 1986, Sodhi 1980, Vaccaro et al. 1980, Verma et al. 1978, Whiters et al. 1977). Studies on young basketball players are rather scarcely (Chovanová and Zapletalova 1980, Hopkins 1979, Mészáros et al. 1980).

The aim of this study is to test the hypothesis that already at adolescence young basketball players are characterised by typical somatic and motor characteristics which are more pronounced in boys competing at a higher level.

Material and Methods

Subjects

The test groups investigated consisted of 16 and 14 young boys competing at high (= national) and lower (= regional) levels, respectively. The boys of the national group were selected by the national coach from different regional clubs of Belgium. The boys of the regional group were all players of the basketball club Standard A.Z.H. from the Leuven regio.

For the national and regional groups mean chronological age of 15.3 ± 0.6 and 15.1 ± 0.4 years, respectively, are observed.

Measurements and Tests

To determine the somatic structure the following anthropometric dimensions were taken: weight, height, reaching height, humerus and femur widths, biceps and calf girths, and triceps, scapula, suprailliac and calf skinfolds. All the measurementes were taken according to the recommendations made by Cameron (1978).

Skeletal age was determined according to the Tanner–Whitehouse II method (Tanner et al. 1975).

The three components of the somatotype were anthropometrically determined according to the Heath–Carter technique (Carter 1975).

To evaluate the motor fitness of our testees the Leuven Motor Ability Test Battery (Renson et al. 1980) was administered.

Statistical Analysis

Mean values and standard deviations were calculated for all variables. Because a significant difference for skeletal age was observed between both groups, differences between the variable means were tested by an analysis of co-variance with skeletal age as the covariate (Nie et al. 1975).

Results and Discussion

The means and standard deviations of the somatic characteristics for both groups are given in Table 1. Significant differences (ANCOVA) between the means are also indicated. For all dimensions boys competing at the national level have bigger body dimensions than boys competing at the regional level. Although both groups are of the same chronological age, the national group is however significantly ($p < 0.01$) skeletally more mature than the regional group.

Table 1. Means (M) and standard deviations (SD) of somatic characteristics of young Belgian Basketball Players

Somatic characteristic	National Group (N=16)		Regional group (N=14)		F-ratio (A)
	M	SD	M	SD	
Weight (kg)	69.8	10.1	58.0	8.8	4.757(*)
Height (cm)	181.9	7.2	173.8	8.0	4.244(*)
Reach. height (cm)	234.4	10.0	225.5	10.9	2.505
Humerus width (cm)	7.2	0.3	6.9	0.4	3.342
Femur width (cm)	10.0	0.5	9.7	0.4	1.617
Biceps girth (cm)	29.3	2.5	25.9	2.2	6.863(*)
Calf girth (cm)	36.4	2.0	34.0	2.2	5.775(*)
Triceps skinfold (mm)	9.1	2.8	8.1	1.6	0.068
Suprailiac skinfold (mm)	9.4	4.3	7.9	2.5	0.072
Subscap, skinfold (mm)	9.7	2.9	7.2	1.5	3.544
Calf skinfold (mm)	8.6	2.6	8.5	2.3	0.344
Sum skinfolds (mm) (B)	28.3	8.2	23.2	4.7	0.784

(A) Ancova/skeletal age
(B) Triceps + subscapular + suprailiac skinfolds
(*) $p \leq 0.05$

The mean skeletal ages of both groups are 16.5 ± 1.0 and 15.4 ± 0.8 years, respectively. When this maturity characteristic is held constant the results of the ANCOVA-analysis indicate (cfr. Table 1) that in the national group significant ($p < 0.05$) higher mean values are found for weight, height, and biceps and calf girths. It is thus indicated that not only a higher stature, but also a more muscular body build are clearly an advantage to play basketball at a higher competing level. These results are in full agreement with the findings of Mészáros et al. (1980) who compared 21 talented young basketball players (mean age: 11 years) with children with normal development and average physical activity. Means and standard deviations of the three somatotype components are given in Table 2.

Table 2. Means (M) and standard deviations (SD) of somatotype components and ponderal index of young Belgian Basketball Players

Component	National group (N=16)		Regional group (N=14)		F-ratio (A)
	M	SD	M	SD	
Endomorphy	2.8	0.8	2.3	0.6	0.688
Mesomorphy	4.1	0.8	3.7	0.9	0.320
Ectomorphy	3.9	1.0	4.4	1.0	0.063
Som. pond. index	44.3	1.4	45.0	1.4	0.065

(A) Ancova/skeletal age

The somatotype distribution of both groups are shown in Figure 1. For the national (A) and regional (B) groups somatotype means of 2.8–4.1–3.9 and 2.3–3.7–4.4, respectively, are observed. The somatotypes of 15–16 year old basketball players of the best Czechoslovak teams, investigated by Chovanová and Zapletalova (1980), are situated in the same sector as that of our groups, indicating that young basketball players have, in general, mesomorphic–ectomorphic body types (classification according to Carter, 1975).

Although no significant differences between the component group means are observed, we can state, in general, that the higher competing group (=national) is more endo-mesomorph than the lower competing regional group, as shown in the somatotype distribution (Fig. 1). Analyzing the physique of New Zealand basketball players (estimated according to the method of Parnell, 1958), Lewis (1966) demonstrated also that mesomorphy is a factor in better playing ability as seen in the steady upward shift on the somatochart of players from A grade club teams (= lower level) to national representatives (= higher level).

The means and standard deviations of the motor characteristics for both the national and regional groups are given in Table 3. When skeletal age is held constant the analysis of covariance reveals significant better results for the national group on the following motor test items: plate tapping, arm pull, bent arm hang and shuttle run, indicating that basketball requires athletes with good performance for speed of limb movement, static and functional strength, and running speed.

Using skill tests to identify successful and unsuccessful basketball performers, ranging in age from 12 to 17 years, Hopkins (1979) found that, beside some specific basketball skill (e.g. speed pass, front shot and zig-zag dribble), also other motor performance tests discriminate effectively between both performing groups, namely: zig-zag run, side step, and free jump. Although the 'free jump' is a slightly modified jump and reach test (in the free jump the participants were allowed to move one foot prior to take off), neither

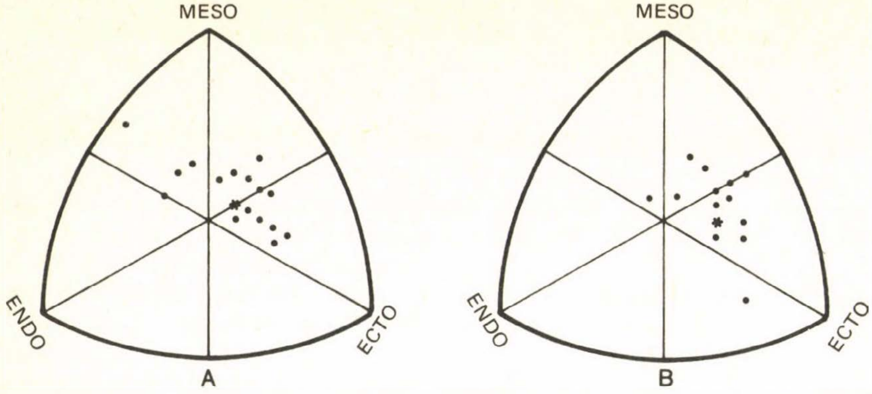

Fig. 1: Somatotype distribution of young Belgian basketball players competing at national (A) and regional (B) levels (N=16 and 14, respectively)

Table 3. Means (M) and standard deviations (SD) of motor characteristics of young Belgian Basketball Players

Motor test item	National Group (N=16)		Regional group (N=14)		F-ratio (A)
	M	SD	M	SD	
Flamingo balan. (N/60 S)	15.4	4.9	14.9	5.1	0.475
Plate tapping (N/20 S)	83.5	10.5	77.8	10.0	6.386(*)
Sit and reach (cm)	24.6	5.5	22.5	4.3	1.349
Vertical fump (cm)	55.2	4.6	47.9	6.9	3.000
Arm Pull (kg)	68.0	9.8	44.2	10.1	27.426(**)
Leg lifts (N/20 S)	16.6	2.7	14.1	1.8	2.898
Bent arm hang (sec)	43.5	16.8	25.5	12.0	7.534(*)
Shuttle run (sec)	18.9	1.0	20.1	0.7	4.719(*)

(A) Ancova/skeletal age
(*) $p \leqslant 0.05$
(**) $p \leqslant 0.01$

in Hopkins' study, nor in our investigation the 'classic' vertical jumb could be identified as a test discriminating boys playing basketball at higher and lower levels, respectively.

Compared to our data, Soares et al. (1986) found also a rather moderate 'regional' result on the vertical jump test (mean: 47.95 ± 8.45 cm) measured on 21 Brazilian basketball players (mean age 24.43 ± 3.59 years) selected for the 1983 Pan-American Games.

In conclusion: Although basketball demands especially athletes with higher stature, results of this study reveal that young players whose tall stature is associated with a more robust body build and some specific basic motor characteristics (e.g. speed of limb movement, static and functional strength, running speed) are at advantage in this specific ball game.

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SELECTED FACTORS OF PHYSICAL PERFORMANCE IN THE HUNGARIAN YOUTH

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Abstract: The author presents a brief report on the study that was initiated as a part of a nation-wide, cross-sectional project to determine the mental, social, biological and physical performance abilities of Hungarian school-children from 3 to 18 years of age. The author's sample size was approximately 28000, boys and girls, aged 6–18 years. The random sample was representative of all types of settlements and all types of schools. The investigation was connected functionally to Eiben's study of „The Hungarian National Growth Standards". These two investigations were carried out simultaneously on the same sample. The functional examinations consist of the testing of the motor performance capacity (strength, speed, endurance). The boys performed better than the girls in the strength tests. In the younger girls' muscular endurance is similar to boys; a difference occurs with the change of ages. The greatest difference between boys and girls occurs in cardio-vascular endurance.

Key words: Physical performance, Hand grip strength, Medicine ball push, Standing broad jump, Sit-up Test, Burpee-test, 60 m dash, 12 minutes endurance run.

Introduction

Biological development manifests itself in the physical structure and physical performance. These factors affect each other mutually but not to the same extent. Numerous studies relating to biological development and physical performance have been published recently (Hebbelinck–Borms 1978, Ostyn 1980, Kemper 1985). Besides the standardized tests of biological development we utilized several kinds of „national test-batterie". There were well-developed, recommended test-batteries of fundamental motion-forms like jumping, running and throwing. In order to make some comparison of the results of the motor tests, it was necessary to evaluate motor fitness (Simons–Renson 1982). The majority of Hungarian studies are characterised by an anthropometrical approach in which some motor performance tests were also used. The present research dealing with physical performance was justified because in the former studies – on the physical performance of Hungarian youth – there were some inadequacies of data collection, in other cases the sample was not large enough or representative of the whole population.

The purpose of the study was to describe the level of physical fitness of the Hungarian youth. It was also aimed to give suggestions on the basis of the comprehensive study on the biological and motor development of the youth and its relation to social structures. The major aims of the study were to

– find out precisely how sexual dimorphism and biological development determine the performance scores that may reflect different trends of physical abilities;

– display the performance scores of different groups categorised by sex, age, size of settlements and type of schools, and to analyse the differences;

– determine the relationship of the school-children's social background to their physical performance.

Material and Methods

A diagnosis of the general state and condition of Hungarian school-children between 6 and 18 was set up in the nation-wide, cross sectional, human biological study. This examination was started under the name of „Youth-research" by the Institute of Social Sciences and by the Council of Physical Education and Sport Sciences.

The size of the examined sample is 27430, 14758 boys and 12672 girls. The random sample is representative of all types of settlements and all types of schools (Eiben–Pantó 1981). The representation is 1.5 percent.

The performance tests used were the following: hand grip strength, two hand medicine ball push, standing broad jump, 30 sec. sit-up test, 30 sec. Burpee test, 60 meters dash, 12 minutes endurance run (Haag–Dassel 1975, Hebbelinck–Borms 1978, Mathews 1973, Ostyn et al. 1980, Simons–Renson 1982, Kemper (1985).

Results and Discussion

The age- and sex-specific means of the motor tests are grafically illustrated and given in tables.

Figure 1 and Table 1 show the *hand grip strength* of the boys and girls right and left hand, respectively. The curves of the right and left hand are similar in both sexes. The difference between the values increases by age and by greater strength values. At each age the boys' grip strength is greater than that of the girls'. The girls' performance approaches that of the boys' best at the age of 12, but the differences are still significant (at 0.001 level). The girls' greatest increase in strength occurs between 11–12 years, after that the increase in development levels off. The boys' greatest strength increase occurs between the ages of 14 and 15. There is also a steady increase in strength thereafter.

Our results show that the tendencies are similar to other international results. There is a marked difference in comparison with the Belgian result (Hebbelinck–Borms 1978) in which the girls' score is higher than the boys' at the age of 12.

Boys and girls follow a similar pattern in explosive strength up to 13 years of age, as demonstrated by the *medicine ball push* (Fig. 2, Table 2). The boys' scores are significantly higher than the girls', there is a levelling off for girls, while boys progressively increase in performance.

In the *standing broad jump,* that is a measure of explosive strength of the legs, a similar trend is obvious (Fig. 3, Table 3). Hebbelinck didn't find differences between the boys and the girls of early ages (6 and 7 years), and the stagnation appeared with the girls after 13 years, moreover, even decreases of the scores occurred (Kemper 1985).

In the *sit-up test* (Fig. 4, Table 4) which measures muscular endurance, there is no significant difference between the boys' and girls' performance at the age of 6, 7 and 8. At the age of 9 the boys' performance continues to increase till the age of 16, while the girls' performance levels off. The tendencies and the curves are similar in other investigations; differences can be seen in comparison with Hebbelinck's results. The girls are better than boys at the age of 6, 7, 8 and after 13 the girls' scores decrease. In our sample there is no decrease, only stagnation in the girls' case.

Boys show a steady and significant increase in performance in the *Burpee-test* from the age of 6 to 18 (Fig. 5, Table 5). There is no significant difference at the age of 6, 7 and 8 between boys and girls. The girls' performance tends to level off from the age of 12 and 13.

Boys are significantly faster than girls in the *60 meters' dash* at every age-level (Fig. 6, Table 6). In Hebbelinck–Borms's case (1978) the girls are faster. At the age of 14 the girls no longer improve while the boys' running times continue to decrease.

Boys show a steady and significant increase in *the 12 minutes endurance run* in every age group (Fig. 7, Table 7). The girls' performance increases from the age of 6 to 12, but is significantly lower than the boys'. The girls' performance scores show no futher increase beyond the age of 12. We didn't find any decrease of the girls' scores as Kemper (1985) did.

Table 1. Number of the subjects investigated and means of hand grip strength in boys and girls (right and left hand)

Age (year)		Hand grip strength (kp) Boys N	$\bar{x}$	Girls N	$\bar{x}$
6	Right	200	11.2	209	9.1
	Left		10.9		8.4
7	Right	1066	12.3	950	10.1
	Left		11.7		9.5
8	Right	1168	14.7	1151	12.2
	Left		14.1		11.4
9	Right	1262	17.0	1151	14.5
	Left		17.0		13.8
10	Right	1160	20.3	1099	17.5
	Left		19.1		16.4
11	Right	1176	23.0	1079	20.8
	Left		21.6		19.6
12	Right	1107	26.6	1055	24.3
	Left		24.9		22.9
13	Right	1165	30.6	1079	27.8
	Left		28.9		26.1
14	Right	1164	35.8	1069	30.5
	Left		33.8		28.6
15	Right	1551	42.1	1224	32.0
	Left		39.9		30.0
16	Reight	1577	46.6	1074	33.4
	Left		43.8		31.3
17	Right	1328	49.4	936	33.3
	Left		46.2		31.0
18	Right	737	51.5	537	33.8
	Left		48.5		31.5
over 18	Right	97	49.8	59	33.2
	Left		47.5		32.1

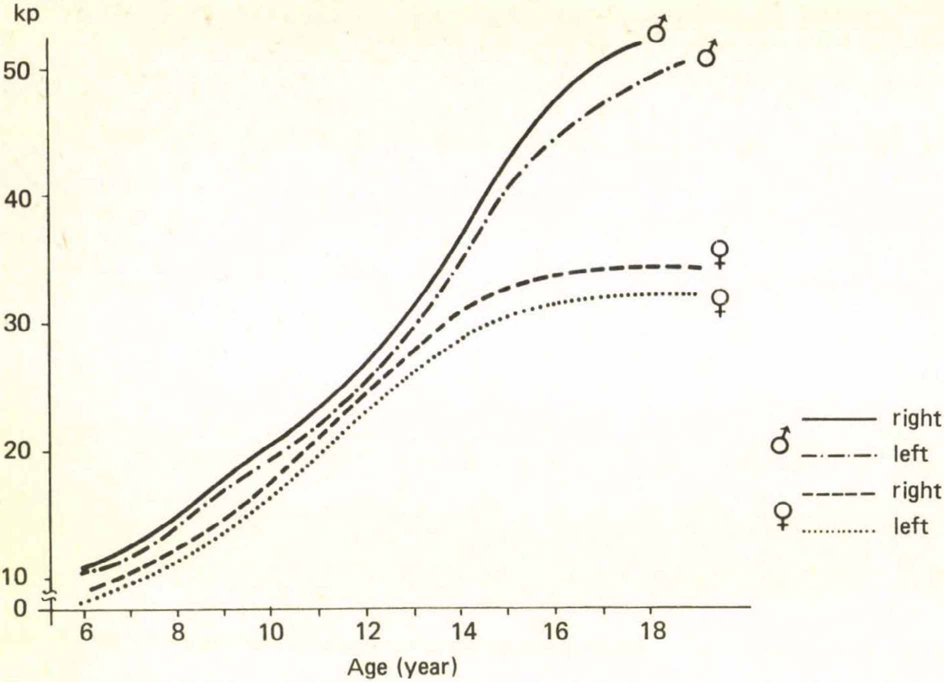

Fig. 1: Means of the hand grip strength in Hungarian boys and girls between 6 and 18 years of age

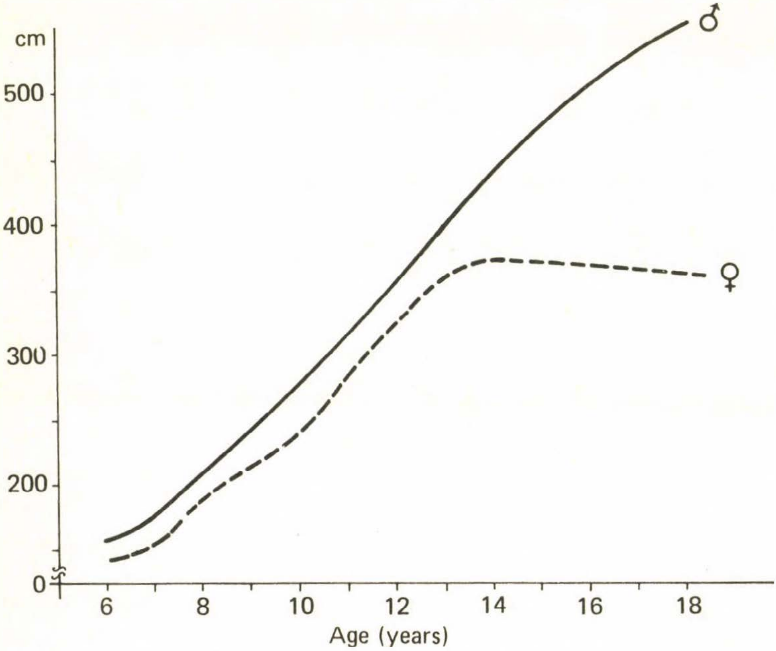

Fig. 2: Means of the medicine ball push in Hungarian boys and girls between 6 and 18 years of age

Table 2. Means and standard deviations of medicine ball push in boys and girls

Age (year)	Medicine ball push (cm)			
	Boys		Girls	
	$\bar{x}$	SD	$\bar{x}$	SD
6	159	28.9	142	34.5
7	176	32.7	154	26.8
8	210	38.7	182	34.0
9	242	43.7	207	38.7
10	276	50.2	237	43.1
11	311	54.5	281	53.5
12	352	64.3	322	56.2
13	402	78.3	363	58.9
14	455	85.3	374	58.6
15	465	81.4	355	52.5
16	506	84.2	362	54.4
17	530	84.4	363	56.6
18	556	86.0	372	64.5

Table 3. Means and standard deviations of standing broad jump in boys and girls

Age (year)	Standing broad jump (cm)			
	Boys		Girls	
	$\bar{x}$	SD	$\bar{x}$	SD
6	100	19.1	96	18.4
7	108	19.2	101	19.7
8	119	20.4	114	18.6
9	130	20.1	124	19.8
10	137	19.4	130	19.5
11	143	17.6	138	18.1
12	150	19.4	145	20.6
13	160	21.7	150	20.2
14	172	23.5	154	20.1
15	185	25.2	155	20.0
16	192	24.7	155	20.0
17	198	25.5	157	19.9
18	206	24.8	160	19.6

Table 4. Means and standard deviations of sit-up test in boys and girls

Age (year)	Sit-up test (N/30 sec)			
	Boys		Girls	
	$\bar{x}$	SD	$\bar{x}$	SD
6	11.1	3.6	10.5	3.3
7	11.4	3.7	11.1	3.4
8	12.8	3.9	12.5	3.6
9	14.0	3.7	13.4	3.5
10	15.2	3.8	14.2	3.6
11	16.0	3.9	15.1	3.3
12	17.2	3.6	15.8	3.3
13	18.1	3.7	15.5	3.2
14	18.8	3.5	16.5	3.1
15	19.4	3.4	16.1	2.9
16	20.0	3.5	16.1	3.0
17	19.9	3.5	16.0	3.0
18	20.1	3.5	16.3	2.7

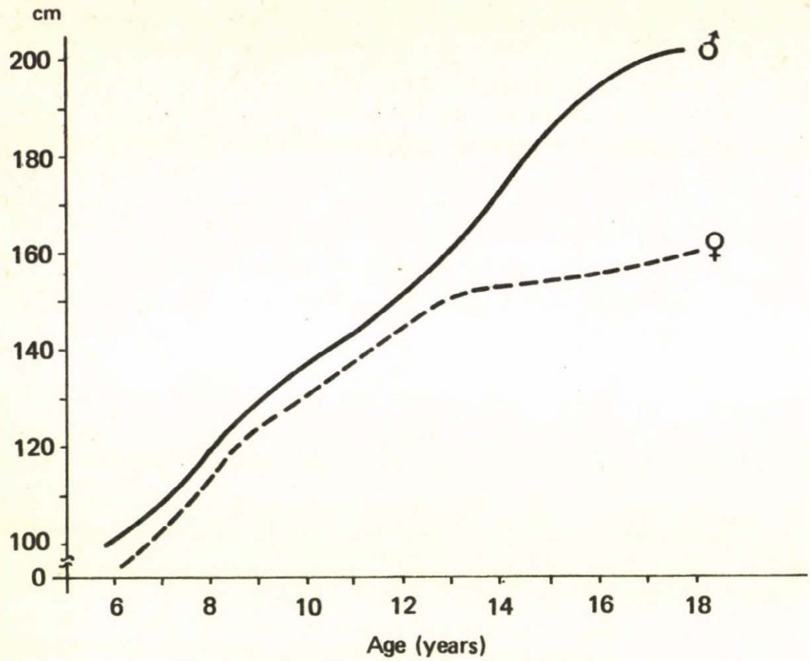

Fig. 3: Means of the standing broad jump in Hungarian boys and girls between 6 and 18 years of age

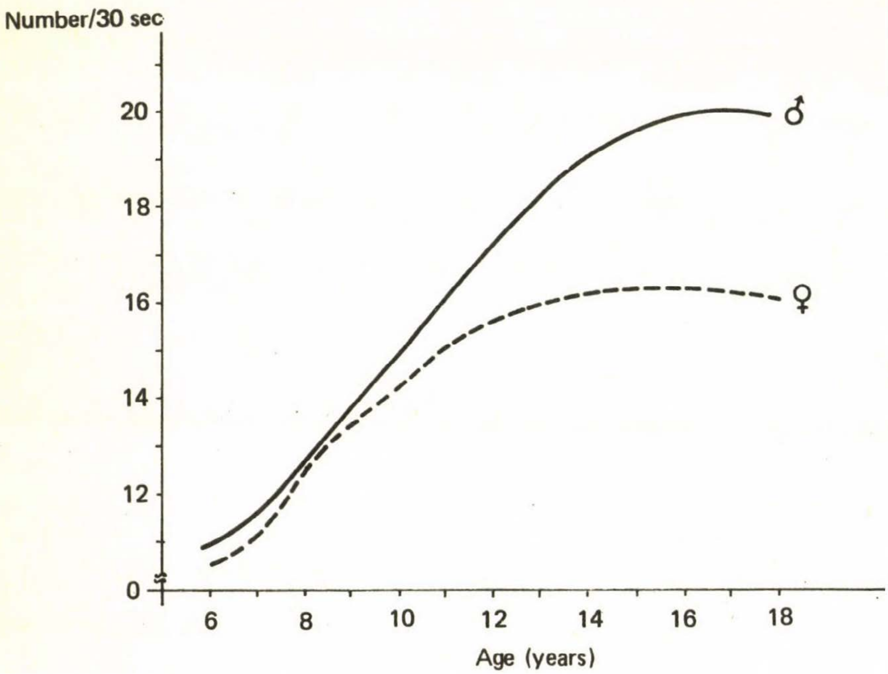

Fig. 4: Means of the sit-up test in Hungarian boys and girls between 6 and 18 years of age

Table 5. Means and standard deviations of Burpee test in boys and girls

Age (year)	Burpee-test (N/30 sec)			
	Boys		Girls	
	$\bar{x}$	SD	$\bar{x}$	SD
6	12.7	2.9	12.8	2.4
7	13.5	3.0	13.5	2.4
8	14.3	3.1	14.1	2.8
9	15.0	3.1	14.6	2.8
10	15.6	3.1	14.9	2.8
11	16.1	3.3	14.9	2.9
12	16.7	3.4	15.4	3.0
13	17.2	3.5	15.6	2.9
14	17.3	3.3	15.5	2.7
15	17.8	3.1	15.6	2.5
16	18.6	3.8	15.6	2.6
17	18.5	3.4	15.4	2.5
18	19.0	3.5	15.8	2.3

Table 6. Means and standard deviations of 60 m dash of boys and girls

Age (year)	60 meter dash (sec)			
	Boys		Girls	
	$\bar{x}$	SD	$\bar{x}$	SD
6	13.85	1.45	14.44	1.30
7	13.18	1.32	13.82	1.34
8	12.44	1.21	12.98	1.24
9	11.91	1.12	12.42	1.18
10	11.47	1.06	12.06	1.27
11	11.13	1.09	11.57	1.13
12	10.75	0.94	11.16	0.99
13	10.35	0.97	10.85	0.93
14	9.88	0.97	10.60	0.88
15	9.34	0.83	10.51	0.92
16	9.08	0.97	10.50	0.91
17	8.89	0.76	10.39	0.84
18	8.71	0.69	10.47	0.88

Table 7. Means and standard deviations of 12 min. endurance run of boys and girls

Age (year)	12 minutes endurance run (meter)			
	Boys		Girls	
	$\bar{x}$	SD	$\bar{x}$	SD
6	1597	330	1459	314
7	1681	315	1524	282
8	1797	339	1647	305
9	1958	367	1738	315
10	2056	374	1823	321
11	2151	368	1922	310
12	2257	353	1981	309
13	2305	358	2010	311
14	2387	365	2002	323
15	2469	361	1978	287
16	2532	365	1996	316
17	2539	367	2000	309
18	2625	356	2041	313

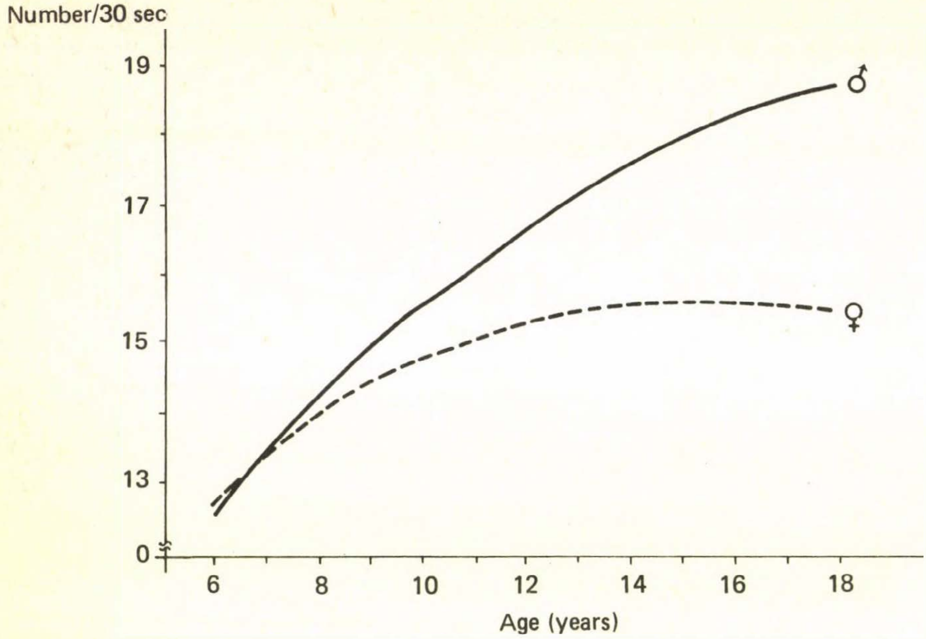

Fig. 5: Means of the Burpee test in Hungarian boys and girls between 6 and 18 years of age

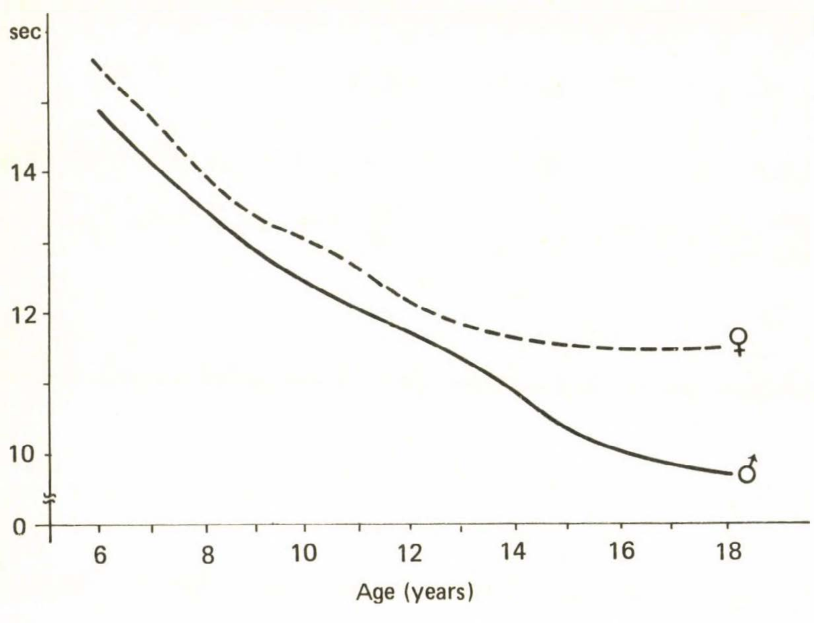

Fig. 6: Means of the 60 m dash test in Hungarian boys and girls between 6 and 18 years of age

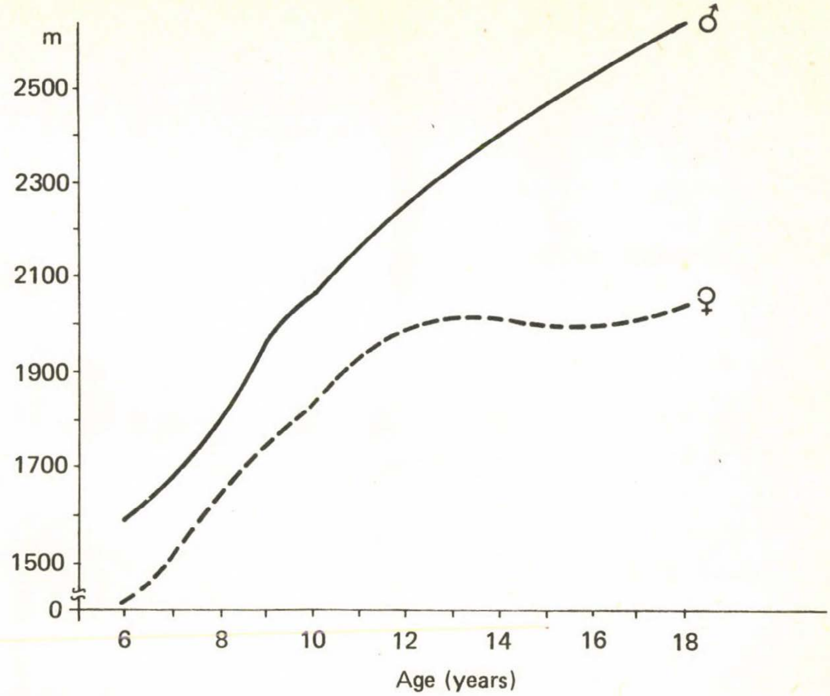

Fig. 7: Means of the 12 minutes endurance run test in Hungarian boys and girls between 6 and 18 years of age

Conclusions

Without going into details concerning the problem of differences of international results of physical performances, we may state that the strength of boys is greater than that of girls at every age level. The boys' explosive strength of the arm and leg extension is greater. The muscular endurance of boys as determined by the sit-up and Burpee tests increase at each age level. The muscular endurance of girls is similar to boys in younger years and increases slightly till the age 12 and than shows no futher increase. The greatest difference between boys and girls occurs in cardio-vascular endurance, where the boys show a consequent steady improvement year to year, while the girls stabilize at a relatively early age and at a lower level. In a later paper, a deeper and more complex analysis will be given to explain the factors effecting these differences of the physical abilities of school-children.

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THE RELATIONSHIP BETWEEN MOTOR PERFORMANCE AND BODY BUILD AMONG THE STUDENTS APPLYING FOR ADMISSION TO THE HUNGARIAN UNIVERSITY OF PHYSICAL EDUCATION

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Abstract: Students applying for admission to the University of Physical Education, Budapest, have to participate in an entrance examination the first phase of which is a complex motor fitness test. Of all the points used in ranking the applicants in the course of the admission procedure, the points scored in the motor fitness test represent 25%.

There are ten items which yield objective scores; these are the medicine ball throw backwards, jump and reach, long and high jump, five-hop jump, shot put, fistball throw, two sprint items (60-m and 100-m) and a medium distance run (600-m for the females and 1000-m for the males).

The present analysis covers the relationships of the motor performance scores with the individual's body dimensions, namely, stature, body mass, per cent body fat content, the somatotype components of the Heath–Carter anthropometric somatotype, and the growth type indices of Conrad.

As shown by the obtained correlation coefficients, the motor performance scores are loosely or moderately related to the somatic parameters. Endurance type performance was found to be independent of the body build Conrad's plastic index was related primarily to the scores achieved in the power test items.

Key words: Motor performance score, Body build.

Introduction

In predicting athletic performance, it is rather important to find out which of the physical characteristics allow an inference on the scores achievable in certain motor tests. Correlations between body dimensions and physical performance was loose in the anthropometric studies of Kohlrausch (1924).

Tittel and Adam (1963) have stated that motor performance indeed cannot be predicted by one or other physical characteristic, nevertheless, a combination of the different indices may be expected to relate the domains of physique and motor achievements.

Some indices of physique may be specific to certain events of sports, with individual variations of the general traits (Maas 1974). On the other hand, the absence of some equally specified characteristic of body build may preclude elite performance (Tanner 1964), or nearly so.

Farmosi et al. (1985) studied the relationship between the somatotype and motor performance in female students of a teacher's college. They found a moderate relationship between grip strength and stature, grip strength and body mass, and grip strength and arm circumference. Fésűs (1981) reported that the motor performance of a large sample of university and academy students was extremly poor, even when related to that of high school students. University students of 18 to 22 were found to achieve average or moderate scores in motor tests by Reigl (1983), but their performance in 800-m run and abdominal strength tests was poor. However, the athletic individuals of the material had significantly better scores.

Bale (1979, 1980, 1986) also observed connexions between physical build and motor performance in female students of physical education. Mesomorphy (IInd component) was closely related to 60-m run times and to strength measures. Polish investigators found moderately strong correlations of shot put with stature and body mass (Haleczko et al. 1978).

The nature of the relationship between the physical build and motor performance of students applying for admission to the Hungarian University of Physical Education also has deserved our attention, because all candidates are ranked by their motor performance in the course of the admission procedure, as well.

In addition to observations on the existence of such relationships, it was attempted to find out if better performance could be predicted by using body dimensions.

Material and Methods

The subjects were 108 female and 98 male candidates aged between 18 and 20.

The motor test items were jump and reach, five hop jump, long jump, high jump, medicine ball throw backwards, fistball throw, shot put, 60-m and 100-m dash, 600-m run (females) or 1000-m run (males). Performance was recorded as appropriate in athletic events or conventionally.

Body build was described by stature, body mass, per cent of body fat, the metric and plastic indices of the Conrad (1963) growth type, the three components of the Heath and Carter somatotype (Carter–Heath 1971), and the relative plastic index. In taking the body measurements the recommandations of the IBP (Weiner and Lourie 1969) were observed.

In addition to the basic statistics, the relationships of the body dimensions and the motor scores were studied by using linear correlations at the. 1% level of significance.

Results and Discussion

Table 1 contains the means and standard deviations of the motor tests' scores for the males and females. In general, motor performance scores were in the mediocre range, i.e. when one considers that these students were candidates for physical education, and the existing system of evaluating motor scores in this admission procedure, these scores can be given marks 3 or 4 in a five mark system where the best score is mark five.

Table 1. The motor performance scores of the two sexes

Tests	Females (n=108)		Males (n=98)	
	$\bar{x}$	s	$\bar{x}$	s
Jump and reach	54.2	4.81	67.8	4.83
Medicine ball throw backwards	10.6	1.45	11.7	1.31
60 m dash	8.6	0.38	7.7	0.31
100 m dash	14.0	0.84	12.2	0.53
Long jump	471.2	39.62	585.6	41.78
High jump	139.0	12.74	168.6	9.22
Shot put	8.1	1.09	10.1	1.10
Fist-ball throw	39.1	8.04	56.4	8.58
Five hop jump	14.7	0.88	17.4	0.87
600 m run	120.7	9.16	–	–
1000 m run	–	–	192.2	12.53

Table 2 shows a summary of the correlation coefficients between female body dimensions and indices and motor test scores. Significant coefficients only are shown. There were few of these, and they referred mostly to the connections of throwing and pushing performance with body dimensions. Thus, medicine ball throw was related to body mass and plastic index. Though their effects are partial the greater the body mass and the greater the plastic index the better the throwing performance. Shot put was negatively related to ectomorphy (IIIrd component). Positive correlation of performance in the throwing events with body mass may be due to the advantage of a larger lean body mass and/or greater maximum strength.

The connexion of 60-m run with stature was moderate and negative. Taller stature helps, therefore, running at this distance, one explanation of which might be the longer stride of taller athletes and this, in turn, has an important effect on the results, provided that the pace is maintained.

Table 2. Correlations between constitution and motor performance – Females

Performace	Dimension			
	Body mass	Plastic index	Stature	IIIrd component
Medicine ball throw backwards	0.36	0.35		
Shot put	0.46	0.44		–0.32
60-m dash			–0.48	
	r ⩾ 0.31		p < 0.001	

Table 3 contains the significant correlations found in the male students, of which there were remarkably more than in the females.

In the throws (medicine ball throw backwards, shot put, fistball throw) positive correlations were again found with body mass and the plastic index, while in the shot put also tall stature was of advantage. Similar findings were reported by Haleczko et al. (1978).

Five-hop jump was negatively correlated with nonessential fat content, phyknomorphic values of the metric index and mesomorphy (IInd component), but positively with the IIIrd component.

Thus, in spite of the different number of significant correlations there were similarities in the two sexes.

Table 3. Correlations between constitution and motor performance – Males

Performance	Dimension						
	Body mass	Plastic index	Stature	%body fat	MIX	IInd component	IIIrd component
Medicine ball throw backwards	0.40	0.31					
Shot put	0.52	0.42	0.33				
Fistball throw	0.42	0.41					
Five hop jump				–0.34	–0.33	–0.35	0.36
High jump							0.31
		r ⩾ 0.31		p < 0.001			

In answer to the problem studied it may be stated that better performance was linked to greater body mass and plastic index in our sample, mainly in such movements that require the acceleration of an implement, but when it was the body mass proper that had to be moved, higher scores of the third component were of greater advantage. All these relationships were associated with low or mediocre correlations.

A further study of the motor tests used in the admission procedure (e.g. the interrelationships of the test items) may help in a more objective assessment of the candidates. These low coefficients of determination evidence that a great number of other factors may be at work in overall motor performance. The weight of several indices of physique appears to increase with the technical complexity of the item.

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THE BODY BUILD OF THE STUDENTS APPLYING FOR ADMISSION TO THE TESTNEVELÉSI FŐISKOLA (HUNGARIAN UNIVERSITY OF PHYSICAL EDUCATION)

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Abstract: In connection with the reform of the Hungarian system of university admission, a „fitness test" assessing the candidates' motor performance level has been introduced at the University of Physical Education, Budapest. The intention was to provide means for classifying the candidates on the basis of their motor preparation. The applicant whose performance did not meet the minimum standards of this screening was excluded from the subsequent phases of the entrance examination.

The last two years' experience showed that the physique of the applicants of the early eighties was not essentially different from the physique of the candidates of the seventies. In these years, the average rate of those who were excluded from the further phases was about 20 percent. When compared to the group of students who were classified as „fit" by these tests, the group of the students who failed was found to be significantly shorter as well as having a greater relative body mass and a mainly endomesomorphic somatotype.

Key words: Body build, Students

Introduction

The project of recording data on the physique of the youth applying for admission to the Testnevelési Főiskola (Hungarian University of Physical Education) started in 1972. The experience gained by it in the first 10 years of the study led us to the inference that those who passed the entrance examination to the University were consistently taller and heavier than those who failed. There was also a difference in the body fat content of the two groups (Mészáros 1979).

However, the admission procedure of all types of higher education was revised in 1983. The essence of the change was the introduction of a standard system of criteria which meant more exacting requirements in general, and the addition of a further step – a fitness test – to the hitherto employed two-step system (theoretical and practical) of entrance examination to the Testnevelési Főiskola, in particular. This third step primarily serves as an assessment of the existing level of motor abilities, but it also has a screening function.

The purpose of the present study was to compare the stature, body mass, somatotype, growth type and percentage body fat content of the successful applicants before and after the introduction of the new admission criteria, in order to report on such effects that could manifest in the body build because of the change.

Material and Methods

The comparison refers to the applicants of 1978 and 1979 scored by the procedure before the change (old group) and to the applicants of 1984 and 1985 (new group). Altogether 546 males and 534 females were studied, all of whom were aged between 18 and 20.

In applying for admission it has been a basic requirement that the applicant should be healthy, a fact to be certified by the district dispensaries of sport medicine. Another specific feature of the sample was that all the applicants had a valid „competition licence" though not every one of them was an elite athlete.

In every case, body dimensions were recorded under laboratory conditions following the recomendations of the IBP (Weiner and Lourie 1969). Individual somatotypes were estimated by the anthropometric method of Carter and Heath (1971). The metric and plastic indices describing the type of growth were calculated by the method of Conrad (1963). Body fat content was estimated by the skinfolds using Pařízková's method (1961).

Differences between the means were tested separately for the males and the females by the F-test after the analysis of variance components at the 5% level of random error.

Results and Discussion

The differences of the several body dimensions will not be analysed here, except for stature and body mass. Discussion will extend mostly to the intergroup differences of indicators combining several measures. The eight variables to be treated here are tabulated for their means and standard deviations (Table 1). The first two columns of the table contain the statistics of the old group of candidates while columns 3 and 4 contain the values of the new group applying for admission in 1984 and 1985.

Table 1. Descriptive statistics of the groups of students in the old and new system of admission

1978 and 1979					1984 and 1985			
Applicants		Passers			Applicants		Passers	
$\bar{x}$	s	$\bar{x}$	s	DIM	$\bar{x}$	s	$\bar{x}$	s
				Females				
162.58	5.70	164.96	5.43	ST	166.61	5.53	166.24	5.59
55.95	5.79	57.15	5.21	BM	58.39	5.94	58.51	7.14
−1.07	0.30	−1.14	0.31	MI	−1.26	0.33	−1.30	0.33
78.07	2.57	78.59	3.00	PI	78.46	3.50	78.83	2.81
3.51	1.00	3.12	1.03	I.	3.53	0.93	3.45	0.95
4.03	0.92	3.98	0.88	II.	3.56	0.91	3.64	1.05
2.57	0.90	2.82	0.86	III.	2.88	0.92	2.88	0.98
19.95	4.22	16.40	3.11	%	17.72	4.05	17.51	4.61
325		102		n	209		108	
				Males				
174.64	6.23	177.85	7.32	ST	177.51	6.61	177.96	6.66
69.21	7.14	71.01	7.30	BM	70.84	8.28	70.30	7.52
−0.86	0.30	−0.92	0.31	MI	−1.02	0.35	−1.07	0.30
86.35	3.26	87.13	3.16	PI	88.90	3.81	89.19	3.25
2.25	1.07	2.05	0.90	I.	2.57	0.86	2.50	0.90
4.98	1.03	4.92	0.91	II.	4.96	1.14	4.87	0.94
2.54	0.90	2.88	0.86	III.	2.88	1.03	3.04	0.92
12.23	2.98	11.28	2.63	%	12.19	3.33	11.60	3.48
316		100		n	230		98	

Abbrevations: ST – stature; BM – body mass; MI – metric index; PI – plastic index; I. – first component of relative fatness; II. – second component of relative robustness; III. – third component of relative linearity; % – per cent of body fat in body mass; n – number of subjects.

As shown by the respective means, both the male and female *applicants* of the old group were significantly shorter and lighter than those who *passed* the admission procedure. The old group of applicants were by about 100 more than the new group, and their dimensions were closer to the peer students of medicine (Frenkl and Mészáros 1979) and technology (Gyenis and Till 1981) than to the dimensions of those who passed from the old group. Apperciable differences between the somatotypes and growth types of the groups were not found either in the males or in the females.

It is worth mentioning, however, that the body fat content in percentage was markedly lower in those who passed than in those who failed the admission procedure in the old group.

In the new group practically no difference was found between the subgroups of passers and failers. The smaller number of applicants were similar in their body build to the passers of the old group.

These results led to two points as inference:

– The number of applicants has markedly decreased, probably under the pressure of the more stringent system of admission to the Testnevelési Főiskola. Though this provided a reduced base of selection, those who were able to pass had a body build comparable to those who would pass in the previous system.

– It should be realized that at this university all priorities favour the education of physical educators rather than elite performance in sports. Accordingly, with respect to the complex physical requirements our future physical educators have to meet, any extreme type of body build would be unfavourable. One has to be aware that in several of the sports the elite athletes display such characteristics of physique that are near to the extremes of body build (Tanner 1964, Maas 1974), and that these traits help to maintain good performance or are even indispensable for it. The students are expected, however, to perform at least at an average level in several sport events. Thus, success in meeting the admission criteria also implies a more or less balanced physique generally. This may be the main reason for the finding that in respect of their physique the prospective successful applicants were very similar and extreme variants in dimensions or combined indices were absent, quite irrespective of whether they had to face the old or the new system of admission.

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242. szakülés, 1985. december 16.

PÁPAI JÚLIA: A hosszméretek növekedési rátái a pubertáskorban.

GYENIS GYULA: Beszámoló a 6 hónapos belgiumi (Laboratorium voor Antropogenetika, Vrije Universiteit Brussel) tanulmányutamról.

243. szakülés, 1986. február 17.

ANCSEL ÉVA: Az emberről – a XX. századi filozófiai antropológia alapján.

KRETZÓI MIKLÓS: Az emberré válás – tények és elméletek.

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FARKAS GYULA: Az élő lakosság humánbiológiai vizsgálata.

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Szakülés 1986. május 5-én

a Magyar gyógypedagógusok Egyesülete

Iskolaegészségügyi Szakosztályával közösen

BUDAY JÓZSEF: Értelmiségi fogyatékos fiúk növekedése (a Homoki Gyógypedagógiai Intézet tanulóinak hosszmetszeti vizsgálata alapján).

Kerekasztal-konferencia az imbecillis tanulók testneveléséről.

245. szakülés, 1986. október 20.

SCHEFFRAHN, WOLFGANG (Zürich): Evolutionary Biology of Human Populations.

NEMESKÉRI JÁNOS: Beszámoló az 1985. évi mexikói tanulmányútról.

246. szakülés, 1986. november 17.

VLČEK, EMANUEL (Prága): Antropologie der böhmischen Könige.

TÓTH TIBOR: Ja. Ja. Roginszkij (1895–1986).

T. A. Trofimova (1905–1986).

EIBEN OTTÓ: Beszámoló az Európai Antropológiai Társaság 5. kongresszusáról.

247. szakülés, 1986. december 8.

HENKEY GYULA: Adatok a dunántúli magyarok etnikai embertanához.

ÉRY KINGA: Újabb jelképes trepanációk a Volga vidékéről.

B. É.

A kiadásért felelős az Akadémia Kiadó és Nyomda főigazgatója
Műszaki szerkesztő: Horváth Judit
A kézirat nyomdába érkezett: 1987. augusztus 6.
Terjedelem: 15.75 (A/5) ív
Készült: az Ipari Technológiai Intézet propaganda és kiadói osztályán
Felelős vezető: Gollob Józsefné

Folytatás a borító 2. oldaláról

6. A táblázatok címeit, az ábraaláírásokat, a táblák címeit és azok minden szöveges részét két példányban külön is mellékelni kell a kézirathoz az idegen nyelvű fordításhoz.

7. A tanulmányok statisztikai feldolgozásánál alkalmazott matematikai képletek jelöléseinek pontos magyarázatát meg kell adnia a szerzőnek. Ugyanez vonatkozik görög betűs vagy egyéb speciális jelölésekre is. Általában a *Biometriai Értelmező Szótár* (Szerk.: Jánosy A.—Muraközy T.—Aradszky G. — Mezőgazdasági Kiadó, Budapest, 1966.) előírásait, jelöléseit célszerű követni.

8. A tanulmányok tagolásában az alábbi beosztási elvek követését tartjuk kívánatosnak: 1. Bevezetés (a probléma felvetése, mai állása). 2. Anyag és módszer. 3. A vizsgálat, kutatás eredményei és azok (összehasonlító) értékelése. 4. Összefoglalás.

9. A tanulmány, közlemény végén irodalomjegyzéket kell megadni, de csak azok a művek idézhetők, amelyeknek adatait vagy megállapításait a szerző tanulmányában valóban felhasználta. Az irodalomjegyzéket a szerzők nevének „abc" sorrendjében kell összeállítani. A szövegben a szerző neve után (zárójelbe) tett évszámmal utalunk a megfelelő irodalomra.

A folyóiratok címeinek rövidítésére a szakirodalomban kialakult és elfogadott rövidítéseket alkalmazunk.

Az irodalomjegyzék összeállításához az alábbi példák szolgálnak útmutatásul:

Folyóiratcikkeknél a szerző(k) vezetékneve, rövidített utóneve, a megjelenési év zárójelben, kettőspont, a közlemény címe, a folyóirat hivatalos rövidítése, a kötetszám arab számmal, aláhúzva, pontosvessző, oldalszám, pl.:

Bartucz, L. (1961): Die internationale Bedeutung der ungarischen Anthropologie. Anthrop. Közl. 5; 5—18.

Könyveknél a szerző(k) neve, a kiadási év zárójelben, kettőspont, a könyv címe, a kiadó neve, a kiadás helye, pl.:

Bartucz, L. (1966): A praehistorikus trepanáció és orvostörténeti vonatkozású sírleletek (Palaeopathologia III. kötet). Országos Orvostörténeti Könyvtár és Medicina Kiadó, Budapest.

Másodidézeteknél — ha azok el nem kerülhetők — az idézett szerző neve után *cit.* szócskát írunk, és a fenti módon idézzük a könyvet vagy a folyóiratcikket, ill. *in* szócskát írunk. ha tanulmánykötetben megjelent cikket idézünk.

Ha egy szerzőnek ugyanabból az évből több tanulmányát idézzük, akkor az évszám mellé írt *a*, *b*, *c* betűkkel különböztetjük meg őket.

10. A szerzők a nyomdai tipografizálásra vonatkozó kívánságaikat a kézirat másodpéldányán jelölhetik be ceruzával, a nyomdai előírásoknak megfelelően.

Kérjük szerzőinket, hogy a fenti alaki előírásokat — a tanulmányok gyorsabb megjelenése érdekében is — tartsák meg. Az előírásoktól eltérő kéziratokat a szerkesztőbizottság nem fogad el.

A kéziratokat a szerkesztő címére kell beküldeni, aki a tanulmány beérkezését visszaigazolja. A közlésről — a lektori vélemények alapján — a szerkesztőbizottság dönt. Erről értesítik a szerzőt.

A közlésre kerülő dolgozatok korrektúráját az ábralevonatokkal együtt megküldjük a szerzőknek. A javított korrektúrát az esetenként megadott határidőig kérjük vissza. A megadott időpontig vissza nem juttatott dolgozatot kénytelenek vagyunk kihagyni a készülő számból.

A szerzőknek a kiadó tiszteletdíjat és 100 db különlenyomatot ad. Ennek előfeltétele, hogy a szerző a kézirattal együtt pontos lakcímét (irányítószámmal) és személyi számát is bejelentse a szerkesztőnél.

A *szerkesztőbizottság* tagjai: Dr. Eiben Ottó (szerkesztő), Dr. Éry Kinga, Dr. Farkas Gyula, Dr. Horváth László, Dr. Lipták Pál, Dr. Nemeskéri János, Dr. Pap Miklós és Dr. Tóth Tibor.

A szerkesztő címe: Dr. Eiben Ottó, 1088 Budapest, Puskin u. 3. ELTE Embertani Tanszéke.

A kiadvány előfizethető és példányonként megvásárolható:

az AKADÉMIAI KIADÓNÁL: 1363 Budapest, Alkotmány u. 21., telefon: 111-010. Pénzforgalmi jelzőszám: 215-11488.
az Akadémiai Kiadó STÚDIUM (1368 Budapest, Váci u. 22., tel.: 185-881) és MAGISZTER (1052 Budapest, Városház utca 1., tel.: 382—440) könyvesboltjaiban.

Előfizetési díj egy évre: 66,— Ft

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