ANTHROPOLOGIAI KÖZLEMÉNYEK

A MAGYAR BIOLÓGIAI TÁRSASÁG
EMBERTANI SZAKOSZTÁLYÁNAK FOLYÓIRATA

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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 Szerkesztő bizottság.

A Szerkesztő bizottság 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 az MBT Embertani Szakosztályának szakülésén előadja.

Az előadásokat a szakosztály titkáránál lehet bejelenteni és azok műsorra tűzéséről a Szakosztály Intéző Bizottsága 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.

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.

Folytatás a borító 3. oldalán

VARIATIONS IN HUMAN GROWTH AND PHYSIQUE

Third International Symposium on Human Biology

Bozsok 1981

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The Symposium was organized by the Department of Anthropology, Eötvös Loránd University, Budapest, and was held at Bozsok (Western Hungary) between 26th and 30th May, 1981.

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OPENING ADDRESS

Ladies and Gentlemen, Dear Friends!

It is my honourable task to welcome all of you to Bozsok. I have a feeling that we, Hungarian human biologists, have a role in the international scientific life: to catalyze colleagues, teams. This role may be due to our geographical situation as well as to our choice of research subjects.

Several friends can remember our first and second Symposium. The Balaton-Symposium at Balatonfüred in 1976 was our first step in this common way: we made an "inventary" of some international research activities, and at the end of the summing up phase of the International Biological Programme we overviewed the different problems in human growth and development, as well as in physique. — The Danube-Symposium at Visegrád in 1979 joined to the International Year of Children, and tried to summarize our recent knowledge on functional biotypology.

Looking back to these meetings, I can establish that we played our catalyzer-role successfully: many of us have become close friends, new teams have come into being. The proceedings volume of the Balatonfüred Symposium contains 50 papers, and was published 13 months after the Symposium. That of the Visegrád Symposium contains 36 papers, and it was published one and a half year after the Symposium as a volume of the Hungarian journal "Anthropologiai Közlemények". — Both volumes present many new ideas and very recent data, and in this way good overviews on their subjects.

Now, during this Bozsok Symposium, we will be investigating different aspects of our main topic: Variations in Human Growth and Physique.

Our special interests are due to the genetic aspects *af these themes. What are the most important recent findings in genetics of growth process and determining hyman physique ? What are the special findings in prenatal development ? How can we recognize the early and late maturers ? What kind of relationship exists between anthropometry and densitometry ? How can we compare different groups of populations by somatovariants ? What does psychiatry establish on genetics of patients suffering from endogenous psychoses ? How do genetic and socio-economic factors influence the body development of students ?*

We would like to discuss the clinical aspects *of our main theme. What is the attitude, what are the work methods of social pediatrics ? What kind of connections can be found between different illnesses and growth process: What about tubular disorders, obesity, minor abnormalities, etc. ? How do we see today the medical* *distances and their application in anthropological studies ? What is the relationship between testicular volume and sexual activity of Down-patients ? What about their physique ? Have we new data on the dental age of children ?*

We will investigate carefully the ecological aspects *of our problems. What kind of relationships can we discover today between climate and human physique ? Is there any connection between nutrient reserves and sexual dimorphism ? How about the growth and maturation process of children living in different socio-economic strata ? Is there any difference in growth between such a special group of children like caravan-camp ones and national average ? What about the gain and loss of weight during growth process in early childhood ? Are there any differences in the components of physique according to socio-economic factors ? How do social and natural factors influence the maturation of girls ? What about the so-called "acceleration" of growth ? How do children living at high altitudes grow up ?*

We will also touch the kinanthropometric aspects *of our problem-circle. What do we know today about biological age, related to physical fitness ? What kind of new experiences have we on body composition, especially on body fat ? What kind of new assessment have we in somatotyping ? What about the recent findings on physique of the top athletes, like paddlers and rowers ?*

Finally, taking into consideration both the genetic and ecologic factors influencing growth and maturation, we would like to see, what the secular changes in Hungary are like on the basis of recalled cross-sectional growth investigations carried out in a small Western Hungarian town, Körmend.

For each aspect of our main topic we have one session with three key lectures which are followed by 3—6 short papers, then we organize a general discussion on all the presentations belonging to the session.

I should like to express my grateful thanks to the Presidium of the Council of County Vas: They have been kind enough to place this marvellous small county-seat at our disposal. I hope that our three-days' conference in this beautiful environment, as well as our excursion to Körmend and to Őrség will be suitable for discussing our recent problems, and bringing all those experts who feel responsibility for our branch of sciences, the human biology, close together.

I declare our Symposium open, and wish success to all of you!

Ottó G. Eiben

Anthrop. Közl. *26;* 5—11. 1982.

QUANTITATIVE GENETICS DURING THE GROWTH PERIOD OF CHILDREN: METHODOLOGY AND FACTORS

by C. SUSANNE

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Abstract: The methodological problems of the quantitative genetics are numerous, especially during the growth period. Many methods are able to give a relative idea of the heritability, based on the study of twins, of sibs, of parent-offspring or of other relatives. But, in the interpretation of these results, one must be careful: the coefficients of heritability are indeed not very adequate to give an accurate prediction of the relative influence of both factors, of genetic or of environmental factors. These coefficients of heritability are specific for a particular population in a particular environment and at a specific time. However, if the population and its environment are good defined, a study of a decreasing order of genetical determination can be useful. These criticisms are also true for the quantitative genetics of growth, supplementary remarks have, however, to be taken into account such as variations of the heritability in function of age and such as difficulties to characterize human growth curve.

Key words: quantitative genetics, growth process, methodology.

The events of growth and development are controled by a multifactorial system. It is well known that morphological characters are determined by factors of genetical origin and also by factors of environmental origin (SUSANNE 1975, 1977, 1980, DEFRISE 1981). Anthropologists and pediatricians know also that growth is a continuous phenomenon from conception to maturity where the different factors influencing growth are changing in the different periods of growth. The methodological problems in the study of the quantitative genetics during the period of growth are related to the fact that the genetical and environmental factors interact almost invariably and are rarely independent. We intend to develop three different problems of methodological origin: (1) the choice of a tool to study heritability, (2) the problem related to the fact that growth is a continuous phenomenon, and (3) the scarcity of suitable longitudinal data.

Heritability

The concept of heritability h^2 has been defined by plant and animal breeders as the amount of genetic variability which can be used for selective breeding. The heritability is generally defined as the proportion of the total phenotypic variance (V_p) due to additive genetic variation (V_A)

$$h^2 = \frac{V_A}{V_p}.$$

This definition corresponds to the heritability in the narrow sense used in selective breeding when the aim is to produce individuals of improved economic quality, when breeders select individuals homozygous for genes related to these qualities, and when environmental correlations are eliminated. Of course, the use of the heritability in the narrow sense is illusory in human populations, where the heritability in a broad sense is mostly used, which is a degree of total genetic determination (V_G) including dominant factors (V_D), epistasis factors (V_i).

$$h^2 = \frac{V_A + V_D + V_i}{V_P} = \frac{V_A + V_D + V_i}{V_A + V_D + V_i + V_E} = \frac{V_G}{V_G + V_E}$$

with V_E, environmental factors.
From this definition, it is apparent that heritability can be change in function of the relative importance of the environmental conditions. In function of a reduced environmental variance or in function of a large environmental variance, the value of the heritability will vary: in these conditions, heritability is inadequate to measure the relative importance of nature versus nurture. These coefficients are only valid for the specific population studied in the specific period and environment of the analysis. The human geneticist cannot control the environments in which people live, these are infinitively variable and very difficult to measure, it is an ever-present source of error.

The additive genetic variance (V_A) refers to the hypothesis that the genes act additively. The regression of this additive genetic value on the phenotypical value gives also a definition of the heritability in the narrow sense. It is only these summed effects of the genes which have a selective value.

The dominant variance (V_D) refers that, for some genes, the phenotypes of the heterozygotes are not exactly intermediate between the two homozygotes. Heterosis would be a very specific example of this deviation to the additivity. The existence of dominance factors will result in a diminution of correlations between relatives, it affects, however, more the correlation between sibs than between parents and children.

The epistasis variance (V_i) results of the interaction between genes, it means that the effects of different genes are not simply summed. In human populations, it is rather impossible to have correct estimations of these effects. The estimation of the importance of linkage between genes and of pleiotropic effects is even difficult.

A genetic factor which can be estimated more easily is the variance due to assortative mating. A positive assortative mating has been observed for different morphological characters (SUSANNE 1967, SPUHLER 1968): it will result in higher frequencies of homozygous genotypes than in panmictic conditions. We must expect also that the effects of assortative mating will be confounded with the additive variance, and that for correlation parent-offspring for instance the existence of a positive assortative mating will increase the value of the coefficients of correlation.

Other possible complications of the method are the influence of X-linked loci (MATHER et al. 1971).

The most difficult variance to estimate is the environmental variance, different components interact and the variability of environmental conditions is immense. In a quite artificial way, artificial for human populations perhaps not for breeding conditions, one can distinguish changes of environment between individuals within families, between families, between socio-economical classes, between geographical groups. The quantification of these variances is very difficult, subtle changes can be observed. For instance, the environmental variance within families will not be the same between twins than between sibs, will not be the same between monozygotic twins than between dizygotic twins. The variance between families and the variance between socio-economical classes inflate the covariance between parents and children, they may thus inflate correlations and interact with the correlations due to the genetic variance. The environmental covariance is expected to have a lower influence in parent child comparisons than in comparison of sibs or of twins.

But, even more complex, the interaction between the different factors have to be taken into account. In the familial studies, you can find four different covariances:

cov. (genotypes parent and child),
cov. (genotypes parent and environment child),
cov. (genotypes child and environment parent),
cov. (environment parent and environment child).

The second and the fourth covariances are in most cases positive.

From all these arguments, it is obvious that the coefficients of heritability are not very adequate to give an accurate prediction of the relative importance of genetic and environmental factors. The estimations of heritability are relative to the studied population, in its specific environment and time (Feldman et al. 1975). The coefficients of heritability are specific for a particular gene pool and environment, as well as for a particular interaction between genotypes and environments.

But, in spite of all these criticisms, measurement of the degree of heritability can be useful in defining for a specific population a decreasing order of genetical determination for different anthropological characters. For this kind of approach, different methods of calculation of heritability can be used (for a review, see Susanne 1980). But, for a definition of a decreasing order of heritability, not real coefficients of heritability could be used, such as coefficients of correlation parent—child for instance.

Predictions from these measurements of heritability must always be done very carefully. For instance, we know that stature has one of the highest coefficient of heritability, this means that the environmental variance is supposed to be low. However the well-known observation of secular trend of stature is almost certainly the result of environmental conditions. Heritability informs us about the ratio genetical versus environmental variance for one specific environment but cannot be extrapolated to other environments.

Growth as a continuous phenomenon

From conception to maturity, the factors determining growth are changing and are not equivalent for the different periods of growth: as a result, the relative influence of genotype and environment and thus the coefficients of heritability will not be constant during these different periods.

A variation with age is evident in the study of self-correlations, where the correlation is calculated between a measurement at an age x with the measurement of the same individual at adult age: an increase of these self-correlations is observed from birth to maturity reflecting an increase of the contribution of the child's own genes (TANNER 1960, FURUSHO 1968, ASHIZAWA et al. 1977). A rapid increase is observed during the first year, a slower increase afterwards till the puberty where a relative decrease is observed.

The same kind of observations has been made for correlations parent—offspring, where the correlations are calculated for the height for instance between the value of the adult parents and the value of the growing children and this of course in function of the age.

Longitudinal studies on twins (VANDENBERG et al. 1965, WILSON, 1976) have showed that, starting from a small influence of fetal genetical constitution at birth, a gradual increase of the genetical factors is observed between monozygotic and dizygotic twins for the weight or the length at birth. The varying degrees of vascular anastomosis of the placentas result at birth even in lower correlation between monozygotic twins than between dizygotic twins. But, after birth, the within pair differences of dizygotic twins will gradually increase and the within pair correlation of monozygotic twins will gradually increase too, resulting in terms of heritability in a gradual increase of the genetical component.

It has also been observed in domestic animals (DICKERSON 1954) and in man (RAO et al., 1975) that the heritability decreases with the age difference between the sibs. In this case, a higher environmental covariance may explain this observation: the familial environment will be more similar by sibs growing up together than by adult sibs living in different environmental conditions, this results in lower correlations by adult sibs. MUELLER (1977) observed indeed larger correlations between school-aged sibs than between adult sibs when they are studied in the same sample and in a rather limited age cohort. Similarly, when the age differences between the sibs increased, the coefficients of correlation between sibs will decrease, especially for weight, fat and muscle measurements, but not for bone measurements (FURUSHO 1968, MUELLER 1978).

Other difficulties of interpretation are found in the comparison of populations of European origin and the non-European ones, higher correlations being observed in European populations (MALINA et al. 1976, MUELLER 1976, RUSSELL 1976). The existence of a positive assortative mating in these European populations is one explanation of these higher correlations, the other explanation consists in a better expression of the phenotype in absence of malnutrition or of other problems in the standards of living.

The standards of living can influence the level of heritability: authors (CHARZEWSKA et al. 1964, BIELICKI et al. 1966, WELON et al. 1971) have observed, on the contrary of European versus Non European, higher coefficients of correlation in populations with low standards of living and of nutrition (village versus town, poor nourished versus good nourished). A possible explanation is the fact that the environmental component interacts with the genetic variance and inflates the correlations in the poor environmental conditions, children having an environmental component more similar to that of the parents in villages than in towns for instance. In these last cases, children could experience perhaps better environments than the parents have had during their growth period.

Suitable longitudinal data

Heritability of specific characters of human growth curve has been hindered by the difficulties to collect longitudinal data of relatives and also by difficulties to characterize the human growth curve.

Of course, many studies have been published comparing isolated longitudinal curves on sibs, on twins or even triplets. The interpretation of these results is, however, difficult, the curves of growth of monozygotic twins are generally more alike than those of dizygotic twins. It is only recently that human growth curves have been better characterised (HAUSPIE et al. 1980).

BOCK and THISSEN (1978) used a triple logistic curve fitting by unweighted non linear least squares in the study of two sets of triplets, where two were identical and one fraternal. The author showed a clear similarity of the curves of the identical twins and demonstrated also an evident heritable component in the appearance of the adolescent growth spurt.

In another longitudinal study of twins (FISHBEIN et al. 1978), the square root of the sum of squared differences between the deviation points and the intraclass correlation for profiles estimated from an interaction term of an analysis of variance have shown a lower deviation of the profiles of growth curves in monozygotic twins than in dizygotic like sexed twins.

The components of variance analysis model were used to estimate the degree of resemblance of growth patterns in 60 sibs distributed, among 25 families of West Bengal (India) (HAUSPIE et al. 1980). The authors analysed twelve biological parameters derived from the Preece Baines model 1 curve, fitted to the longitudinal data for height growth: a significant added variance component was observed for peak height velocity and the age at peak velocity, for these two parameters the similarity being greater among sibs than among non-related subjects.

These few results are stimulating but more studies on quantitative genetics of the synchronisation of the patterns of growth is suitable.

Conclusion

In this paper, the author has only one object in view, that is to illustrate some of the methodological problems of the quantitative genetics, especially during growth. The fundamental problem is surely the concept of heritability itself. These coefficients of heritability are only valid for the specific population studied at a specific time, it is only relative to the particular environments and genotypes characteristic of this population. If we consider interactions between genotypes and environments, genetic variance depending of the distribution of environments and environmental variance depending of the distribution of genotypes, the interpretation of heritability seems vain. The coefficients of correlation also are the result of genetic variance inflated by the variance between families and between socio-economic groups for instance. This does not mean that quantitative genetics is always useless: in a specific population, the definition of a decreasing (or increasing) order of genetical determination can be useful.

This kind of study when applicated to growing children has to taken into account a change with age of the relative influence of the different factors in the determination of growth status. These changes are related to a gradual increase with age of the contribution of the childs own genes, and to changes in function of the environments of the expression of the phenotypes and thus of the environmental variance interacting with the genetical variance.

Anthropologists, pediatricians, auxologists must be stimulated to studies of quantitative genetics during growth, but specially of the synchronisation of the patterns of growth and of the patterns of maturity.

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EARLY AND LATE MATURERS

by M. PROKOPEC

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Abstract: Individual growth curves of six boys and six girls with the earliest and of six boys and six girls with the latest onset of physical maturation from a group of 300 Prague children followed up longitudinally from birth to maturity, were analysed and the intergroup and intersexual differences were compared. There was a 6 year difference in the peak velocity heights between the most early and most lately maturing boys, 5 year difference between the girls and nearly 8 year difference between the most early maturing girl and most lately maturing boy. A difference of 14 cm was found in boys and 18 in girls between the means of height of early and late maturers at the age of peak velocity height.

From the point of view of psychology (M. HAVLÍNOVÁ) the late maturing boys tend to be socially more reserved and more frequently serious in contrast to early maturers. This finding has not been confirmed in the girls. School achievements were slightly better in the late than in the early maturing groups, in agreement with the generally known fact, that school progress is temporarily changing for worse during the puberty period.

Key words: early and late maturer children, peak height velocity (PHV), High School Personality Test (HSPT), longitudinal growth study, Prague children.

Introduction

Two examples may illustrate the point that the problem of the growth of children and youth is essentially a biological process, like in all other living organisms and that in human beings it is simultaneously a highly social matter. This year an exhibition was held in Prague of bonsai, i.e. fully developed trees 20—30 years old which, however, due to special cultivation, reach a height of 20 to 25 cm. From the activities of the bonsai growers (practised in Japan for centuries), we get a good idea of what harms or inhibits growth of the organism (at least for a number of trees grown in miniature form) and from this again we can draw the conclusion what benefits the organism — fundamentally it is just the opposite from what retards growth. The bonsai growers nip off leaves, sprouts and fruits, cut the roots, do not expose the trees much to heat, light and the sun and plant them into poor soil. Analogical to the leaves of plants are human lungs, and to roots the digestive organs or rather nutrition generally. So much only, for demonstrating the biological essence of growth (Fig. 1).

An example of the importance of human society for healthy development is provided by two Indian girls which from babyhood grew up without human company under the care of a she-wolf in the jungle, and whose story was

Fig. 1. Bonsai — a grown up tree of miniature size as a result of special treatment oppressing growth

published in the journal L'Anthropologie. The girls were seven and nine year-old, respectively, when they were found. They moved around on their knees on which they had large callosities, and ran on all fours. They imitated wolves also by not using their hands when eating. Under clinical care lasting several years one of the girls did not learn more than 45 words. Their return to human society was no more possible. Man has evolved as a species during his phylogenetic development and during his ontogenetic evolution he again develops into human only under conditions prepared for him by the family and human society.

The problem of early and late maturers has attracted the attention of many authors. Several of them summarised the present knowledge of factors, influencing the velocity of physical maturation and the biological age in the second decade of life (Tanner 1962, Marshall 1977, Wieringen et al. 1971, Hauspie 1980 and others). Nevertheless, neither an early start nor a late onset of puberty and/or its duration has been satisfactorily explained. This makes any sort of prediction at this age difficult and inaccurate. Last but not least an extreme deviation from the normal in this or that respect implies a social problem. In case of late maturers an unpleasant impact may be exerted on personality development, especially in boys.

In 1981 we brought to a close a longitudinal study of 300 Prague children, lasting for 25 years, followed-up from birth to maturity, which gives us the possibility to participate in solving the still open problem of early and late maturing boys and girls (Kapalín et al. 1969, Prokopec et al. 1981).

Material and Methods

We have analysed both distance and velocity curves of 89 byos and of 89 girls followed-up longitudinally from birth to maturity. The 300 children had been selected at random from a part of Prague (Žižkov) with about 100,000 inhabitants in 1956—1960. Only children born on one particular day in the week (Wednesday) were included into the sample. The children were investigated by a team of specialists clinically, anthropologically and psychologically five times in their first year of life and semiannually thereafter. The original number decreased until 1981 by about one third. Out of twenty measurements taken at each visit and from a series of descriptive features only body height (growth curves), menarcheal age, somatotype, school achievement, eye colour, social background, Cattell's High School Personality Questionnaire and pro-

Table 1

Parameters of growth curves of Prague children and adolescents

No. Symbol	Parameter	Boys n = 89				Girls n = 89			
		$\bar{x}$	s	min.	max.	$\bar{x}$	s	min.	max.
1. AMHV	age at minimal prepubertal height velocity (yr)	10.6	1.0	7.6	14.2	8.9	1.1	6.4	12.1
2. APHV	age at peak height velocity (yr)	13.5	1.0	11.3	17.0	11.4	1.1	9.1	13.6
3. AMHVR	age at minimal prepubertal height velocity return (yr)	15.1	1.0	13.1	18.7	12.8	1.1	10.4	15.3
4. H 4	height at age 4 (cm)	105.0	4.0	97.1	126.2	103.9	3.3	97.6	111.9
5. HMHV	height at minimal prepubertal height velocity (cm)	143.6	7.4	126.2	162.3	134.2	7.3	119.3	159.7
6. TAG	total adolescent gain (cm)	30.7	4.8	15.9	42.1	25.6	5.0	11.9	38.3
7. HPHV	height at peak height velocity (cm)	162.2	6.5	145.0	177.2	150.0	6.4	135.1	170.2
8. HMHVR	height at minimal prepubertal height velocity return (cm)	174.2	6.0	160.3	187.8	159.7	6.1	143.1	178.5
9. HA	adult height (cm)	178.9	6.1	164.9	192.1	167.1	5.8	155.3	186.6
10. V 5	height velocity at age 5 (cm/year)	6.7	0.8	4.8	8.3	6.8	0.9	3.5	8.9
11. MHV	minimal prepubertal height velocity (cm/year)	4.6	0.7	3.2	6.6	5.2	0.7	3.1	7.2
12. PHV	peak height velocity (cm/yr)	8.6	1.1	6.1	11.8	7.5	0.9	5.5	9.6
13. PH	peak height (cm/yr)	4.0	1.2	0.9	8.5	2.3	1.0	0.5	5.5
14. PB	peak basis (yr)	4.6	0.7	2.5	6.2	4.0	0.7	2.2	5.9
15. PAR	peak area = PH×PB	18.5	6.7	2.2	45.2	9.3	4.9	1.1	26.7

fessional orientation were used. Incomplete records were not involved in the present study.

The individual growth curves (distance curves) were evened out and some missing observations were incorporated by the method described by CLINE (1974) — a third grade polynomial using 7 points (arguments), which are shifted. This procedure had been used twice on the distance curve, from which yearly increments were derived and used for construction of velocity curve. The velocity curve has been also smoothed by the same polynomial of third grade (seven points), which may be applied not only to concave and convex parts of a curve but also to S-shape sections. Fifteen parameters have been recorded from each velocity curve following the method and nomenclature described by STÜTZLE et al. (1976). Each individual velocity curve has been described by parameters shown in Table 1. Items No 1—3 concern age, 4—9 height, 10—12 velocity and 13—15 characterize the size of the proper peak.

Results

Results are given in Tables and Figures. Fig. 2 shows an individual distance (above) and a velocity curve (below) with some of the parameters derived from its course (minimum growth increment before puberty, peak height velocity, total pubertal gain etc.) Data in Table 1 show average parameters, standard deviations and minimal and maximal values of the parameters of the velocity curves of 89 boys and 89 girls. Similar values reveal mean height

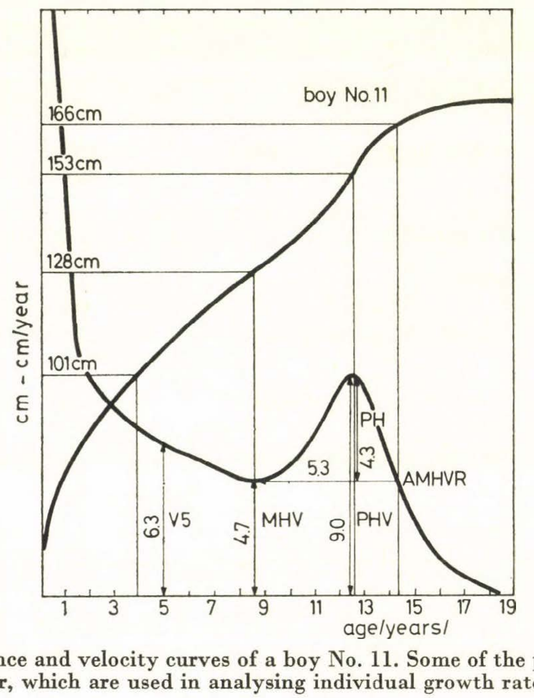

Fig. 2. Stature distance and velocity curves of a boy No. 11. Some of the parameters described in the paper, which are used in analysing individual growth rate are shown

at 4 years in both sexes (105.0 cm in boys and 103.5 cm in girls), height velocity at 5 (males 6.7 cm/yr, females 6.8 cm/yr) and to a certain extent the peak basis (4.6 yrs in males and 4.0 yrs in females). Dissimilarities in both sexes are to be seen in all other parameters — ages, heights, velocities and in the peak heights and areas. At the age of the PHV (13.5 yr in boys and 11.4 yr in girls) a difference of 12 cm occurs between the sexes in height which corresponds with the final difference between the sexes in height at an adult age.

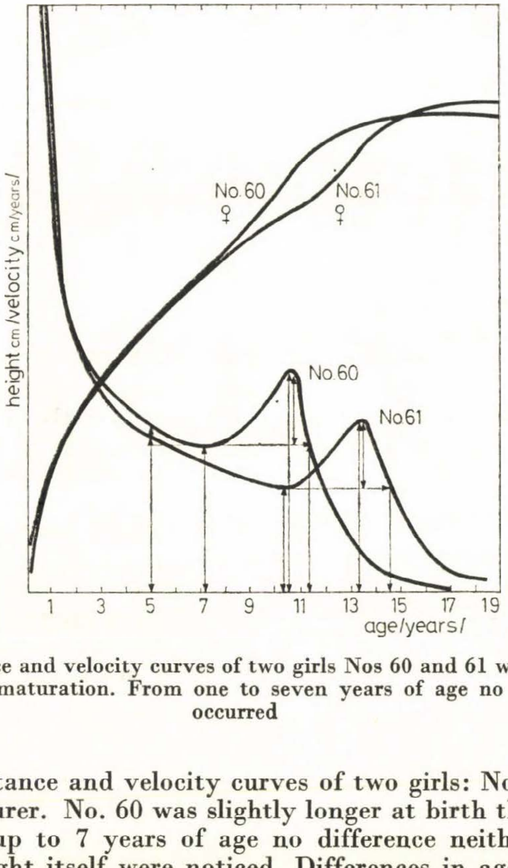

Fig. 3. Stature distance and velocity curves of two girls Nos 60 and 61 with a different rate of growth and onset of maturation. From one to seven years of age no difference in growth occurred

Fig. 3 shows distance and velocity curves of two girls: No. 60 an early and No. 61 a late maturer. No. 60 was slightly longer at birth than No. 61 but in the later growth up to 7 years of age no difference neither in the growth pattern nor in height itself were noticed. Differences in ages at peak height velocities of the two girls amount to three years. The late maturing girl reached a higher final adult height, though at a later age (at 18). The early maturing girl reached her adult height already at the age of 15.

The maximal velocity of growth, achieved during the adolescent spurt — PHV has a biological meaning. The growing organism is at this stage more sensitive than in any other section of growth (with the exception of the first year of life) to ecological factors (increased ecosensitivity). PHV is in girls closely correlated with menarcheal age and thus may help in defining a similar landmark in the body development in boys as is menarche in girls. PHV has a normal (Gaussian) distribution in each sex as shown in Table 2 and in a simplified version graphically in Fig. 4. If we round up our findings the earliest PHV

Table 2

Age at peak height velocity
(Numbers represent individual children from the Prague longitudinal study)

Age (years)	Girls (n = 89)	Boys (n = 89)
9.0	63, 203,	
9.5	3, 8, 36, 37, 110, 246, 252, 282	
10.0	5, 41, 51, 60, 89, 121, 157, 199, 230, 267,	
10.5	26, 48, 130, 163, 202, 266, 274, 276, 281,	9,
11.0	39, 64, 68, 99, 105, 136, 141, 232, 243, 284, 149, 152, 158, 174, 186, 218, 220, 229, 231,	100, 215, 259,
11.5	7, 57, 65, 74, 84, 135, 148, 168, 209, 213, 221,	71, 79, 122,
12.0	4, 30, 54, 66, 67, 102, 111, 126, 127, 156, 171, 191, 192, 262, 264,	11, 123, 271, 157, 189, 257,
12.5	58, 73, 104, 151, 195, 205, 216, 236,	1, 35, 91, 113, 134, 145, 247, 255, 272, 166, 176, 227, 233, 239, 254, 263,
13.0	61, 88, 137, 154,	2, 19, 20, 21, 47, 50, 52, 75, 85, 114, 140, 235, 260, 265, 275, 279,
13.5	59, 76, 82,	14, 24, 45, 55, 72, 117, 128, 234, 253, 285, 172, 177, 196, 201, 208, 210, 219, 268,
14.0		49, 53, 81, 86, 112, 116, 153, 167, 169, 179, 184, 187, 204, 206,
14.5		12, 15, 115, 223, 194, 251,
15.0		6, 40,
15.5		92, 95, 211,
16.0		
16.5		13,

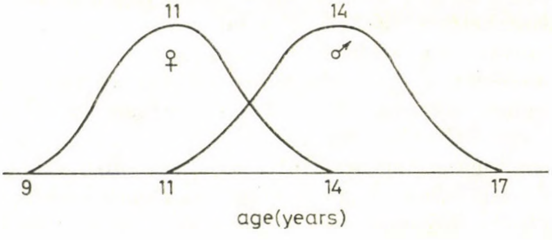

Fig. 4. Schematic age distribution of peak velocity heights in boys and girls from the Prague longitudinal study (age in years)

in girls occurred at 9 years, the mean age for the whole group was 11 years and the highest age of one of the girls from our sample was nearly 14. Boys as a group started to enter the maturation period signified by PHV at the age in which the distribution curve of the girls culminates i.e. at the age of 11. At 13.5 years of age about half of the boys had attained their PHV — nearly at the same age, when already all the girls passed their PHV. The oldest boy from our group who reached his PHV was nearly 17 years old.

Early and late maturers

We have selected from our samples amounting to 89 boys and 89 girls four groups: six most early and six most late maturers from each sex. Their distance and velocity curves are shown in Figs 5 and 6. Early maturing boys were those, whose PHV was below 12 and girls below 10. Late maturing boys were those, who attained their PHV after 15 and girls after 13 years of age. The means of the investigated parameters of velocity curves for each group are given in Table 3. Similarly as in comparing the mean parameters of velocity curves of boys and girls from the original samples, smallest differences were found between both sexes and between early and late maturers within each sex in heights at the age of 4 and in growth velocity at 5 years of age. Sex differences were in these and some other parameters smaller than those between early and late maturing groups within each sex. The mean age at menarche was 11.8 ± 1.1 year in the early and 14.4 ± 1.6 year in the late maturing girls.

Somatotypes after SHELDON et al. (1954) were estimated from photographs in each child at the age of 16 to 18 years. Ectomorphy was found to be more frequent in both sexes in late maturers than in early maturers. In early maturers endomorphy was prevalent in girls before mesomorphy and ectomorphy;

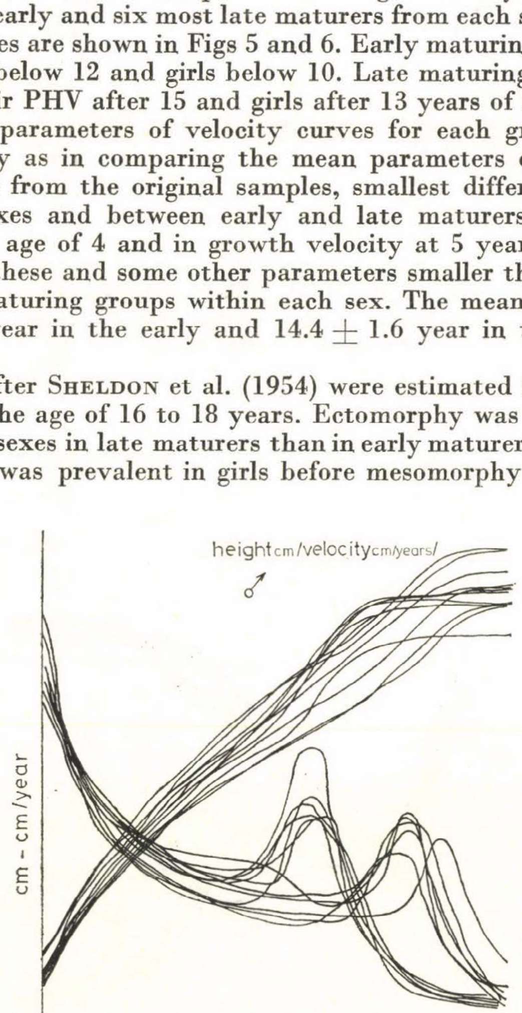

Fig. 5. **Individual stature distance and velocity curves of early and late maturing boys**

Table 3

Mean parameters of velocity curves in early and late maturing boys and girls

Parameter No. Symbol	Boys maturing		Girls maturing	
	early	late	early	late
1. AMHV (yr)	8.8	12.6	7.1	11.0
2. APHV (yr)	11.6	15.7	9.5	13.4
3. AMHVR (yr)	13.5	17.4	11.2	14.4
4. H 4 (cm)	103.9	104.3	102.7	104.7
5. HMHV (cm)	133.9	150.1	124.0	145.9
6. TAG (cm)	33.5	27.2	28.5	19.1
7. HPHV (cm)	153.1	167.0	140.5	158.5
8. HMHVR (cm)	167.4	177.3	152.5	165.0
9. HA (cm)	172.9	180.8	164.2	170.8
10. V 5 (cm/yr)	6.9	6.4	7.1	6.6
11. MHV (cm/yr)	5.0	4.0	6.1	4.7
12. PHV (cm/yr)	8.9	7.3	7.9	6.2
13. PH (cm)	4.0	3.4	1.8	1.7
14. PB (yr)	4.7	4.8	4.1	3.5
15. PAR (PH × PB)	19.1	16.5	7.9	6.0

Boys — early maturing: PHV before 12 years (n=6)
— late maturing: PHV after 15 years (n=6)
Girls — early maturing: PHV before 10 years (n=6)
— late maturing: PHV after 13 years (n=6)

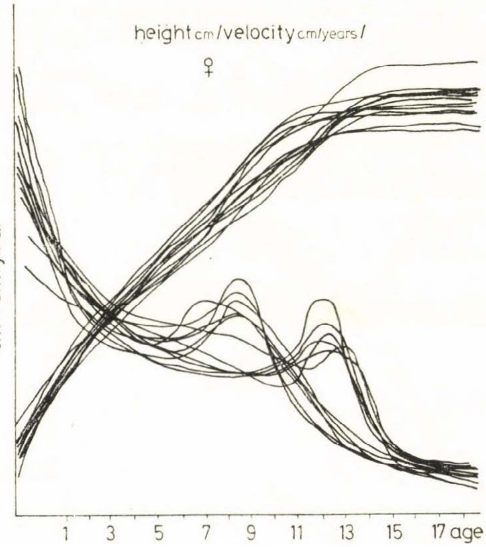

Fig. 6. **Individual stature distance and velocity curves of early and late maturing girls**

mesomorphy prevailed in boys before endomorphy and ectomorphy. In late maturers of both sexes endomorphy dominated over ectomorphy and over mesomorphy more distinctly in girls than in boys. The late maturers as a group were less pigmented than the early ones, who had darker eyes.

It is interesting to note an unimportant role of different social background of the children investigated in relation to early or late onset of maturation. School progress was found to be slightly better in the late than in the early maturers. Average school progress was in general worse during the adolescent period than before and after puberty. Girls revealed better average school achievement than boys.

The psychologist of our research team, H. Havlínová applied the High School Personality Test after Cattell to each child at the age of 15, 16 and 17 years of age with the aim to obtain the personality characteristics in each child in the adolescent period. HSPQ concerns 14 bipolar factors of personality (28 characteristics). The early maturing girls with PHV before 10 years and boys before 12 years of age were characterized by relaxed, unfrustrated behaviour with advanced social maturity and were found to be emotionally stable. On the other hand the late maturing boys and girls were emotionally unstable and socially immature. Boys from the late maturing group were in contrast to the girls of the same group shy and introverted. The characters of the late maturers may be explained as a result of discrepancy between uniform constant social demands for the group of the same age and the slow rate of biological maturation. No big differences between early and late maturers were found in the later choice of their professional career.

Comparison with other longitudinal studies

Tab. 4 brings results from European and American growth studies (after Malina 1978, rearranged and completed). Parameters of the Prague velocity curves are close to those from Zürich. The next similar group in many respects is that from Harvard and of Harpenden (though the Harpenden group is of lower mean stature). Children from the Fels, USA and Berkeley studies are on the average taller than the European and Harvard samples.

Discussion

The age span in which individual boys and girls differ in reaching their PHV, is about 5 years in girls and 6 years in boys. Between the most early maturing girl and most lately maturing boy there is a span of 8 years. This knowledge of the wide range of variability in the onset of puberty in still normal children gives to each pediatrician a strong argument in explaining individual situation in deviant cases at a certain age. Pedagogical staffs in schools may benefit from this fact when dealing with children of the same chronological age but of a very different biological age who sit next to each other in the same classroom. School has the same demands for all children of the same age disregarding their different stage of biological development. Some children may be thus wrongly classified be it in mathematics or in physical education.

The question arises whether it is good or not to be an early maturer. It seems that in some cases it may have a positive effect on personality development —

Table 4

Selected parameters of growth curves in various longitudinal studies
(after MALINA 1978, rearranged and completed)

Study		Height at minimal prepubertal growth velocity HMHV (cm)			Total gain during puberty period TAG (cm)		Peak height velocity PHV (cm/yr)		Age at peak height velocity APHV (years)		Adult height HA (cm)	
		n	x̄	s	x̄	s	x̄	s	x̄	s	x̄	s
Boys												
1. Prague	(1)	89	143.6	7.4	30.7	4.8	8.6	1.1	13.5	1.0	178.9	6.1
2. Zürich	(2)	112	143.8	7.7	29.2	—	9.0	1.1	13.9	0.8	177.4	6.3
3. Fels	(3)	83	149.9	7.0	30.9	4.3	7.0	1.1	13.0	0.9	180.9	5.6
4. USA	(4)	54	149.4	7.1	31.0	4.7	6.9	1.1	13.3	0.9	180.4	5.4
5. Berkeley	(5)	65	150.6	7.0	30.1	5.4	6.6	1.0	13.1	1.1	180.7	6.6
6. Harvard	(6)	54	147.4	5.7	31.2	5.5	7.1	1.3	12.3	0.9	178.6	6.1
7. Harpenden	(7)	55	146.1	6.3	27.6	3.5	8.8	1.1	13.9	0.8	173.6	6.1
Girls												
1. Prague	(1)	89	134.2	7.3	25.6	5.0	7.5	0.9	11.4	1.1	167.1	5.8
2. Zürich	(2)	110	135.8	7.3	23.2	—	7.1	1.0	12.2	1.1	164.9	5.7
3. Fels	(3)	74	138.6	7.4	29.5	6.8	6.3	0.9	11.0	0.8	168.0	5.1
4. USA	(4)	49	137.3	6.6	31.0	4.0	6.5	0.9	11.0	0.9	168.2	6.7
5. Berkeley	(5)	64	141.8	7.6	26.3	5.7	5.7	0.8	11.0	0.8	168.1	6.2
6. Harvard	(6)	54	140.3	7.2	25.4	5.6	6.2	1.1	11.1	0.9	165.7	5.1
7. Harpenden	(7)	35	137.9	7.0	25.3	4.1	8.1	0.8	11.9	0.9	163.2	5.9

1. Prague — PROKOPEC, TOMÁŠEK 1979
2. Zürich — STÜTZLE et al. 1977
3. Fels Research Institute, Yellow Springs
4. Child Research Council USA
5. Berkeley Growth Study
6. Harvard School of Public Health
7. Harpenden Growth Study, England

early maturing children are less problematic, more easy going, some of them tend to become leaders among their peers (this may bring disappointment in later years, when the late maturers overtake their earlier mature peers). We failed to find a satisfactory answer as to the cause of early maturation. The answer should be sought on a cellular level — in the rate of cell division (mitosis). A certain amount of mitosis must have taken place in the organism before a functioning organ — say hypophysis, thyroid, ovary etc. developed. The role of provoking agents, of heredity, social relations and nutrition etc. on speeding up and/or on slowing down the rate of biological processes in growing organism still remains to be defined.

When observing side by side early maturing and late maturing children and youths (Plate I), early maturers seem to be those living in affluence, unhindered by disease of any sort, well adapted to living conditions they live in. They are swimming in "their well known waters". On the other hand, late maturing individuals seem to be overcoming some difficulties, covert illness not apparent to a clinician, or still adapting to their milieu. We may also view the early maturers as a "quick job" and later maturers as a longer lasting but "a solid piece of work unhurriedly put together". The answer to this thought would be: investigation into morbidity and longevity of early and late maturing individuals.

Conclusions

1. Individual growth curves of 89 boys and 89 girls from the Prague longitudinal study have been analysed and the results are presented.

2. Fifteen parameters were studied in each individual velocity curve.

3. Attention was paid to the variability of the peak height velocity (PHV). A difference of 5 years in girls and 6 years in boys was found between the earliest and most late maturing individual of the respective sex. Between the earliest maturing girl and latest maturing boy from the studied sample there was a period of 8 years.

4. Selected groups of 6 early and 6 late maturing boys and girls showed little differences in the mean body height before the age of 5 years but big differences at the age of the PHV.

5. The PHV is on the average smaller in late than in the early maturing groups of both sexes.

6. The final mean height at an adult age was found to be bigger in the late than in the early maturers.

7. Differences between most of the studied parameters of velocity curves were smaller between the sexes (averages) than between early and late maturers of the same sex.

8. Lighter pigmentation (eye colour) was found in the late maturers and darker in the early maturers.

9. The late maturers were slightly better in school progress than the early maturers.

10. The late maturing boys were less mesomorphic and more ectomorphic than the early maturing boys. Late maturing girls were less endomorphic and more ectomorphic than early maturing girls.

11. Social background correlated neither with early nor with late maturation. Also the choice of profession (students and apprentices) had no bearing on early or late start of maturation or on its length of duration.

12. The Cattell's HSPQ test performed repeatedly at the age of 15, 16 and 17 years of age showed that the early maturers were unfrustrated, relaxed, emotionally stable and socially mature, whereas the later maturers were socially immature and emotionally unstable. Boys from the late maturing group were also shy.

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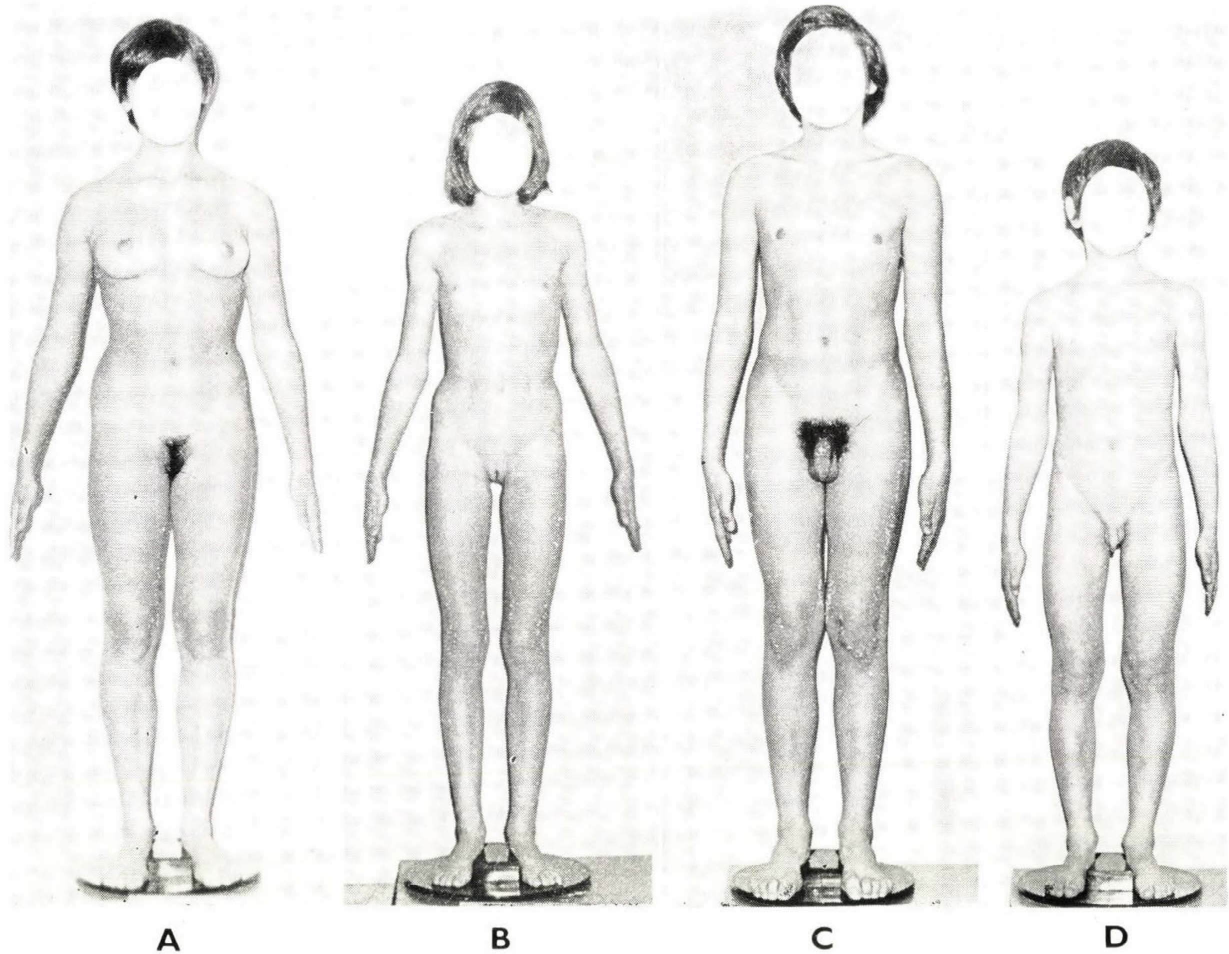
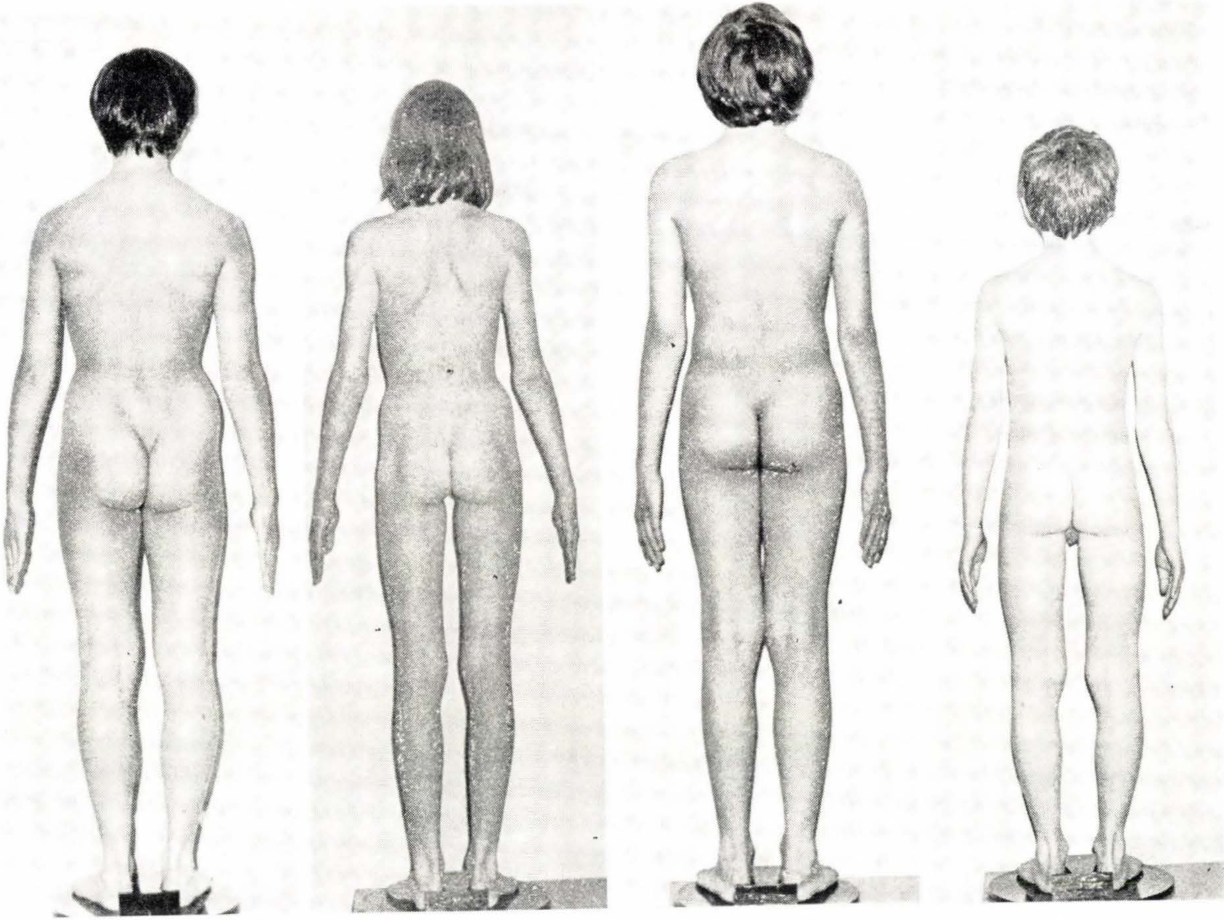


Plate 1: A — early maturing girl, age 12 years, height 162.2 cm, weight 51.1 kg, No. 36, B — late maturing girl, age 12 years, height 149.1 cm, weight 31.8 kg, No. 61, C — early maturing boy, age 13 years, height 159.6 cm, weight 47.1 kg, No. 259, D — late maturing boy, age 13 years, height 137.4 cm, weight 29.8 kg. No. 211



A B C D

Plate 2

Anthrop. Közl. *26;* 25–32. 1982.

ANTHROPOMETRIC PREDICTION OF BODY COMPOSITION IN AMERICAN YOUTHS 12–17 YEARS OF AGE

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Abstract: Prediction equations for estimating fat weight from age, Quetelet's Index, and the triceps skinfold thickness were developed, for each sex, in 169 males and 66 females, 12 to 17 years of age, from Minneapolis and Philadelphia. Validation was carried out by a sequence of analyses done on 90% of the sample, the remaining 10% used for validation. This was conducted until all combinations of 90% had been used for prediction and of 10% for validation. The standard errors of estimate were too high to permit acceptable estimates to be made in individual subjects, the one SD error amounting to 27% of the mean fat weight. Even though good results were obtained for the sample as a whole, systematic errors were noted when the errors of estimate were calculated for Minneapolis and for Philadelphia youths separately. It is recommended that prediction equations for body composition not be used in adolescents of this age range.

Key words: anthropometric prediction, body composition, American youths.

Introduction

The most widely-used indicators of body composition in humans are anthropometric ones, derived from the careful measurement of the body using accepted techniques. The scientific and clinical literature abounds with reports which analyze various issues and problems related to body composition based upon anthropometry. The reasons for the widespread use of anthropometric techniques are obvious. They are relatively simple to apply, they are much less expensive than all of the presently available laboratory procedures and, most important of all, anthropometric methods are appropriate for large samples of all ages, male and female, located wherever they may be found in the world.

While anthropometry has many advantages as a technique used in the study of body composition, it also has its limitations. Anthropometric indicators are indirect ones and, rather than yielding estimates of variables such as the lean body mass, percent body fat, and the like, they provide measurements of whole body mass or of linear dimensions. As a result, considerable effort has been devoted by researchers to the validation of body measurements as indicators of body composition and numerous publications are available which report of the relationships between anthropometric dimensions and whole body composition (BROŽEK 1963a, 1963b, BEHNKE–WILMORE 1974, PAŘÍZKOVÁ 1977, MALINA 1980, LOHMAN 1981).

In general, the relationships between anthropometric variables and estimates of body composition derived from methods such as ^{40}K, densitometry, or the determination of body water are quite high. For example, in an early study, PASCALE et al. (1956) reported correlations between various skinfolds and body density in American adult males which ranged from −0.74 to −0.83. Similar results have been published by other investigators for additional samples, using such anthropometric indicators as weight, circumferences, skinfolds, and indices of weight-for-height (SATWANTI et al. 1977, HARSHA et al. 1978).

In view of the generally high relationship between anthropometry and estimates of whole body composition derived from laboratory procedures, many investigators have utilized combinations of body measurements, usually through multiple regression analysis, in an attempt to optimize the relationships, to account for a greater proportion of the variance, and to permit usable estimates of body composition to be made from combinations of anthropometric variables. A count of the number of papers which have presented such prediction equations is neither necessary nor fruitful; however, well over 100 equations may be found in the scientific literature without undue effort.

Unfortunately, the impact of this mass of equations upon researchers has been minimal. Only occasionally does one find a study in which an investigator has used someone else's equations in his or her study. Instead the majority of workers prefer to rely upon their own anthropometric data.

The reasons for the lack of utilization of the available prediction equations are based to a large extent upon methodological flaws present in the research designs of the studies from which the equations were generated. These flaws have been discussed (LOHMAN 1981, JOHNSTON 1982), and need not be repeated here. However, it is important to realize that the development of prediction equations which may be used on other groups is a complex task requiring a careful and rational selection of independent variables, as well as rigorous and appropriate means for validating the equations which result in order to determine their usefulness among other samples.

This paper examines the issue of predicting whole body composition in 12 to 17 year old youths from a linear combination of anthropometric dimensions. In particular, it addresses the question of the appropriateness of such equations for this age group, as opposed to the use of the body measurements themselves.

Subjects and Methods

The data presented in this paper have been drawn from a study of a sample of American youths, 12 to 17 years of age. The sample totalled 235, 169 males and 66 females and have been described in detail elsewhere (JOHNSTON et al. 1982). Of the total, 48 males and 41 females were from the Minneapolis, Minnesota, area, and 121 males and 25 females were from the Greater Philadelphia area. All techniques were applied similarly in both cities to minimize and effects due to different laboratories.

Estimates of body composition were made by means of body densitometry, determined by underwater weighing. The hydrostatic weighing technique involved four to six determinations of the weight in water taken to the nearest 25 gm, the mean of the last three recorded for analysis. Residual volume was estimated by the oxygen dilution technique of WILMORE (1969)

Table 1

Means and standard deviations of selected variables

Variable		Age (yr)					
		12	13	14	15	16	17
Males							
n		13	21	37	40	37	21
Height (cm)	x̄	151.2	160.7	165.7	169.6	173.5	175.0
	s	6.0	10.5	7.3	7.1	6.0	7.0
Weight (kg)	x̄	43.9	48.6	56.5	61.9	66.8	69.8
	s	8.4	12.3	12.3	9.0	9.9	16.2
Triceps (mm)	x̄	11.1	9.5	10.2	9.5	10.3	6.4
	s	6.7	4.6	6.1	4.1	5.5	3.0
Arm Muscle C (cm)	x̄	20.2	20.8	23.1	25.2	26.0	27.7
	s	1.8	2.3	2.3	2.2	2.0	3.2
% Body Fat	x̄	23.2	24.0	16.9	15.7	14.3	12.7
	s	8.4	6.2	7.1	7.5	7.3	6.3
Fat Weight (kg)	x̄	10.6	11.7	10.0	10.0	9.9	9.4
	s	6.2	4.5	6.3	5.6	6.1	6.4
Lean Body Mass (kg)	x̄	33.2	38.0	46.4	51.9	56.8	60.3
	s	4.2	9.5	8.7	7.2	7.1	12.0
Females							
n		6	10	12	16	12	10
Height (cm)	x̄	157.3	154.4	161.9	163.7	162.9	165.7
	s	3.4	5.9	7.3	6.0	4.4	5.8
Weight (kg)	x̄	43.4	44.8	53.8	58.3	57.2	55.3
	s	8.9	9.3	7.1	6.0	7.4	7.5
Triceps	x̄	10.1	10.9	13.9	16.2	15.2	13.2
	s	2.7	5.7	5.4	6.8	3.7	4.7
Arm Muscle C (cm)	x̄	19.1	19.8	20.8	21.6	21.8	20.7
	s	3.2	1.5	1.5	1.7	2.1	1.7
% Body Fat	x̄	24.9	25.1	26.6	27.4	28.1	27.9
	s	7.0	6.8	3.8	4.9	3.7	6.3
Fat Weight (kg)	x̄	10.8	11.6	14.4	16.1	16.2	15.7
	s	3.8	5.6	3.2	4.8	3.7	4.7
Lean Body Mass (kg)	x̄	32.6	33.7	39.4	42.0	40.9	39.8
	s	7.1	5.0	4.9	6.1	4.4	4.2

The standard deviations of the errors of estimate of fat weight are 3.1 kg and 2.3 kg in males and females respectively. That is, two-thirds of the errors of estimate fell within a range of 6.2 and 4.6 kg.

We next examined the prediction errors which resulted from applying the equations derived for the total sample by city of residence, i.e., Minneapolis or Philadelphia. The results are given in Table 4, where it is immediately apparent that the errors of estimate, when calculated separately by city, are conand the percent body fat calculated from body density using the forn of BROŽEK et al. (1963):

$$\text{Percent Body Fat} = \frac{4.570}{D} - 4.142$$

where D = body density, expressed in gm/ml.

Because of the dangers of over-determination, we did not utilize all o anthropometric variables which had been measured. Rather, we atten to use the minimal number of measurements, those obtained easily on sub under varying conditions. After analyzing the correlation matrix forme the body measurements, we chose, as predictor variables, the thickness o triceps skinfold and Quetelet's Index (weight/height^2). Since our sub spanned a six-year age range in which body composition is known changing rapidly (PAŘÍZKOVÁ 1977, TANNER 1962), the age of each indiv was also used as a predictor variable.

For the dependent variable we decided to use the body fat weight. Th cent body fat was not used because of its lower correlations with anl metic dimensions while density was not chosen because of the difficu interpreting variability in meaningful units of body composition.

The predictor variables were entered sequentially into a linear reg model of the form:

$$\text{Fat Weight} = \text{Age} + \text{Quetelet's Index} + \text{Triceps}$$

and optimal regression weights derived for each sex.

Validation of these equations was accomplished by means of the Ja technique (MOSTELLER–TUKEY 1977). The sample was divided ran by sex, into 10 groups. Separate regression analyses were carried combinations of nine groups and validated on the tenth, until all combinations had been analyzed. This resulted in 10 separate vali each one on 10% of the sample; thus each of the 235 subjects partici this validation procedure once. The error of estimate was calculated mean error of the 10 validations, again by sex.

Results

Table 1 presents the means and standard deviations of selected a metric and densitometric variables. The values are not notably differ those found by other investigators and confirm that this sample is not for any reason. Table 2 presents the prediction equations resulting analysis of the total sample. In males, 72% of the variance in fat weight explained by this model while, in females, the percentage is somewha 76.8%. These values correspond to multiple r's of .849 and .876 res In males, the regression weighting for Quetelet's Index is somewh than that for the triceps skinfold, while, in females, Quetelet's Index is considerably more than the triceps fold. In both sexes, each regressi is significantly greater than zero.

Table 3 gives the results of validating this approach using the technique. The mean errors of estimate are only about .01 kg in b

Table 2

Equations for predicting fat weight in white American youths, 12—17 years*

Variable	Regression Weight		Units
	Males (n = 169)	Females (n = 66)	
Constant	−1.024	−15.869	—
Age	−0.492	+0.355	yr. + decimals
Quetelet's Index	+0.584	+1.109	kg/m^2
Triceps Skinfold	+0.668	+0.170	mm
R^2	0.720	0.768	—

* Predicted fat weight in kg

Table 3

Mean errors of 10 validations each of 10% of sample

Sex	n[a]	$\bar{x}$[b]	s[c]
Males	10	0.008	3.099
Females	10	0.012	2.300

[a] number of validations; sample size for each: males, 16 or 17, females, 6 or 7
[b] mean of predicted-actual fat weight
[c] standard deviation of sample means

Table 4

Mean error of predicted fat weight by city[a]

City of Residence	n	$\bar{x}$[b]	s
Males			
Philadelphia	121	−0.489	2.919
Minneapolis	48	+1.232[c]	3.330
Females			
Philadelphia	25	−0.568	2.552
Minneapolis	41	+0.346	2.056

[a] fat weights predicted from equations of Table 2
[b] mean predicted-actual fat weight in kg
[c] significantly different from zero, p = .02

siderably higher than for the combined sample. In three of the four sex/city groups, these errors cluster around one-half kilogram, though these three mean are not significantly different from zero. However, in the case of Minneapolis males, the mean error of predicted fat weight is +1.232 kg, a value which is significantly different from zero at a probability of 0.02. The standard deviations of the errors of estimate, calculated by city (Table 4), did not differ from the SD's for the sample as a whole (Table 3).

Discussion

The results of this analysis would seem to indicate that suitable estimates of whole body composition may be made from the equations presented here, for youth in the 12 to 17 year age range. This is suggested by the validation data of Table 3, which indicated quite low mean errors of prediction.

However, a closer examination of the analyses suggests that there may be problems in the use of prediction equations for adolescents. The first such problem is indicated by the values of the standard deviations of the errors of estimate. In males, the SD's approximate 3 kg and in females, 2.3 kg. In other words, an estimate of fat weight in an individual subject, using these equations, can be expected to be accurate to within a ± 3 or ± 2.3 kg.

We may express the error of estimate for individuals in another way. If we combine our sample, giving a maximum of 235 subjects, we find that the standard deviation of the error of estimate is 2.966 kg. For all subjects, sexes combined, the mean fat weight determined by densitometry was 11.075 kg. If we use the one standard deviation value as a reference, the error of prediction of fat weight in an individual is 2.966/11.075, or $\pm 27\%$. Clearly, an error of 27% is unacceptable in human biological research. We must therefore conclude that it is not possible to derive prediction equations for individuals of this age range which allow us to estimate their body composition with a suitable degree of accuracy.

On the other hand, one may argue that, even if predictions in individuals are not justified, that it may be possible to make predictions for groups, i.e., to predict the mean fat weight of a sample from their body measurements. While it is true that the mean errors from the validation procedure (Table 3) were quite low, the errors were higher when the sample was subdivided by city. And, in fact, in one of the four subgroups, the mean error was significantly greater than zero.

It is somewhat surprising that the mean errors were so much higher when the sample was subdivided by city of residence. While Minneapolis and Philadelphia are hundreds of kilometers from each other, and occupy different climatic zones, the subjects of both sub-groups are of predominant European ancestry and better results might have been expected intuitively. Two reasons for this difference are immediately apparent. First, the two groups (Philadelphia and Minneapolis subjects) might differ enough biologically due to ethnic and environmental factors to display differences in the relationships between anthropometry and body composition. Second, despite our efforts, there may have been enough systematic difference in the determination of body density or in the measurement of the anthropometric variables to cause a difference. Whatever the case, this argues that prediction equations derived from one group may be applied, with any confidence, only to that specific population from which they were derived. To apply them to any other population, no matter how biologically close they might be thought to be, runs the risk of systematically biasing the results of one's research.

Other investigators have commented on the specificity of equations for predicting body composition. HUGHES et al. (1981) applied these equations to a sample of 45 12—14 year old Mexican-American boys, on whom densities had been calculated by underwater weighing. They found that the equations overestimated the percent body fat by 21% and the fat weight by 8.9 kg.

FLINT et al. (1977) concluded that it may be impossible to generalize prediction equations from one group to another. In another study, SATWANTI et al. (1977) applied 12 separate formulae, obtained from the literature, to data from 65 young adult Indian females. They found that, in each case, the formulae systematically underestimated body density and none could be used to generate usably-accurate estimates of fatness in their subjects.

It seems certain that the problems discussed here are especially acute in adolescents. Body composition is known to be changing rapidly during this time and inter-individual variability is increased by other factors, such as the rate of biological maturation (JOHNSTON and MALINA 1966). In addition, where there is significant under- or overnutrition, illnes and disease, and variation in daily levels of energy expenditure, estimates would be expected to be more biased.

Thus, it seems inadvisable to attempt to utilize prediction equations for estimating body fatness in adolescents from their anthropometry. To be sure, such estimates are inadmissible for individuals in view of the very high errors associated with individual predictions. The nature of the population specificity of any equations indicates that significant systematic errors may also be expected when such equations are used to predict mean values for body composition variables. At this time, it would seem better for investigators to continue to utilize the anthropometric dimensions themselves. Even though body measurements are indirect, their judicious use will result in fewer errors than the utilization of prediction equations.

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A SIMPLE ATTEMPT FOR POPULATION COMPARISON BY SOMATOVARIANTS

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Abstract: Based on the means and standard deviations of three body measurements, stature (linearity), weight (muscularity and fat) and biepicondylar width of the humerus (robusticity) from 2 male and 2 female series of European students 5 percentiles were computed. Using these percentiles each variable was classified and the three class-numbers were combined to form a triplet. The advantages of the method were discussed, and also some statistical problems.

Key words: anthropometric comparison, somatovariants, students.

Introduction

It has always been one of the general aims of physical anthropologists to get informations about the affinities and relationships between and within human populations. With respect to body constitution the typological methods elaborated are numerous, generally based on the combination of somatoscopic and of somatometric characters (CARTER 1975, EIBEN–CSÉBFALVI 1977, EIBEN et al. 1976, KNUSSMANN 1961, MARTIN–SALLER 1957, ROSS–WILSON 1974). It is not the purpose of this study to discuss the advantages and disadvantages respectively of one or the other of these methods but to introduce a simple method for the investigation of body dimensions based on three body measurements only. The method is not thought to replace any of the others but could prove useful in those cases where several of the generally required measurements can not be taken because of the problems known to exist in field work.

These three measurements were also chosen under consideration of methodological-technological aspects and with respect to biological reliability (HAUSER et al. 1981). From several basic studies have resulted rather conformingly three to four factors as to body dimensions which also agree well with regard to the loadings of the underlying measurements. Thus stature, weight and biepicondylar width correspond well to the practical claims (easily measurable, not bothering people, small intra- and interindividual measurement differences) and though very roughly represent linearity, muscularity, and fat, and robusticity.

Material and Methods

Stature weight and biepicondylar width (bilaterally) were measured on 117 male and 120 female Viennese as well as those from 78 male and 75 female German (Bremen) students. The age of all the probands (unrelated) ranged from 20—30 years. Care was taken to check interindividual measuring difference which proved to be negligibly small between the three investigators.*

From each of these variables were computed classes separately for males and females by calculating the percentiles for 5%, 15%, 50%, 15%, 5% of a theoretical distribution on the basis of the relative means and standard deviations (Tab. 1). According to these percentiles the variables were subdivided into five classes which could be named very small (I), small (II), medium (III), big (IV) and very big (V). Using these classes the classnumbers of the three variables were combined to triplets; one triplet thus representing one person. Then the frequences of the five cubed commutations, 125 theoretically possible combinations, were computed for each of the four groups separately.

Table 1

Statistical parameters of the three body measurements in the investigated groups

Measurement	$\bar{x}$	s	Range	Curtosis	Skewness
Viennese male students (N=117)					
Stature (cm)	180.1	6.37	165—198	.99	—.026
Weight (kg)	72.1	8.81	53—99	—.046	.371
Width Humeri (mm)	71.4	3.40	64—78	—.736	.004
German (Bremen) male students (N=78)					
Stature (cm)	177.0	6.24	163—191	—.378	—.092
Weight (kg)	71.8	8.72	50—99	.470	.125
Width Humeri (mm)	70.3	3.26	63—78	—.059	—.012
Viennese female students (N=120)					
Stature (cm)	165.5	5.82	151—180	.446	.026
Weight (kg)	58.1	8.26	44— 90	1.221	.938
Width Humeri (mm)	61.0	2.91	55— 68	—.554	.323
German (Bremen) female students (N=75)					
Stature (cm)	165.1	6.57	148—180	—.062	.039
Weight (kg)	55.8	5.99	40— 71	—.074	.172
Width Humeri (mm)	60.8	3.52	49— 67	.378	—.445

To measure the biepicondylar width of the humerus the spreading caliper was used as the data proved more reliable than with the sliding caliper; for the computation the bigger one of the two measurements was taken.

* The author wants to thank Mag. Heidi DANKER and Mag. Reinhild JAHN for most valuable help.

Results and Discussion

It was not expected to find all the theoretical triplets realized, yet the fact that only 47 triplets altogether were found in the four series is rather useful in the sense of need for a typological characterisation not to result in too many subdivisions. Of course the frequencies of the triplets shown in Fig. 1 and 2 are to be understood only in the sense of an example as the sample sizes are insufficient for reliable statements. Yet they reveal the usefulness of the method for population comparison as well as for the two sexes, but also for the comparison of specific groups within a population. These triplets not showing up at all or very rarely in the normal population could prove valuable for example in medical research.

With respect to the use of indices these triplets have the advantage of not losing all the information of the actual dimensions of the traits involved.

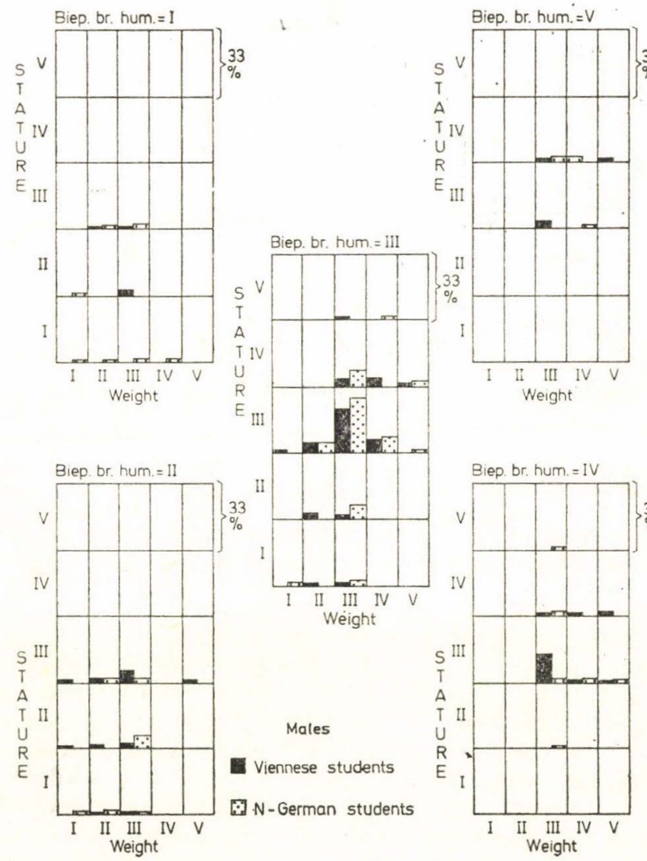

Fig. 1. **Body somatovariants of 117 Viennese and 78 Northern-German (Bremen) male students. *Stature:* I—168 cm, II—169—173 cm, III 174—184 cm, IV 185—189 cm, V 190— cm; *Weight:* I —57 kg, II 58—64 kg, III 65—79 kg, IV 80—86 kg, V 87— kg; *Biepicondylar width of the humerus:* I —65 mm, II 66—68 mm, III 69—73 mm, IV 74—76 mm, V 77— mm (i.e. II, III, II means: small dimension for stature, medium for weight and small for biepicondylar width of the humerus)**

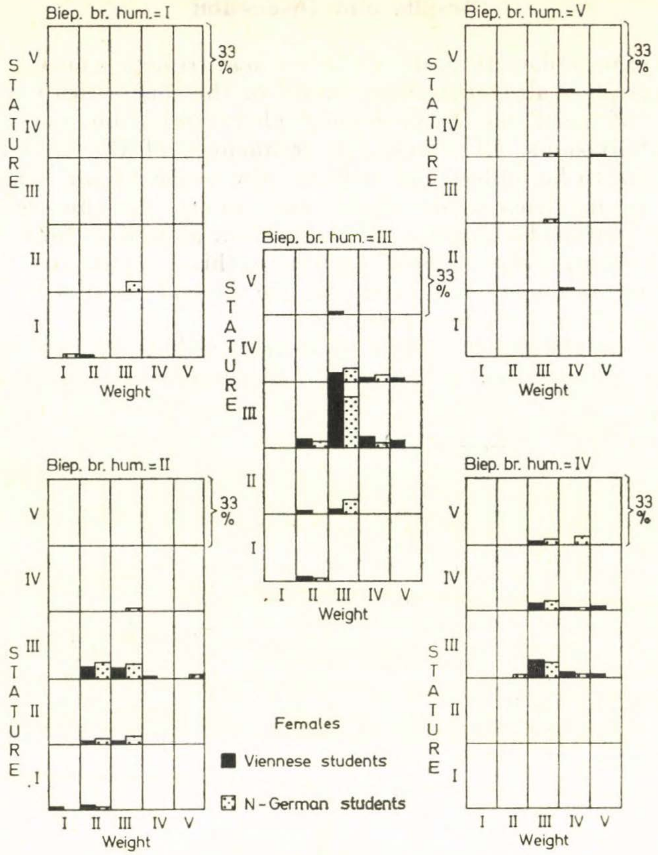

Fig. 2. **Body somatovariants of 120 Viennese and 75 Northern-German (Bremen) female students.** ***Stature:*** **I —154 cm, II 155—159 cm, III 160—170 cm, IV 171—175 cm, V 176— cm;** ***Weight:*** **I —44 kg, II 45—50 kg, III 51—63 kg, IV 64—69 kg, V 70— kg;** ***Biepicondylar width of the humerus:*** **I —55 mm, II 56—58 mm, III 59—63 mm, IV 64—66 mm, V 67— mm (i.e. III, III, III means: medium dimension of all the three characters)**

But also for genetic and growth studies the possibility of comparing different age groups might prove interesting as the classes are always computed with the same percentiles based on the relative means and standard deviations of the group-characters studied.

Yet it should be mentioned that there exist some statistical problems: (1) The requirement for normal distribution is not always fulfilled. (2) Partially the empirical percentiles do not correspond with the theoretically requested ones. Thus instead of an expected value of 15% a higher or smaller one is observed. It is planned to solve this problem by means of smoothing the empirical distribution.

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A STUDY OF ENDOGENOUS PSYCHOSES FROM THE GENETIC ANGLE

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Abstract: A humanitarian motivation of social psychiatry is indispensable f or reaching the rehabilitative purposes. But, the assumption of aetiological role of the socio-psychiatrically decisive factors seems to be an abuse in cases of endogenous psychoses. Of primary importance is — a possibly exact, nosologically grounded — clinical diagnosis. Despite this, great difficulties are being encountered in demonstrating the genetic determination. As an example, the author sum up the results of family studies. Using strict diagnostical criteria, the interpretation of the somatometric data of 274 female patients suffering from endogenous psychoses became possible. The estimation of the distance measured between the clinical groups separates the cyclic clinical pictures from the schizophrenic ones, and also casts light upon clinically well interpretable differences even among the forms of schizophrenia. Among the causes of these differences, genetic determination has a part, and upon this the examination of the parents' ages at conception serves with confirmative data.

Key words: social psychiatry, endogenous psychoses, schizophrenics, somatometry, size and shape, population genetics.

Introduction

Psychiatric illnesses can be traced back in part to biological factors and in part to disturbing environmental factors, the latter particularly in the area of human relations. The aetiology of the so-called *endogenous* psychoses is debated. The concept of "endon" refers to the emergence of these illnesses from a disorder rooted in the basic biological structure (TELLENBACH 1961). The overall picture gained from aetiological research is that in this case the social psychiatric approach is of decisive importance not in determining the origin of the illness, but mainly as an important basic approach to the therapy. This is because the symptoms of a patient suffering from an endogenous psychosis are such that they restrict the ability to adapt and provoke an attitude of rejection in the patient's environment. Therapy is based on biological treatment, particularly pharmacotherapy. With the biological therapy available, the patient's symptoms of great psychomotor agitation, acute anxiety, extreme fluctuations of mood and aggressive behaviour can be greatly reduced within a short time. For this reason rehabilitation and the methodology of reintegration into society and the immediate environment — sociotherapy — have greatly increased in importance. At the same time, the method of treatment prevents the emergence of secondary hospitalization syndromes aggravating the illness.

The diametrically opposed biological and dynamic approaches clash most spectacularly in the questions of aetiology. The situation is simpler if we consider the endogenous psychoses among the psychiatric illnesses. It is quite widely known that the major social upheavals and catastrophes have not had any influence on morbidity due to schizophrenia or on the prevalence of this illness in the most varied geographic and cultural environments. In this way the accumulation of schizophrenia in certain sub-cultures can rather be attributed to social selection trends, that is, to certain manifestations of social mobility.

Despite this, great difficulties are being encountered in demonstrating the genetic determination (this is what maintains the psychogenic and sociogenic theories). As one of the best examples of this, we sum up the results of family studies:

Table 1

The risk of schizophrenia in the relatives of index patients examined

Relationship	% risk	
	$\bar{x}$	v
Parent	6.3	0.3—13
Half-sibs	9.0	3.2—10.8
Sibs	10.3	3.3—14.7
Children	13.7	7.0—17.0
Uncles or aunts	3.6	0.9— 6.9
Nephews and nieces	3.5	0.5— 5.5
Cousins	1.4	0.8— 2.9
Grandchildren	3.0	1.3— 4.4

It is clear that mathematical demonstration is impossible in view of the great deviation in the findings of the different studies. For example SLATER (1972), assuming the influence of a partially dominant gene, considered that in theory the probability of occurrence of schizophrenia in the sibling of the person studied would be 9.9%, this figure would be 8.4% for the child and 4.6% in the cousin; while KARLSSON (1972), postulating the influence of two-locus recessive genes, calculated a probability of 14%, 16% and 3% for the same degrees of relationship. If we accept the 0.85% morbidity for schizophrenia and assume a polygene origin for the disease, on the basis of the modified Edwards formula (CZEIZEL and TUSNÁDY 1972), the observational risk of schizophrenia in the first, second and third degree relatives is 11.7%, 3.9% and 2% respectively. As Table 1 shows, the scattering of the data from studies is so wide that they are able to include the figures for each of these hypotheses.

For this reason, I consider that clinical diagnosis on a sound nosological basis and as precise as possible is a fundamental requirement in research on the endogenous psychoses. This will make it possible in the first place to screen out non-endogenous (somatogenic and psychoreactive) psychoses; it will also contribute to a better knowledge of the sub-classes of the endogenous psychoses. A conclusion which begins by stating that the researcher examined a specified number of schizophrenic patients without more precise sub-classification is not acceptable.

A nosologically acceptable classification must be based on clinical entities in which the course of the disease is taken into account and the conceptual system describing the syndromes reveals the contours of the clinical picture, its saturation and coherence (PETHŐ 1972). Distinction of the cyclical psychoses and the schizophrenias among the endogenous psychoses is as yet the most accepted but even in these two cases a conceptual blurring also occurs, for example, in the concept of the so-called "mixed psychoses" (where a "combination" of schizophrenia and manic-depressive psychosis is postulated) Even the cyclical psychoses are not entirely uniform (e.g. there may be unipolar or bipolar disturbances of mood); however in the case of schizophrenia the picture is much more heterogeneous. This is the reason for distinction such as essential and process schizophrenia (SULLIVAN 1953) or typical and atypical schizophrenia (PAULEIKHOFF 1975). Leonhard has attempted a highly detailed classification of the endogenous psychoses. In our experience his main disease entities provide a good foundation for the separation of clinical disease entities (LEONHARD 1957).

Leonhard's *systemic* forms of schizophrenia are characterized by a steady progression. This group includes the systemic paraphrenias (characterized chiefly by symptoms of experience), the systemic catatonias (characterized by behavioural aberrations) and the hebephrenias (where emotional blunting is the central symptom). The *nonsystemic* schizophrenias take the form of remittent attacks, with the course of the illness fluctuating between deterioration and improvement. In the case of *cycloid psychoses or cyclophrenias* the patient may be free of symptoms for considerable periods of time between two stages of the illness.

Material and Methods

Using these diagnostic categories, the author examined 274 endogenous female patients from the inner area of Budapest. The distribution was as follows:

Diagnosis	*number of cases*
(H) hebephrenia	49
(P) systemic paraphrenia	29
(K) systemic catatonia	28
(p) affective paraphrenia	30
(k) periodic catatonia	28
(C) cyclophrenia	51
(M) maniac-depression	35
(D) monopolar depression	24

The psychiatric study was supplemented with 59 body measurements. The chief concern in processing this data was to attempt to ascertain whether there is any difference in body measurements between the different clinical groups of endogenous psychotic patients indicating the study of differences in physique as a promising approach. For this reason the author selected the Penrose method for estimation of the Mahalanobis D^2 procedure (PENROSE 1954).

Results

Comparing the results obtained for each group with every other group gave the interrelationships shown on the following dendrograms (Figures 1 and 2).

The results can be summed up as follows:

1. The main groups (particularly the systemic and non-systemic schizophrenias) do not act as entities. This can be given an adequate clinical interpretation since catatonia, paraphrenia and hebephrenia, for example, differ markedly in their symptoms.

2. The distance between the catatonic patients (especially the systemic catatonias) and the other patients is significant.

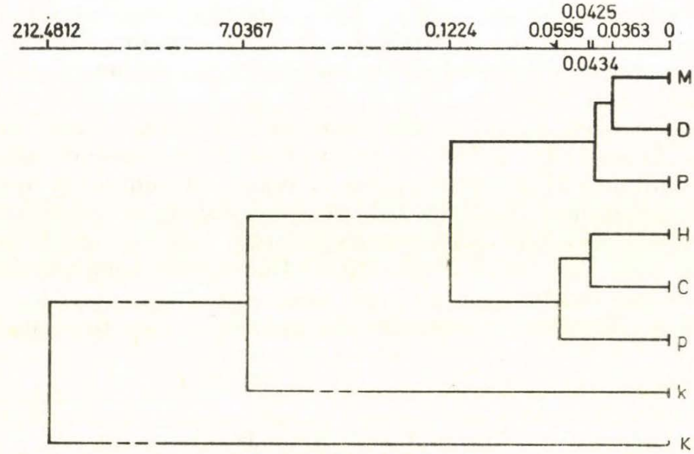

Fig. 1. Distances between the individual clinical groups according to shape

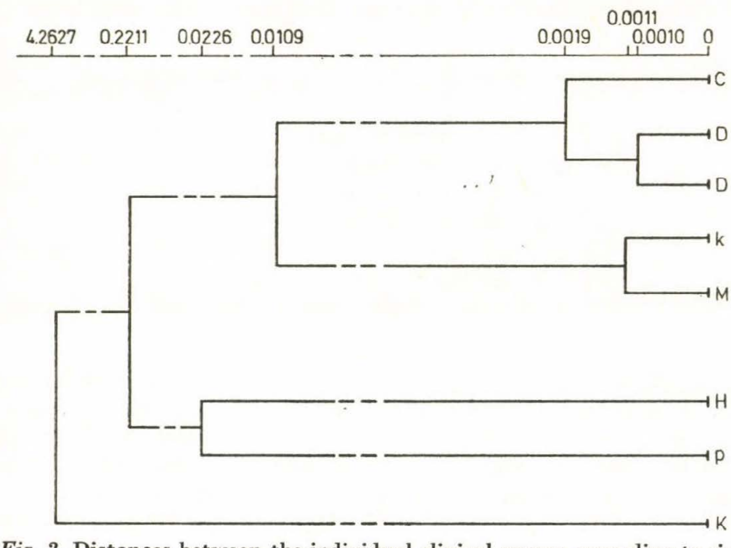

Fig. 2. Distances between the individual clinical groups according to size

3. The overwhelming majority of endogenous psychotics form two large groups. Partly in conformity with KRETSCHMER (1931) the picture presented by the body measurements for manic-depressive psychotics differs markedy from that for the majority of schizophrenics (especially as regards "shape"). At the same time, among the schizophrenics the smallest body measurement values were obtained for the hebephrenics, although together with the affective paraphrenics. The group of cyclophrenics falls into this category on the basis of "shape" but not on the basis of "size".

Studies the author has carried out in another direction tend to confirm the genetic soundness of the conclusions that can be drawn from these body measurement data. He shall only refer briefly here to these studies. Assuming the role of new mutations in maintaining the incidence of schizophrenia, he recorded the age at the time of conception of the patient, for the parents of patients isolated from the family angle (that is, the first occurrence in the family of endogenous psychosis). The data for female patients is not yet complete. The author has reported elsewhere on the data for male patients and shall only sum up the findings here (KELEMEN 1977). For 130 male patients the age of the mother at the time of conception proved to be higher than that for the control group of 383 normal subjects. After excluding the influence of social factors and the influence of parental age differences, by fixing the maternal and then the paternal ages, χ^2 statistics were made for the normal and pathological values of altering paternal age groups. Then determining the partial correlation coefficients weighted by the number of elements from the previous contingency tables, the author reached the conclusion that the probability of incidence of the illness only rises with the increase in maternal age ($p < 0.01$). There are significantly more elder mothers in the case of systemic schizophrenics ($p_{syst} < 0.001$) and in particular among the paraphrenics. However, the maternal age for cyclophrenics did not differ from that for the normal control group. Another indication of the important role of new mutations is the fact regularly found in family studies that there are more mentally ill persons among the children of patients than among their parents. The same explanation can be given for the fact that although schizophrenics have a reduced level of fertility — and excessive fertility of a compensatory nature cannot be found among their siblings either — the prevalence of schizophrenia nevertheless remains constant. If we compare these data with the fact that Lindelius found a higher than average level of fertility in the parents of patients (LINDELIUS 1970) it would seem that it is often children born late who become schizophrenics; that is, the incidence of schizophrenia is in correlation not with the number of children but with the more advanced age of the parents.

The data given here point to the need for a genetic study of the endogenous psychoses and to the possibility of explaining the differences in the clinical condition and physique of the various disease entities on the basis of the differing genetical backgrounds.

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EFFECTS OF GENETIC AND SOCIO-ECONOMIC FACTORS ON BODY DEVELOPMENT OF STUDENTS OF THE BUDAPEST TECHNOLOGICAL UNIVERSITY

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Abstract: The paper is dealing with the genetic and socio-economic factors influencing the body development of the fifth year students of 1975/76. The age of the students were between 22 and 27, but we have only analyzed in detail the data of the two largest age groups of males and females each, i.e. the data of 321 boys of 23 years and 430 boys of 24 years old as well as 73 girls of 22 and 128 girls of 23 years old. From the genetic and socio-economic factors only the place of birth, father's occupation and number of children per household are presented in this paper. Regarding to the birth place a distinction was made between students born in Budapest and in the country. The father's profession was classified in three groups: intellectual, employee and manual worker. The number of children per household was simplified as 1, 2, 3, and more than 3. — The data show genetical and socio-economic differences in body measurements of the students, which are analyzed in detail in the paper.

Key words: Growth and development, genetic and socio-economic factors influencing growth, university students.

Human body measurements and body development are resultants of both genetical and enviromental factors. From the time of the "industrial revolution" (1778: the invention of the steam-engine), the environment and human society have been changing rapidly, ever according to various degrees but not uniformly in the different countries. One result of these changes is the secular trend. This phenomenon shows various patterns nowadays. In the countries of the so-called "Consumer's Societies" secular trend as well as social differences in the body development have been decreasing or even completely disappeared (BAKWIN 1964, DAMON 1965, 1974, MARESH 1972, WALTER 1977). Opposite to this, in the countries of the "Third World" they are characteristic phenomena (MALHOTRA 1966, SOMOGYI 1970, 1973). In the countries intermediate between these two large groups (e.g. in East-European countries) secular trend as well as the social differencies on body development can be observed, too (SCHMIDT-KOLMER 1965).

Material and Method

In order to study these phenomena on Hungarian university students, regular screening tests have been made for a long time on first and fifth year students in the Polyclinic of the Technological University, Budapest (TILL—GYENIS 1975, 1977).

The present paper is dealing with the genetic and socioeconomic factors influencing the body development of the fifth year students of 1975/76. 17 body and head measurements were measured, but only the data of height, weight and the Rohrer index are presented here.

The age of fifth year students was between 22 and 27, but we have only analyzed in detail the data of the 2 biggest age groups of males and females each, i.e. the data of 321 boys of 23 and 430 boys of 24 years old as well as 73 girls of 22 and 128 girls of 23 years old. From the genetic and socio-economic factors only the place of birth, fathers' occupation and number of children per household are presented in this paper. As to birth place distinction was made between students born in Budapest and in the country. The fathers' profession was classified in three groups: intellectual, employee and manual worker. The number of children per household was simplified as 1, 2, 3 and more than 3.

Results and Discussion

The male students (Table 1) born in Budapest are taller and heavier than those of born in the country. However, they are not better developed, because the values of their Rohrer index are equal or less than that of the students born in the country.

According to the fathers' occupation, the male students with intellectual fathers are also taller and heavier than the students with manual worker father. In spite of this the values of their Rohrer index show that they are less developed, than the other two groups.

The number of children per household has an important effect on income of a family (TANNER 1964). The data of the weight and Rohrer indices show this effect very well (except of the 23 years old students where the sample

Table 1

Data of male students

Factors	N		Height (mm)		Weight (g)		Rohrer-index	
	23 yr	24 yr	23 yr	24 yr	23 yr	24 yr	23 yr	24 yr
Birth-place								
Budapest	179	209	1767.2	1760.8	69008.4	68916.3	1.25	1.26
Country	142	221	1746.6	1746.5	66908.4	68079.0	1.25	1.28
Together	321	430	1758.1	1753.2	68079.4	68485.9	1.25	1.27
Fathers' occupation								
Intellectual	215	254	1766.6	1762.7	68188.4	69380.7	1.24	1.27
Employee	32	48	1745.2	1747.6	68453.1	67510.4	1.29	1.27
Manual worker	74	128	1738.9	1737.5	67601.3	67076.2	1.28	1.28
Number of children per houselhold								
1	79	89	1756.6	1751.5	68481.0	69606.7	1.27	1.29
2	177	210	1755.3	1752.8	67768.4	68352.1	1.25	1.27
3	41	85	1757.8	1756.6	66304.9	68158.8	1.22	1.26
more than 3	24	46	1784.0	1754.5	72083.3	67532.6	1.27	1.25

Table 2

Data of female students

Factors	N		Height (mm)		Weight (g)		Rohrer-index	
	22 yr	23 yr	22 yr	23 yr	22 yr	23 yr	22 yr	23 yr
Birth-place								
Budapest	48	65	1637.7	1629.4	56093.8	54938.5	1.28	1.27
Country	25	63	1624.8	1622.4	55400.0	55119.0	1.29	1.29
Together	73	128	1633.3	1626.0	55856.0	55027.3	1.28	1.28
Fathers' occupation								
Intellectual	57	80	1637.7	1631.5	55912.3	54856.2	1.27	1.26
Employee	5	17	1625.8	1625.9	53400.0	56029.4	1.24	1.31
Manual worker	11	31	1613.9	1611.7	56681.9	54919.3	1.35	1.32
Number of children per household								
1	14	28	1641.8	1631.9	57178.6	55464.3	1.30	1.27
2	33	69	1634.5	1621.1	55227.3	55231.9	1.26	1.30
3	20	23	1626.3	1630.4	55200.0	54608.7	1.28	1.26
more than 3	6	8	1629.7	1633.9	58416.7	52937.5	1.35	1.21

of the more than three children in the family was small and there was a very large and heavy student in the group). For the height no such tendency could be observed.

The two samples of female students (Table 2) were smaller, than the samples of males but in general they show the same tendencies like those of the male students. Thus, the female students born in Budapest are also taller and heavier, than those born in the country. But their Rohrer indices are less, than the latter. According to the fathers' occupation the girls with intellectual fathers are taller than the girls with manual worker fathers, but their weight are equal or less than the latter. Therefore the value of the Rohrer indices of the female students with manual worker fathers are higher, than the girls with intellectual fathers.

According to the number of children per household there is no connection with the height, but there is with the weight and at the Rohrer indices, except of the small sample (only 6 person) of the 22 years old girls with more than three children in the family, where an overweight female students was in the group, too.

On the basis of our data the following conclusions may be drawn:

Genetical factors we observed in the relation of height and number of children per household.

According to our data the height of the students is independent of the income of the family (measured with consideration to the number of children). The reason of this is the strongest genetical controll of the body height than body weight (Knussmann 1977). The effect of the genetical factors appears in the relation of the investigated measurements to the birth-place and the fathers' occupation, too. These data show constitutional differences between students born in Budapest and born in the country as well as between students with intellectual and with manual worker fathers. Students born in Budapest and of intellectual fathers are taller but slighter, than the students born in the country and of manual worker fathers which is caused by the so-called "social shifting effects".

Finally, the effect of socio-economic factors appears in the relation of weight and Rohrer index and the number of children per household, where the students with sibs are less developed than the students having no sibs. The reason of this may be the lower income level per head in the families.

We obtained similar data in a former study (TILL—GYENIS 1977) where the first year students of the 1974/75 academic years was examined, thus according to our data the effect of the genetic and socio-economic factors can be observed on Hungarian university students, yet.

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GROWTH AND DEVELOPMENT AS A BASIS OF SOCIAL PEDIATRICS

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Abstract: Social pediatric consultation consists of biometry (growth and neuromotoric and physical development), physical examination and mental observation in order to detect (hidden) pathology and disorders, exploration of the functioning (behaviour, play, learning, sports) of the child at home, at school, and in other social settings, and the early recognition of threats of health (individual and environmental risk factors). The main parameters for a general medical assessment of growth and physical development are height attained, weight for height, in the case of infants and pre-school children neuro-motoric development, and in the case of adolescents the stages of secondary sex characters.

Key words: social pediatrics, growth, neuromotoric development, physical development.

Medical activities concerning the status of health of children may be distinguished into two complementary systems:

curative medicine (cure) as performed by the general practitioner, the pediatrician and other clinical specialists, and the paramedical professionals like the logopedist and the physio-therapist,

social pediatrics (preventive medicine, care) as performed in

— maternity care for the healthy new-born, hospitalized or at home,

— health clinics for infants and pre-school children,

— school health,

— adolescent health care ("pre-prenatal").

Between these two fields of pediatrics mutual influences exist. The following examples may be given:

— medical experience and science as developed in the clinical, curative situation are the sources of the methods which are applicated in social pediatrics. Some of these methods have to be modified and adapted to the possibilities and limitations of the extra-mural practice, that is to the situation in rather modestly equipped clinics and schools. Examples of adapted methods are peak flow-metry, screening-audiometry, the method of measuring body-height (without traction) and the observation of those items concerning the psycho-motor development of infants, which are suitable to be examined and judged in the infant health clinics,

— on medical indications a number of individual children visiting health clinics or the school-doctor, will be referred to clinical specialists. But this forms only part of the interest of social pediatrics for the curative sector. For in particular the epidemiological approach of social pediatrics, and the results thereof, are of importance for the clinical pediatric practice. Epidemiology is the study of collective phenomena and their determinants concerning health, morbidity, and mortality of a population.

Descriptive statistics, *analytic* studies of the relationship between environmental factors and the parameters of health and disease, and *experimental* epidemiology, including the controlled introduction of mass-vaccination programmes, have made available a.o. reference data of growth and development, have provided insight into priorities in curative medicine, and have changed sorts and conditions of the patients attending children's hospitals.

Not contradictory to these close interrelationships there are also remarkable differences between curative and preventive medicine. The first system is focussed on the individual, enters into the individual demand for help, and tries to treat a current disease, defect, or handicap. In the preventive sector the organization for social pediatrics takes the initiative by inviting — in some countries by forcing — the child and its parents, or teachers, to visit the consultationroom. The medical history and the physical examination are focussed on needs, and less on demands, on threats of health, and on the interaction between health and the promoting or disturbing factors, respectively, in the environment.

In most industrialized countries child mortality has decreased considerably. For the greater part this is the result of improved living conditions like sufficient nutrition, modern sanitation and housing, extended education, better clothing, and the introduction of social facilities for everybody. In the nineteenth century infant and child mortality decreased almost without any improvement of medical treatment. We may assume, that in the twentieth century improved medical cure and care have become of positive influence as well. This is proven for the effects of vaccination programmes, and we think, but for the greater part without convincing proof, that health education and anticipatory guidance and counseling, as performed in child health, were of importance also. It is an established fact, that when nowadays children get a disease, by better treatment the seriousness is less, the duration is shorter and handicapping consequences are less frequent than before.

In 1900, when in the Netherlands the first child health clinics and school health services were founded, the main scope was the fight against infant and child mortality, later on followed by the emphasis on the fight against morbidity. Although these aspects have not disappeared, after the second world war the accent has gradually been shifted to the promotion and protection of health and development. Today, in prosperous countries, the parents who visit the doctors and nurses in social pediatrics are no longer primarily worried about the possibility that their children will die or will become seriously ill. Nowadays they respond to the invitation of the organization because they are interested in and feel the responsibility for the health of their children. As today it is in general no longer a matter of life and death, the implicit question of the parents is rather "Is my child healthy, as healthy as possible"? If this question of the parents is held as justified, and moreover is considered to be a question in the medico-biological sphere, it will be the medical profession, in particular the social pediatrician, who has to react upon it.

No answer and advice without examination, no synthesis without a preceding analysis! In the case of the individual child, the analysis is built up by the periodically performed medical examinations. The content of these contacts includes:

— a medical and psycho-social history (anamnesis) focussed on medical risk factors in the child itself and its relatives, on threats in the domestic circle, and on the functioning and the behaviour of the child at home, at school and in clubs and sports;

— the opportunity for the parents, the child itself, and the teachers to ask attention for complaints or worries;

— a medical examination on pathological disorders. Often these disorders are hidden. However, sometimes the parents are aware of it, but do not consider it as serious enough to consult the general practitioner;

— assessment of growth, development, and as far as adolescents are concerned, the stages of sexual maturation. The longitudinal biological observation of growth and development is indispensable for the medical judgement of the status of health of children and adolescents;

— the medical consultation, with its aspects of counseling and advice, forms the synthesis. If necessary, consult together with other care-givers may follow or the child may be referred to the general practitioner or the medical specialist.

It should be considered as a misunderstanding to think that only the indications for individual advice, consultation and referral form the profit of the periodical contact. Another important aspect of the output of social pediatrics is the assurance — in most cases — that the child has no (hidden) pathology, that it is growing and developing well, and that no serious menace of health is discovered. Evaluation of the outcome should also look at other purposes like the contributions to the work of other disciplines working for children, and the epidemiological description of the status of health of children and adolescents as based on the processing of collected individual data.

Needless to say that it is impossible to give an answer to the parents with a hundred per cent certainty, or an answer that remains in force for an unlimited period. So the consultations have to be repeated. For practical reasons, and partly based on knowledge about growth and development and about risks to health, the frequency of the periodically performed medical examinations decrease with age: monthly at infancy, twice per year at pre-school age, annually and later on once per two or three years at school age and at adolescence.

In the Netherlands the medical records in social pediatrics are established according to the main lines mentioned: they provide a longitudinal observation by means of adequate registration of the periodical examinations, notes about the history of the child itself and its relatives, about housing, information from the school, and growth and development visualized in a diagram. A summary has to be made of every consult, including the items of health education, specific advice and eventual referral. On a voluntary basis two types of medical records are almost nation-wide used: the one by the health clinics, and the other by the school health services, respectively (copies with a translation in English will be sent by request). The content and the lay-out of both charts are linked in order to achieve an integrated longitudinal picture of each individual's medical history, observations and examinations, anthropometrical data, consultations, and vaccinations.

So far in brief the underlying thoughts and the main lines of social pediatrics in developed countries. Though emphasis and details may differ according to the age-group concerned, the global scope of social pediatrics as presented here, covers the whole of the group of young people from zero to twenty years of age.

More detailed attention may be drawn to the two subjects growth and development in the framework of our medical judgement of the status of health either of the individual child, or of young people as a sub-population.

The health status itself of a population can not be measured directly, but only indirectly. Morbidity and mortality are the indirect impression of the health status: the lower the rates of morbidity and mortality, the better the general status of health. The secular shift of the growth and maturation pattern of a specified population forms a "direct print" of the health status: it has often been observed that an increase of stature at a given age, an increase of adult height which is reached at an earlier age, and an earlier maturation, follow closely an improvement of the living conditions and coincide with decreasing morbidity and mortality rates. For several populations in history also the combination of opposite changes has been described. A concurrent existing difference in height between subpopulations may be considered as an indicator of differences in the status of health, but, since genetically determined differences are sometimes very difficult to exclude, prudence and reservation are recommended.

Very illustrative is the concurrent difference in the heights of conscripts hailing from Northern and Southern provinces of the Netherlands. "Everybody" in the Netherlands knows that people in the Northern area are taller than in the Southern. But historical data on statures of conscripts made clear that half-way the nineteenth century there were no such differences in height. In the second half of the nineteenth century these differences generated parallel to divergent courses of marital fertility and child mortality, while since the first world war the differences have been diminishing gradually (VAN WIERINGEN 1979).

In the Netherlands the secular shift of height and maturation is going on, according to the still steadily increasing heights of conscripts and the preliminary results of the third nation-wide biometric survey in 1980. The interpretation of the secular shift of the last century as a positive health indicator was quite reasonable, and perhaps this interpretation will be correct also for the recent situation. But some reserve is recommended. For one is inclined to wonder if a shift in the very low infant mortality from 8 per 1000 to 7 per 1000 still may be considered as an indicator of an improving general status of health of the population, or even of this particular age-group. And concerning the positive secular shift during the last decade one may ask oneself if this phenomenon is rather a "hurry after" than the expression of a still every year improving status of health.

One of the reasons for periodically performed cross-sectional surveys of growth and maturation is to make available up-to-date reference data for practical use in curative and preventive medicine. Concerning a growth diagram the reference data of choice are attained height, weight for height, and the median ages of sex characteristics like menarche, pubic hair, breast development and genitals (Fig. 1). The preparation of weight for height standards requires a rather big sample, but when there is the opportunity to carry out a nation-wide survey of growth of all age-groups between birth and adulthood, extension of the number of individuals in the sample is rather easy (VAN WIERINGEN 1973).

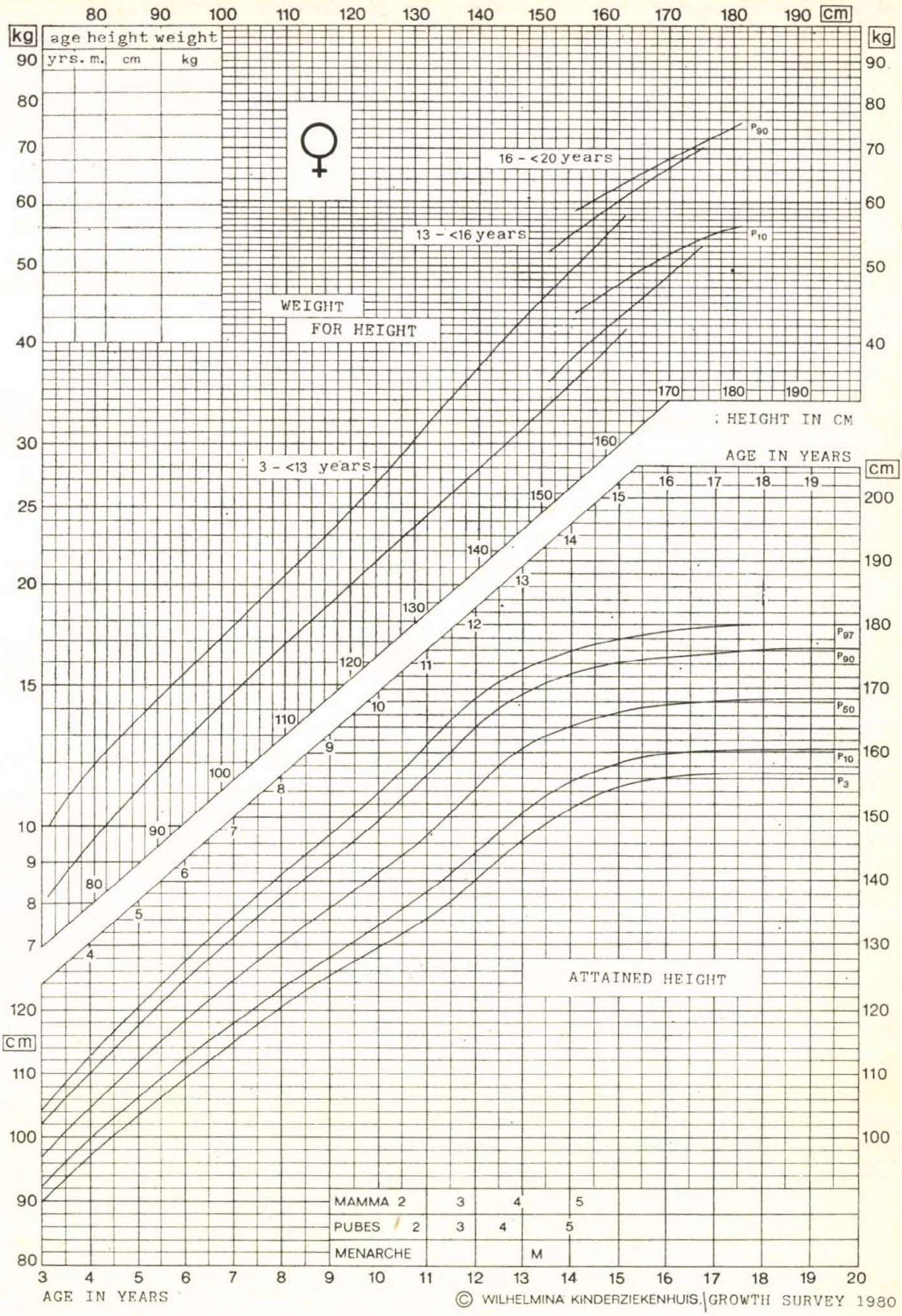

Fig. 1. **Growth Diagram: girls 3–20 years of age, the Netherlands, 1965**

A child is expected to grow within the distribution of the standards for height and weight and to develop within the age-limits of developmental items as found for the population it belongs to. Tabulated results of repeated measures of a child's height and weight, including the age of examination, are not suitable to give an impression of its growth. Regularity, velocity, unexpected deviations, maintenance of the own "growth canal" may be judged only on the basis of visualized data in a growth diagram. Therefore, a growth chart forms an essential part of every medical record for children, in the hospital as well as in the maternal and child health center or in the school health service. Drawing a curve in a two-dimensional grid is rather difficult and must always be checked, also when the doctor him/herself has plotted the figures in the diagram.

The medical profession has the task to integrate knowledge of growth and development into the clinical and social pediatric work, in favour of sick and healthy children. But growth and development data are only part of the medical examination and can never take the place of it. The standard values of the growth diagram represent what is usual at a given time and for a particular population. So they represent what may be acceptable, not what is normal or optimal. Extreme individual values are not by definition unacceptable or pathological, but may indicate the need for a clinical examination. Needless to say that not all pathological disorders are attended with stunted growth, and a child with stunted growth may even remain above the curve of minus twice the standard deviation.

Indications for further medical examination as based on the individual growth curves are:

— unexpected deviation from the course of the standard-curves,

— a curve at about minus three times the standard deviation,

— a curve which gradually bends downwards, in particular after perinatal troubles,

— a deviated course in combination with symptoms like abnormal stools, neurological symptoms, urinary tract infections, or when medicines are used,

— a course that is much lower than expected considering the mid-parent height, or the height of siblings.

In particular in social pediatrics one is aware that world-wide spoken, nearly all children with stunted growth are victims of under- and malnutrition. Sometimes the expression "adaptation" is used for the idea that the small statures of indigent populations should be a wise reaction of nature. But the term adaptation is misleading. The commission to the developed world is to prove that starving children are not being helped by the description of their situation as being adapted to. They only will be saved when we succeed in giving them the food that is already available, but we fail to distribute to the places (countries, regions, districts, towns and villages) where there is shortage of it.

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SINGLE PRIMARY TUBULOPATHIES CAUSING GROWTH IMPAIRMENT

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Abstract: About 25 primary tubulopathies of the kidney are known in man. At least ten of them may cause disturbed growth.

In renal vastage of water, sodium, potassium, calcium, magnesium or inorganic phosphate the mechanism of growth failure is quite obvious, repletion therapy is an important factor in treatment.

Deficient excretion of hydrogen ion invariably leads to stunted growth by secondary mechanism.

Some tubulopathies (dibasic aminoaciduria, Hartnup disease) may cause growth retardation by accumulation of toxic compounds or deficiency of essential substances.

Congenitally disturbed endocrine function of the renal tubule (1-hydroxylation of 25-hydroxycholecalciferol) has also been described.

Primary tubulopathies often manifest themselves by growth failure preventable by early diagnosis or screening.

Key words: tubulopathies, growth impairment.

The machinery of the renal tubule fulfills a large variety of excretory and reabsorptive tasks. Organic compounds like glucose, aminoacids, uric acid are nearly completely reabsorbed in the proximal segment of the tubule while inorganic compounds (sodium, potassium, chloride, bicarbonate, hydrogen, other ions and water) are regulatively reabsorbed, rejected or excreted all along the renal tubule. All these processes need intricate collaboration of transport systems and enzymes. Inherited defects of single transport functions may be innocuous, knowledge of them is still important since they have to be distinguished from severe disorders, e.g. renal glucosuria from diabetes mellitus. Most primary tubulopathies follow a clear-cut mode of inheritance; some tubular defects are shared by the intestinal mucosa. As expected, increasing insight into the subtilities of the underlying biochemical defect has helped to subdivide these disorders into genetically distinct varieties.

Most renal tubulopathies causing symptoms at all interfere to some degree with normal growth during childhood. As a rule, renal vastage or pathological retention of inorganic compounds invariably leads to stunted growth as can be seen in the Table 1 while loss of organic compounds like glucose or dibasic aminoacids is usually compatible with normal growth or lead only quite indirectly to growth impairment.

One of the best indicators of effectiveness of treatment is restitution of normal growth or achievement of catch-up growth. For example, in renal tubular acidosis alkali treatment properly adjusted to the patient's needs

Table 1

Primary disorders of single tubular functions

Name of disorder	Compound(s) involved	Stunted growth	Treatment
1. Bartter syndrome	K^+	+++	++
2. Disabled K^+-excretion	K^+	++	+
3. Idiopathic hypercalciuria	Ca^{++}	++	+
4. Idiopathic hypermagnesiuria	Mg^{++}	++	?
5. Familial hypophosphatoemic rickets	PO_4	++	+
6. Renal tubular acidosis			
Type I(distal)	H^+	++	++
Type II(proximal)	HCO_2^-	++	++
Dista RTA+VIII. nerve	H^+	++	?
7. Renal diabetes insipidus	H_2O	++	+
8. Familial azotaemia	urea	— not necessary	
9. Hypouricaemia	uric acid	— (?) not necessary	
10. Renal glucosuria, Types A, B	glucose	— not necessary	
11. Hyperglycinuria	GLY	(+) ?	
12. Iminoglycinuria, Types I—IV	GLY, PRO, HYPRO	— not necessary	
13. Cystinuria, Types I—III	CYS, LYS, ARG, ORN	—	++
14. Hypercystinuria	CYS	—	++
15. Dibasic hyperaminoaciduria			
Type I, protein intolerance	LYS, ARG, ORN	++	+
Type II	LYS, ARG, ORN	(?)	?
16. Hyperlysinuria	LYS	(+)	?
17. Hartnup disease, Types I, II	neutral aminoacids	(+)	++

results not only in correction of acidosis and concomitant hypercalciuria but also induces acceleration in delayed growth.

Severely impaired growth may be caused by a very long list of disorders, many of which are quite obvious, only a small proportion of children with growth problems have primary tubulopathy; still, it is imperative to look after this group of disorders in every case of stunted growth since early introduction of treatment may lead to complete correction of symptoms.

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PHYSICAL FITNESS IN OBESE, NON OBESE, AND SPECIALLY TRAINED BOYS

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Abstract: Body composition, PWC_{170}, and oxygen uptake were assessed in a selected sample of 60 boys distributed in three homogeneous groups regarding age and sexual development: (a) obese (body fat percent over 25), (b) controls, and (c) specially trained boys attending to a swimming training program for at least 2,5 years. The aerobic capacity of the obese was significantly reduced. The swimmers, on the other hand, exhibited the best indices of fitness, as it might be expected due to the influence of systematic training on the development of positive conditioning factors. These differences, however, must not be related to an alteration of the work efficiency but to an extra work due to the permanent "overload" that constitute their excess of body fat, results that are in concurrence with previous reports in adults.

Key words: physical fitness, obesity, swimmers.

Introduction

In the so called developed countries and in those which are in an actual process of development a dangerous tendency to sedentarism, overconsumption of sugar, saturated fats, a low fiber content in the diet, among other factors, contribute to the deterioration of health.

There is an increasing interest in the preventive role concerning conditions which may cause morbidity in adulthood, and in which nutritional factors and physical activity play an important role (BOULTON 1981). Obesity, indeed, is one of them. This multifactorial syndrome regarding its etiology, constitutes a major health problem at the present.

Obese subjects have been characterized as poor performers with a reduced economy of work, and a relative lower aerobic capacity (BALABANSKY 1979, PAŘÍZKOVÁ 1977). It has also been suggested that their work efficiency is reduced (APFELBAUM et al. 1971). Otherwise many authors have studied the effect of systematic physical training and have demonstrated significant improvements of most of the functional indices of the cardiovascular and respiratory systems, when comparing with untrained individuals (PAŘÍZKOVÁ 1977, OELSCHLÄGEL 1976, PEÑA et al. 1980). DIETRICH et al. (1974) pointed out that physical activity is beneficial in the period of growth spurt, although an influence on the growth sport itself has not been yet demonstrated (ŠPRINAROVA 1973). KOCH (1978) observed a positive effect of training on local muscle blood flow. HOLLOSZY (1967) and KIESSLING et al. (1971) reported an increase in the number and size of mitochondria of the skeletal muscle with exercise. In a recent study PLACHETA (1980) concluded that in a group of children with a controlled physical training during three years their fitness were different and exceeded the natural increments of untrained boys by ten to forty percent.

The aim of our study was to compare three different groups of boys with same chronological age and sexual development.

Material and Methods

A selected sample of sixty boys from 10 to 14 years old have been studied, to each of them the body weight (BW) was recorded. Skinfold thickness on the right side of the body was measured over triceps, biceps, subscapular, suprailiac, and calf with a Holtain caliper with a standard pressure of 10 g/mm^2 according to the methodology recommended by the International Biological Program (WEINER—LOURIE 1969). Body fat percent was estimated by the prediction equation of PAŘÍZKOVÁ and ROTH (1972). The subjects were distributed in three homogeneous groups respecting chronological age and sexual development according to TANNER (1962) as follows:

Control group: Twenty healthy boys whose body fat percent was between 14 and 20.

Obese: Twenty boys, otherwise healthy, whose body fat percent was over 26.

Specially-trained group: Twenty swimmers who have a systematic training for at least 2.5 years whose body fat percent was in the same range as the fat percent of the controls.

Functional test: The subjects reported one hour earlier to their test in order to observe their companion being tested, enabling them to know the general details of the procedure. All of them established friendly competition and enhanced the likelihood of attaining maximum effort.

The exercise protocol consisted of three loading periods until a steady state is reached, with one minute of rest between them. After the third period and two minutes of rest the load was increased 15 watts until the maximal effort was achieved. The load was related to body weight and the subjects started with 1 watt per kg of BW, each successive period it was increased and based on the heart rate reached in the preceding one (KEMPER et al. 1978). A Mijnhardt electronic bicycle ergometer was used with parabolic and hyperbolic systems, hence the variations of pedalling frequency did not affect the power output. The subjects were coupled to a computerized Mijnhardt Ergo-analyzer which registered every minute the oxygen uptake ($\dot{V}O_2$), the ratio $\dot{V}CO_2/\dot{V}O_2$ — respiratory quotient — heart rate (fh), and the oxygen pulse ($\dot{V}O_2$/fh), all these variables were recorded until the subject appraised the maximum effort.

The Physical Working Capacity (PWC) was calculated by a regression line obtained through a correlation between heart rate and the watts of each work load. The PWC that could produce a heart frequency of 170 was recorded as PWC_{170} of the individual.

A one-way analysis of variance (ANOVA) was performed to assess the differences among the three groups with respect to each of the variables studied. When the differences were found to be significant pairwise comparisons were done using the Student's *t* test. Regression line and correlation coefficient between log PWC as dependent variable and the percent of body fat (%BF) as independent variable were also determined (DANIEL 1974).

Results

The body weight and the %BF for the three groups are summarized in Table 1. ANOVA yielded highly significant F values ($p < 0.001$). Obviously, by definition, the obese exhibited the highest figures of BW and %BF. The trained boys — although slightly heavier than the controls — had less %BF due to the known influence of systematic training upon body composition (PAŘÍZKOVÁ 1977, PEÑA et al. 1980).

Figure 1 shows the means and standard deviations of the PWC_{170} and Figure 2 the PWC_{170} related to BW and to lean body mass of the three groups. The swimmers, as it could be expected, achieved the highest values; on the

Table 1

Body weight and percent of body fat of the three groups studied

Group	Body weight (kg)	Body fat (%)
Controls	41.6 ± 9.4	18.0 ± 2.6
Obese	55.4 ± 14.6	29.2 ± 1.9
Swimmers	46.5 ± 8.7	16.5 ± 2.5
F	128.31	173.11
Probability	0.001	0.001

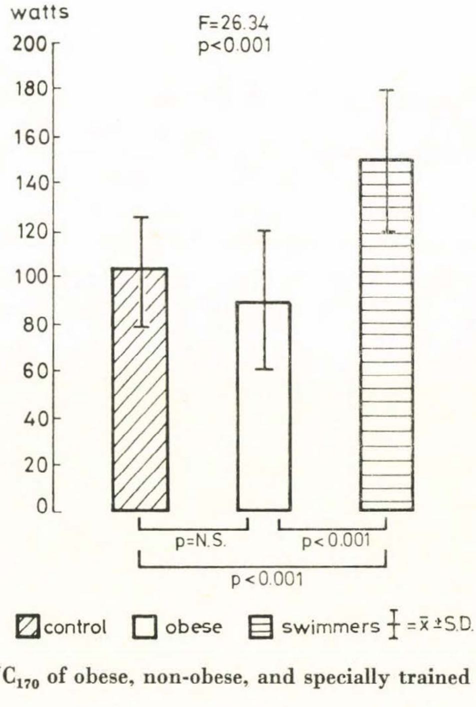

Fig. 1. PWC_{170} of obese, non-obese, and specially trained adolescents

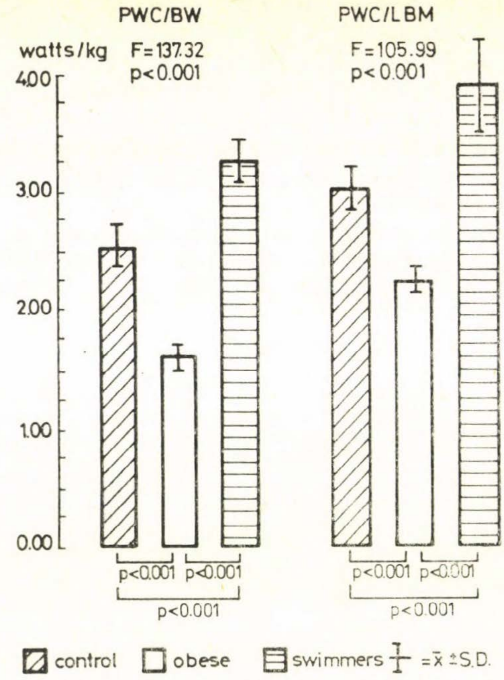

Fig. 2. Relative values of PWC_{170} of obese, non-obese, and specially trained adolescents

other hand, no differences were seen between the obese and the non trained boys regarding PWC_{170}, but when comparing their relative values the obese yielded lower results.

It may be observed in Figure 3 the $\dot{V}O_{2\,max}$ and in Figure 4 its relative values. The controls, — with similar figures reported by SUZUKI et al. (1978) and the obese raised to practically similar values of $\dot{V}O_{2\,max}$; however, respecting the relative ones the obese revealed the poorest results. Evidently, since the swimmers were able to perform more work, they got the highest $\dot{V}O_{2\,max}$, values comparable to those obtained earlier in a similar sample (ŠPRINAROVÁ et al. 1978).

A correlation study between %BF and the logarithm of PWC_{170}/BW appears in Figure 5 showing that the higher the %BF is, the lower the functional capacity confirming once more the disadvantages of overfatness in performances.

An attempt was done to know how much oxygen the boys consumed per kg-m of work performed during a submaximal work load in which the establishment of a steady-state was guaranteed in order to obtain an accurate measurement, as recommended by MARGARIA et al. (1965). The obese consumed more oxygen per unit of work done than the non obese groups did (Figure 6) and this was also seen in the same proportion in each of the submaximal work loads, result that agrees with previous findings (WHIPP et al. 1975a, BRAY 1977) which have been explained by the increased work of moving the greater

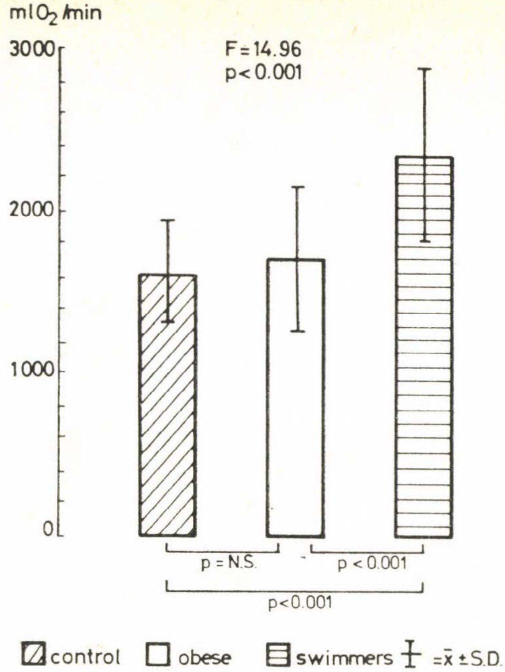

Fig. 3. **Maximal oxygen consumption of obese, non-obese, and specially trained adolescents**

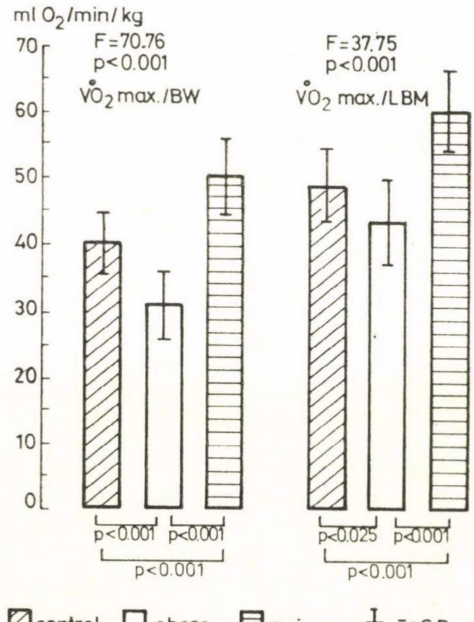

Fig. 4. **Relative values of maximal oxygen consumption of obese, non-obese, and specially trained adolescents**

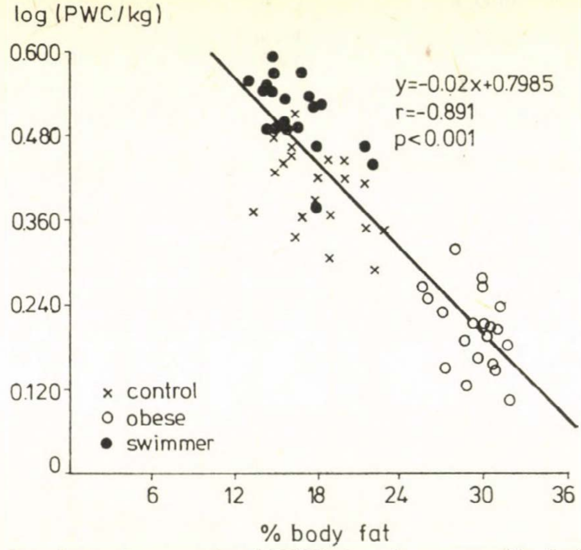

Fig. 5. **Correlation between log (PWC/kg) and percent of body fat**

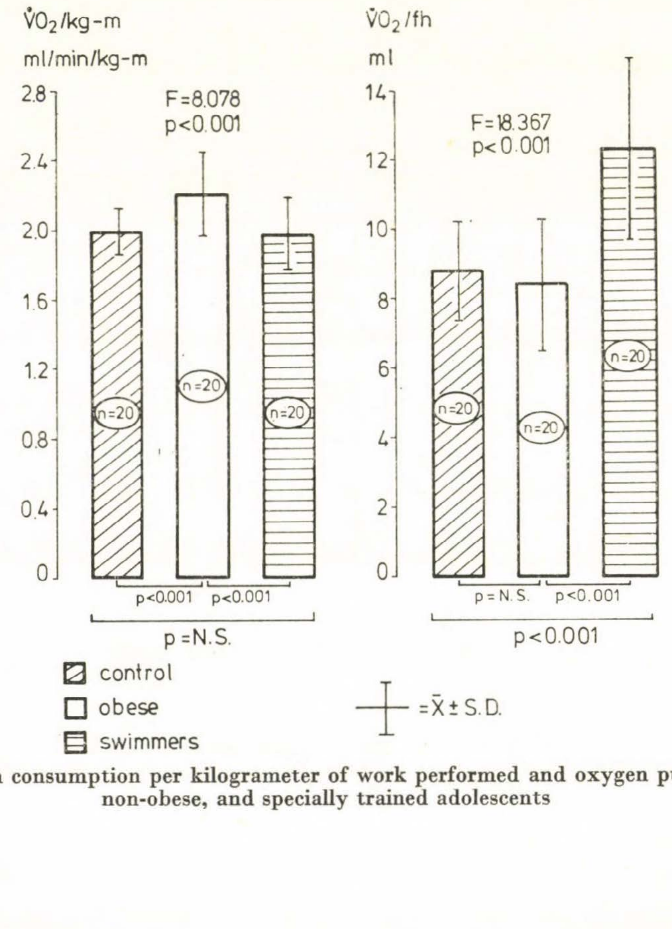

Fig. 6. **Oxygen consumption per kilogrameter of work performed and oxygen pulse of obese, non-obese, and specially trained adolescents**

leg mass during a bicycle test. Moreover, swimmers and controls did not differ in their results, thus, confirming that training itself does not modify the work efficiency (ÅSTRAND—RODAHL 1970). Also in this Figure the oxygen pulse of each group may be seen, the highest values were obtained by the swimmers, while no differences existed between the obese and the controls.

Discussion

Obese subjects are handicapped when performing a given physical work with respect to lean ones, this fact contributes to their "laziness" and aggravates the well known cycle: overfatness-sedentarism (PEÑA—PEÑA 1977).

PWC_{170} and $\dot{V}O_{2\,max}$ relative values, considered as reliable parameters for measuring aerobic capacity, were significantly reduced as it has been reported by many authors (PAŘÍZKOVÁ 1977, NORGAN—FERRO-LUZZI 1978, PEÑA et al. 1980). Moreover, although physical fitness is a biological feature dynamically influenced by the combined action of several factors involved — body composition among them — the excess of body fat exerts a negative influence (Figure 5) contributing to a constant increase in the energy cost of external work. Usually this energy cost of physical activity is expressed in total values rather than net ones (MILLER 1978), therefore, in this angle, work is a more expensive task for them than for the leans when we related to the kg-m of work performed during a steady state. In studies carried out very carefully in adults by several investigators (WHIPP et al. 1975b, BRAY et al. 1977, DEMPSEY et al. 1966) the rate of oxygen uptake was not really increased, and work efficiency was not really reduced. Our findings are in agreement with these considerations. Other mechanism by which fat could limit the continuation of exercise is interfering even more the rate of heat transfer from the body core to the skin (NADEL 1980) inducing a greater anaerobiosis.

The swimmers who were attending to 11 sessions per week of training during — at least — a period of 2.5 years, were able to perform more work and they developed skills of positive conditioning factors. Enhanced fitness, and resistance as it is observed in the higher oxygen pulse, — but again —, no differences in the efficiency of work can be stated.

Relying upon all these and the tendency to a growing lack of exercise influenced by "civilization" (EIBEN 1977) it is extremely necessary to promote physical activity from early childhood associated with adequate nutritional habits. These facts are of great importance and could have a beneficial impact upon human health.

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NORMAL VALUES FOR PALPEBRAL FISSURE LENGTH, PHILTRAL LENGTH, ORAL INTERCOMMISSURAL DISTANCE, AND STERNAL LENGTH IN NEWBORN INFANTS

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Abstract: Palpebral fissure length was measured in 475 neonates, philtral length, oral intercommissural distance and length of the sternum were determined in 252 newborn infants. Mean $\pm$ 2SD values according to gestational age and birth weight are provided in tables and charts. The data promote objectivation of these variants in the newborn infant with special reference to prematurity and intrauterine growth retardation. Since abnormalities of these measures are characteristic of several syndromes, comparison with normal values may facilitate syndrome delineation.

Key words: palpebral fissure length, philtral length, oral intercommissural distance, sternal length, normal values, newborn infants, anthropometry.

The results have been published in details in the following articles:

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MÉHES, K. (1980): Palpebral fissure length in newborn infants. — Acta Paediat. Acad. Sci. Hung. *21;* 55—56.

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SOMATOTYPE OF ADULT DOWN'S PATIENTS

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Abstract: The authors analysed the variation in physique of 137 adult Down's patients (89 men and 48 women; aged between 17 and 55 years) living in social occupational institutions in Hungary. A detailed anthropometric programme was carried out. Heath—Carter's anthropometric somatotyping methods were used.

In somatotypes of the Down's patients values of endomorphy and mesomorphy are generally high. These values in men increase with age; in female patients this tendency is not so considerable. Values of ectomorphy are very low, and they decrease in older patients in both sexes. The means of somatotype components in male patients are 5.86—5.90—1.05, they are mostly mesomorph-endomorph and meso-endomorphic. Those in female patients are 7.14—6.27—0.69, most of them are endomesomorphic. Distribution of male somatotypes is more dispersed (SDI = 3.98) than in female patients (SDI = 3.67).

The authors describe the typically corpusculent, stocky, fatty *Down's physique.*

Key words: physique, somatotype, adult Down's patients, Down's physique.

Longitudinal studies carried out on children suffered from Down syndrome have pointed out that a surplus in chromosome 21 results in a deviated body development compared to that of normal children (e.g. WERNER et al. 1939, THELANDER and PRIOR 1966, RARICK and SEEFELDT 1974, IKEDA et al. 1977). It is to be regretted that growth studies like these usually deal only with a few body measurements. On the other hand, however, it is worth mentioning that certain characteristics of the physique of adult patients can be found also in Down's patients of any age.

This paper deals with the physical characteristics of adult Down's patients, and presents their somatotype.

Material and Methods

137 patients with Down syndrome were investigated: 89 men and 48 women, their age varied between 17 and 55 years. They live at different social occupational institutions in different parts of Hungary. The majority of them have studied at the type of schools suitable to their intelligence level, and at present they regularly work in their institutions. According to their age our patients were sorted into three groups: (I) adolescents (17—24 year), (II) young

adults (24.1 — 40 year), and (III) persons of mature years (40.1 — 55 year in men and 40.1 — 45 year in women).

A detailed anthropometric programme (MARTIN—SALLER 1957, TANNER et al. 1969) was carried out. Besides the usual parameters of 23 selected body measurements also some indices as well as proportionality characteristics (ROSS and WILSON 1974, EIBEN et al. 1976) were calculated (with a R—40 computer).

The *Heath—Carter*'s anthropometric methods were used to determine somatotypes (CARTER 1975). Distribution of somatotypes of the patients was estimated by Somatotype Dispersion Index (SDI, ROSS and WILSON 1973).

Besides pictures necessary to standard somatotype photos were taken also of the more frequent developmental disorders. It should be mentioned that investigation of mental retarded, especially Down's patients is more difficult than that of normal subjects.

Results and Discussion

Growth studies of Down's children emphasize that several body measurements of them are considerably smaller compared not only to averages of normal children of the same age, but also of mentally retarded children without Down syndrome. Our investigations show similar experiences also in adults. Table 1 shows selected body measurements and indices of the examined patients. Comparing them to the 18 year-old young Budapest adults (EIBEN

Table 1

Selected body measurements and indices of adult Down's patients

Body measurements and indices	Male			Female		
	$\bar{x}$	SD	z	$\bar{x}$	SD	z
Stature (cm)	154.3	6.75	—	142.3	5.00	—
Sitting height(cm)	83.7	3.75	+0.23	76.6	3.90	+0.18
Chest circumference (cm)	89.7	7.79	+2.14	87.5	9.11	+3.23
Abdomen circumference (cm)	89.8	12.30	+2.86	95.3	16.36	+5.02
Biacromial width (cm)	36.3	2.20	+1.04	33.4	1.68	+1.00
Bi-iliocristal width (cm)	27.6	2.05	+0.88	28.1	2.22	+2.74
Weight (kg)	60.6	11.05	+1.81	57.2	12.64	+3.73
Rel. sitting height (%)	53.98			53.88		
Density*	1.013			1.009		
Per cent fat**	38.55			40.39		
Body fat (kg)	23.17			22.97		
Lean body mass (kg)	37.40			34.18		

* DURNIN—RAHAMAN (1967)
** SIRI (1956)

et al. 1971), the under-development in height and sitting height was found to be —5 SD and —3 SD, respectively. Stature (and sitting height) of Down's patients is also significantly smaller than the mean in Hungary. This type of differences in Down's patients is well-known also in childhood (ØSTER 1953, Dutton 1959), and it is specially expressed in the first decade of life (Rarick and Seefeldt 1974).

Growth in height in Down's patients is less quick than that of normal youth (Roche 1965). This kind of an underdeveloped stature explains why the majority of the body measurements are proportionally great (Figures 1 and 2). The only exception is the length measurements. Thus, the z-values of the upper extremities are negative, and those of the lower extremities practically equal to 0, i.e. the extremities of our Down's patients are proportionally small. This finding meets with statement of Ikeda et al. (1977), who also pointed out that length of the extremities are smaller than that of normal subjects, and this difference increases with age. In Grigorjeva's (1973) opinion an expressed decrease with age only in length measurements can be seen; the other body dimensions stay closer to the normal subjects — she said. The short lower extremities also explain the relatively short stature (cf. Thelander and Prior 1966).

Although no significant differences were found in breadth, girth dimensions and in body weight, these measurements, as well as the bicondylar widths and skinfolds in Down's patients are proportionally great (Figures 1 and 2).

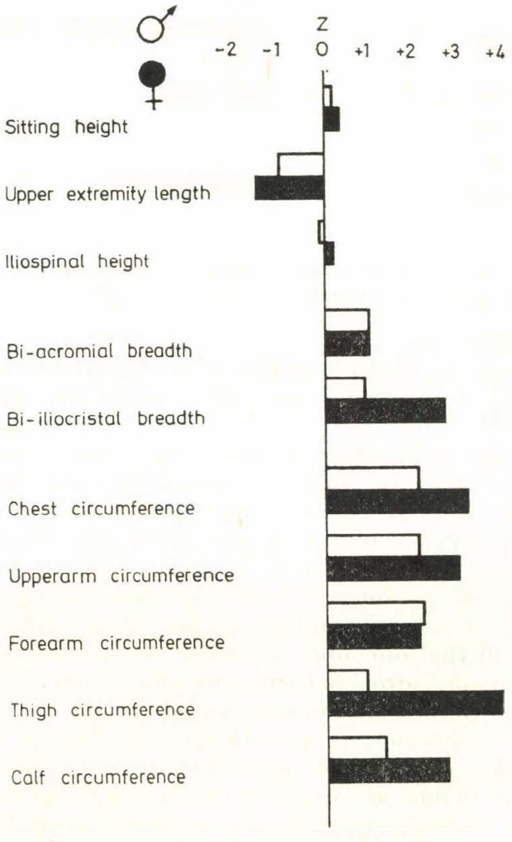

Fig. 1. Proportionality expressed by z-values of selected length, breadth and girth measurements

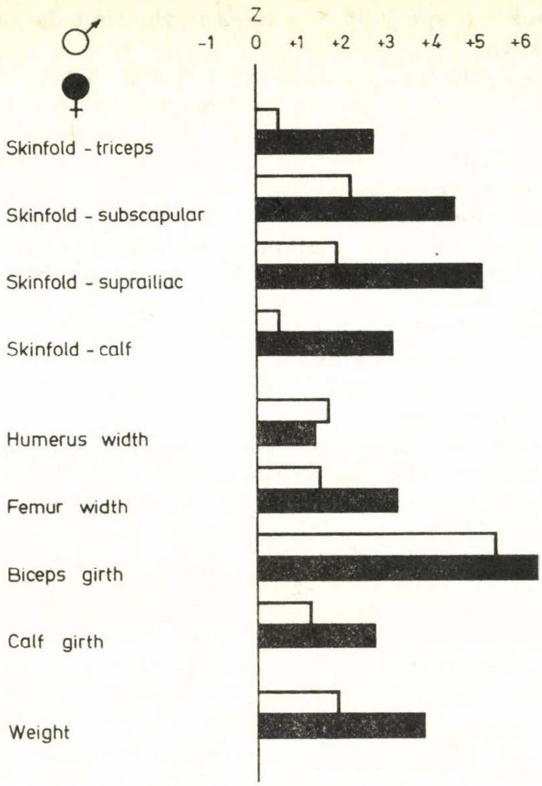

Fig. 2. Proportionality expressed by *z*-values of body measurements connected with Heath—Carter anthropometric somatotype method

Body density of the Down's patients is apparently low. Based on this total body fat and lean body mass were calculated. High means of body fat are considerable.

Figure 3 shows the distribution of men with Down syndrome in the somatochart. The exceedingly low values of ectomorphy are characteristic. Mesomorphy and endomorphy are balanced compared to each other while the former often has slightly higher values than the latter one. These components frequently have extreme values over 7. About a half of the adolescent male patients are out of the somatochart, i.e. their values in endomorphy and mesomorphy are over 5 or 6. The majority of the young adults is also out of the somatochart, and all the four older patients are also out of it. The means of the somatotype of male Down's patients are 5.86—5.90—1.05. They are mostly mesomorph-endomorph and meso-endomorphic.

Also in women ectomorphy is exceedingly low (Fig. 4). Endomorphy often shows slightly higher values than mesomorphy does. These two components show more extreme values in women than in men. This is also expressed by the means of these two components which are higher in all the three age groups. The means of somatotype of female Down's patients are 7.14—6.27—6.69. They are mostly meso-endomorphic.

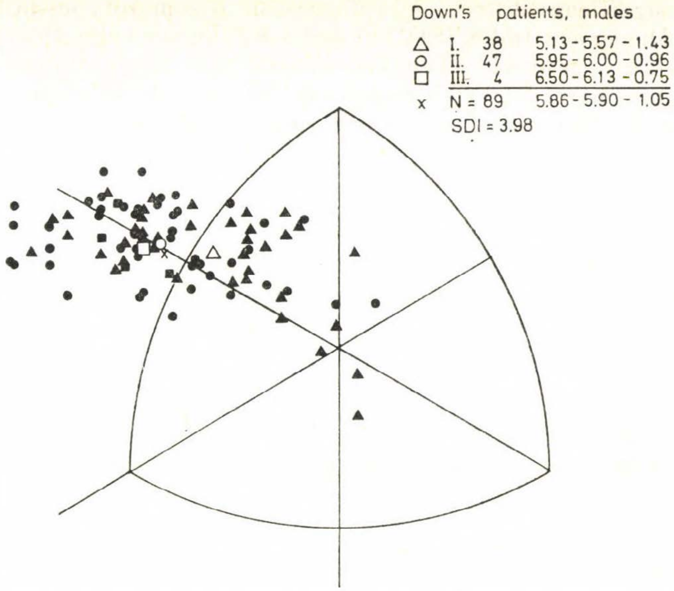

Fig. 3. **Somatotype of male Down's patients. I: Adolescent age group, II: Young adults, III: Mature persons**

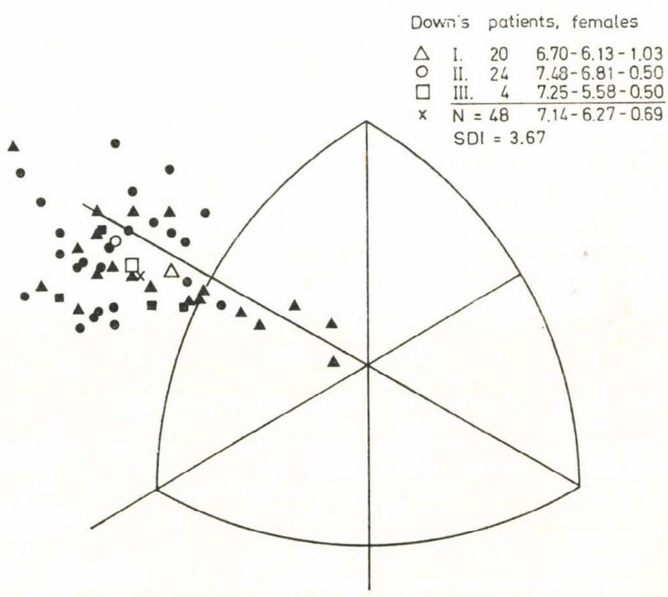

Fig. 4. **Somatotype of female Down's patients. (I, II and III: as in Fig. 3)**

There is a significant difference in dispersion of somatotypes in both sexes. Somatotype Dispersion Index (SDI) in males has higher value than in females: 3.98 and 3.67, respectively. The phenomenon that the physique of Down's patients becomes more fatty with age, appears in both sexes, and has a consequence that endomorphy in general increases, ectomorphy decreases in older ages.

Summary

To summarize this brief characterization of our adult Down's patients, it has been found that their stature and their extremities are short, their breadth and girth measurements, weight, bicondylar widths, subcutan fat are proportionally great. A considerable dysproportionality of Down's patients is observed also in childhood, and it persists during their growth process, and results the *typically corpusculent, stocky, and fatty Down's physique* described in this paper (see also Plate I and II). Its characteristics become more expressed with age, and it is more remarkable in female patients than in male ones.

Acknowledgements. We should like to thank the directors and collaborators of the social occupational institutions, where the Down's patients live, for their co-operation. We should also like to thank Mrs I. KAPOSI for her work developing the computer programme to this study.

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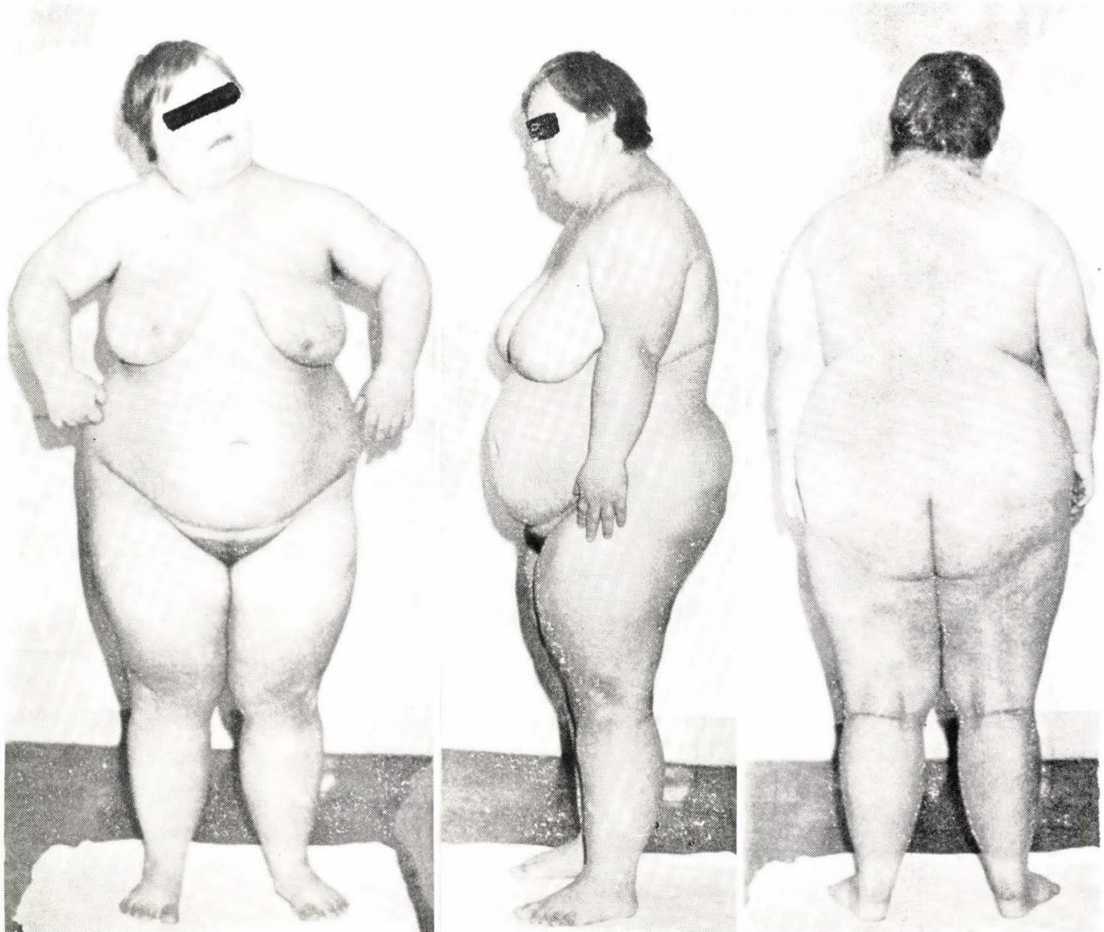

Plate II. Picture of a 32 year-old female Down's patient. Her somatotype is 10.5—11.0—0.5, extremely meso-endomorphic

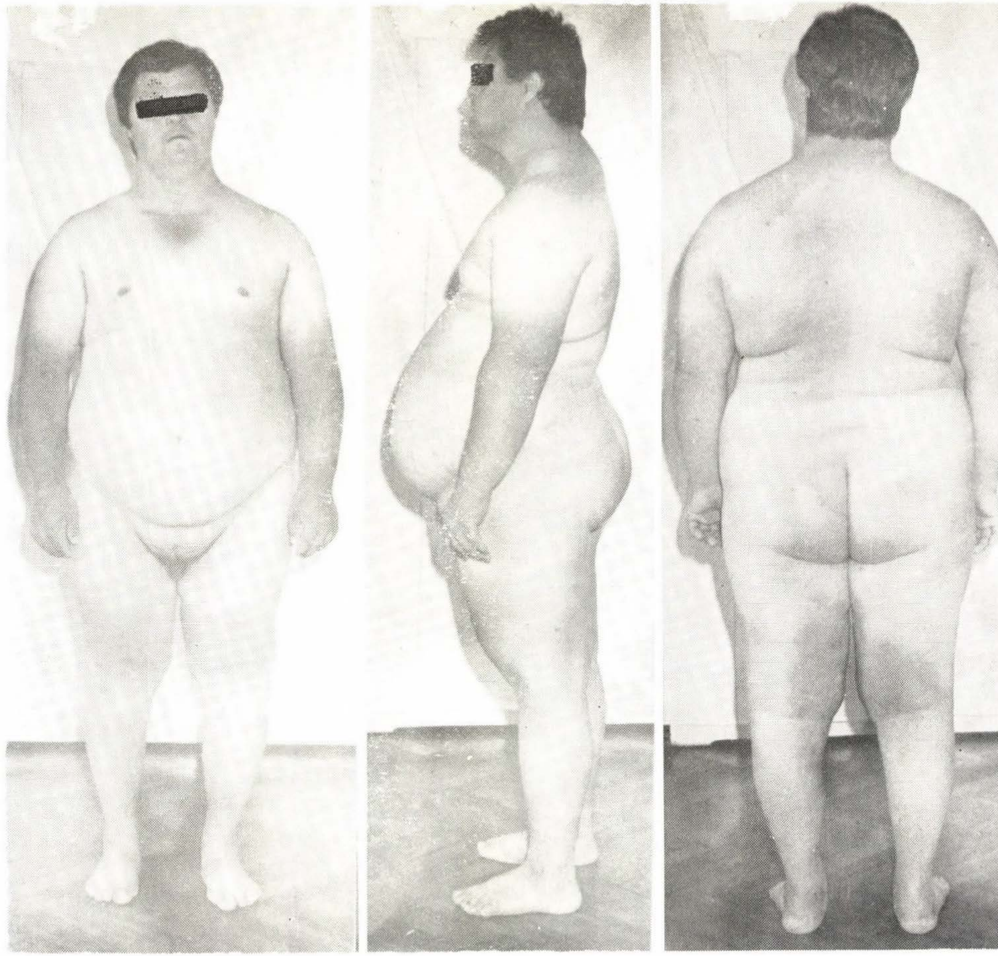

Plate I. Picture of a 28 year-old male Down's patient. His somatotype is 9.5—7.5—0.5, extremely meso-endomorphic

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TESTICULAR VOLUME OF DOWN'S PATIENTS

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Abstract: 24 index patients were examined by means of SZONDI's testometer and phantom. The mean value of bilateral testicular sum was 13.5 ml. (SD = = ±5.3). No significant correlation was found with age ($\bar{x}$ = 24.9; SD = ± 5.2), body height ($\bar{x}$ = ± 156 cm; SD = ± 5.4) and body weight ($\bar{x}$ = ± 56.9 kg; SD = ± 8.3).

The data mentioned mean that the Down male patients are characterized by a significant testicular hypotrophy which is realized in their under-developed sexual life.

Key words: testicular volume, Down male patients.

First of all we have to say some words about the characteristics of the Down syndrome. LANGDON DOWN physician in London was the first who published the features of this illness in 1866. It was so well characterized in the above mentioned paper that we could not do better. It is a well known fact that the so called "mongolism" is not suitable for the diagnosis, therefore we use — as in general — the name of "Down-syndrome".

The Down syndrome as a worldover well known chromosomal mutation is characterized by a genetic material surplus concerning the 21th chromosome. Whether trisomy or translocation is showed by karyotyping the clinical signs are just the same.

The following obligatory symptome are to be mentioned: mongolid eyelids, microcephaly, oligophreny, mesenchymosis, muscular hypotony, ectodermal disorders (dermatoglyphic features).

Our knowledge about the sexual organs and the sexual life of the Down patients is very limited. Whereas the details about the fertility of Down females are well-known, no data concerning the fatherhood of Down males have been published. Only a few publications deal with the fertility of adult males suffering from Down syndrome (RUNDLE et al. 1959, STEARNS et al. 1960, HORVÁTH 1978).

Although the scientific attitude in this regard is uncertain — in general the specialists are convinced that the Down males are infertile.

25 adult Down males were examined. Mean age was 24.9 years (min.: 18, max.: 35 y.). The testicular volume was estimated by means of SZONDI's testometer and phantom. The mean value of bilateral summarized testicular volume was 13.5 ml (SD = ±5.3). Comparing this value with the summarised bilateral testicular volume of fertile non Down men, which is 31.91 ml (SD = = ±9.89), we can observe a high significant difference. On the other hand,

Table 1

Somatic data of Down patients

No.	Name	Age (years)	Height (cm)	Weight (kg)	Testis volumen ml	Sperm volumen	M/ml	IF*
1.	B.J.	24	158.6	50.4	20	—	—	—
2.	G.K.	28	158.9	58.0	20	—	—	—
3.	H.G.	20	158.0	58.5	10	0.5	1	0.5
4.	H.I.	21	159.2	56.6	—	—	—	—
5.	H.J.	31	169.0	75.0	24	0.5	80	20
6.	K.A.	20	158.0	56.0	18	1.0	5	2.0
7.	K.K.	26	155.0	53.0	12	0.5	25	8.7
8.	L.L.	31	157.2	62.0	10	—	—	—
9.	L.L.	18	150.6	50.5	25	—	—	—
10.	M.J.	18	155.8	52.1	10	—	—	—
11.	N.A.	19	151.0	58.0	8	—	—	—
12.	N.J.	21	154.5	50.6	20	—	—	—
13.	N.Z.	24	141.0	54.5	16	0.5	10	3
14.	P.I.	25	161.3	48.0	16	—	—	—
15.	P.L.	27	154.0	42.0	10	—	—	—
16.	P.O.	35	148.0	75.0	10	0.3	0.001	0
17.	S.F.	30	155.0	54.0	20	0.2	40	5.6
18.	S.G.	19	152.0	47.0	10	0.5	1	0.02
19.	S.L.	31	156.4	60.8	10	—	—	—
20.	S.L.	35	149.0	53.0	20	—	—	—
21.	Sz.Gy.	31	156.3	57.5	10	—	—	—
22.	T.L.	23	158.0	55.5	14	—	—	—
23.	V.A.	33	156.0	64.9	15	—	—	—
24.	V.J.	23	164.3	69.9	20	—	—	—
$\bar{x}$	—	24.9	156.0	56.9	13.5	0.438	20.25	5.046

* IF = Index of fertility (FARRIS)

no significant correlation was found with age ($\bar{x} = 24.9$; SD $= \pm 5.2$), body height ($\bar{x} = 156$ cm; SD $= \pm 5.4$), and body weight ($\bar{x} = 56.9$ kg; SD $= \pm 8.3$) (Table 1).

The data mentioned mean that the Down male patients are characterized by a significant testicular hypotrophy which is realized in their under-developed sexual life.

Only 8 patients were able to deplete sperm (Table 2). The 5-day period of abstinence was assured. The characteristics of the investigated sperms were as follows:

1. HYPOPOSY. The mean quantity of the depleted sperm was 0.5 ml (min.: 0.3 ml, max.: 1.0 ml).
2. OLIGOZOOSPERMIA. The mean cell density was 20 million/ml (min.: 0.001 million/ml, max.: 80 million/ml).
3. pH mean value = 8.32 (!).

The characteristics of the sexual behaviour were (1) low libido, and (2) inhibition from and/or lack of motivation for searching a sexual partner. In view of these characteristics the present study revealed that adult Down males are practically infertile.

Table 2

Spermatologic data of Down patients

No.	Lique-faction (min)	pH+	Motion %	Speed	Motion % after 60'	Character of propulsion	Qualitative					
							young	norm.	head	neck	tail	old
3.	10	8.1	100	3–4	0 0	Suitable	—	50	50	—	—	—
5.	20	8.1	50	3–4	10 1–2	Suitable agglut. (H-H; T-T)	—	80	14	2	2	2
6.	10	7.8	50	1–2	0 0	Astheno-spermia	—	30	58	4	4	4
7.	10	8.1	70	1–2–3–4	20 1–2	Shaking 10% suitable	2	50	30	4	2	12
13.	10	8.7	60	1–2–3	60 1–2	Shaking meandering	2	42	46	2	6	2
16.	10	8.1	0	—	—	Necro-spermia	—	—	—	—	—	—
17.	10	8.7	70	3–4	50 1–2	Suitable	3	41	35	10	8	3
18.	10	9	40	1–2	40 1–2	Astheno-spermia	—	32	42	10	6	10
$\bar{x}$		8,3										

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ERUPTION OF PERMANENT TEETH AMONG PEOPLE OF GULBARGA, KARNATAKA

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Abstract: A cross-sectional dental study has conducted on 2,564 children (M: 1,366; F: 1,198) of different income levels of Gulbarga, Karnataka, South India revealed that most permanent teeth of either jaw in general like deciduous teeth erupted earlier in females than males. The first tooth emerged as early as 4 years in children of either sex and all economic groups. Slightly over 50 per cent of the teeth erupted by the age of 10 years and majority of them by about 18—19 years irrespective of sex and economic status. The eruption of the full complement of teeth including the third molars appears to have completed after 24 years of age. The mean number of teeth erupted at given ages and the sequence of their eruption in the author's sample are more or less similar to those of other populations studied earlier. In eruption ages, however, his sample is ahead of majority of the populations with respect to all maxillary teeth, some of mandible like incisors, canines and first molars and majority of the female teeth of either jaw.
Key words: Eruption of teeth, permanent teeth, Gulbarga/India.

Introduction

In a previous article the results of the deciduous teeth eruption pattern among the children of Gulbarga, Karnataka were presented (Rami Reddy 1981). The study showed delayed eruption of teeth as in a few other Indian populations surveyed earlier although the order of eruption of different teeth, their eruption ages, and the mean number of teeth erupted at specified ages were found to be basically similar to other populations of this country or abroad. In the same town, investigation was conducted between 1971 and 1975 and data were gathered on the eruption pattern of permanent dentition also among the children of different endogamous groups which forms the subject of the present paper.

As in the case of deciduous teeth eruption, most of the previous studies on the permanent teeth eruption, longitudinal or cross-sectional, concerned with the British (James—Pitt 1912, Ainsworth 1925, Stones et al. 1951, Clements—Picket 1953, Miller et al. 1965), and American (Cattell 1928, Cohen 1928, Klein et al. 1938, Steggarda—Hill 1942, Hellman 1923, 1943, Fulton—Price 1954) children and some with those from New Zealand (Leslie 1951), and China (Lau 1971). In addition to these, studies for the assessment of eruption have also been conducted among the American Negroes (Steggarda—Hill 1942, Hellman 1923, 1943, Fulton 1954, Leslie 1951, Lau 1971, Suk 1919), American Indians (Steggarda—Hill 1942, Hellman 1923, 1943, Fulton 1954, Leslie 1951, Lau 1971, Suk 1919, Dahlberg—Menegaz-Bock 1958), African Bantus (McKay—Martin 1952), Gambians (Billewicz—McGregor 1975), and Australian aborigines (Barrett 1957, Barrett et al. 1964). Data on the eruption of permanent teeth among the Indian populations are awfully missing excepting Shourie's (1946) pioneering work conducted on the Southern Indian boys and girls, and on Lahore boys over four decades after that of Powell in Bombay. The most recent studies on these lines consist of those on the Magar and Gurung Gurkhas of Dehradun in U.P. by Awasthi—Khare (1978), on the Chandigarh school children by Kaul et al. (1975), and on the Kuluis of Himachal Pradesh by Bhasin et al. (1977).

In this paper it is proposed to describe the development of permanent teeth in Gulbarga children and to evaluate the relationship between the level of dentition attained at a given age in either sex and income status of the children.

Materials and Methods

Gulbarga town in the Hyderabad-Karnataka area of Karnataka state is a taluk and district headquarter of the same name, with a population of 145,630 according to 1971 census. Brahmins and Lingayats characterise the dominant caste groups of the town besides the Muslims and Christians. Other castes with small population sizes inhabiting the town are Reddis, Vaisyas, Kshatriyas, Marathas, Jains, Kurubas, Harijans etc.

Most of the children for the study came from randomly chosen nurseries and primary schools, high schools and colleges. The rest of them were drawn from a random sample of houses. In any case, the selection of children was made in such a way that the socio-economic character of the town was maintained. Birth dates were recorded from school/college records, which were later cross-checked for correctness with those entered in the horoscopes and birth registers maintained by the parents of the children and the local municipal authorities. Cases with doubtful birth dates were excluded from the study. The materials for the study comprised 2,564 normal healthy boys (1,366) and girls (1,198) aged 3 to 25 years and above.

The survey was conducted with the help of an experienced dental surgeon attached to the local Medical College and Hospital. In all dental inspections alternate pairs of mouth mirrors and a probe were employed. Any tooth that had at least partly pierced the muco periostium was considered as erupted and was marked as present by the method of encircling the concerned numbers of the teeth on a specially developed proforma which was field-tested and standardised for entering the information for each subject. The eruption pattern has been studied on the basis of only those teeth that were present at the time of examination. All cases with history of extraction were dropped from the study. Based on the information collected on the family income of each child examined in rupees per annum, the children have been divided into three economic groups: Upper (with an income of Rs. 10,000 — and above), Middle (with an income of Rs. 5,000 to 10,000) and Lower (with an income of Rs. 5,000 and below). The results of teeth eruption have been studied according to these groups to assess the influence of the latter on the former.

Analyses of the data were made by the IBM-370/155 computer. In the tabulations, the mean number of teeth was calculated out of the total number of children examined by age, sex and economic status. From the tabulations on the number and per cent children with teeth erupted, the median eruption age for each tooth was calculated using the graphic method. Further the first and third quartiles were also calculated and presented along with the medians. To test the effects of region, side, sex and economic status, the analyses of variance were made. The cases have been grouped following the 'completed age' mode, i.e., as age of last birth days.

Analysis and Results

Teeth erupted at specified ages

Means with standard errors for the numbers of teeth at various ages by sex and economic status are portrayed in Tables 1 and 2. The tables on the percentage distribution of children with a specified number of teeth at a specified age, which are not presented here, reveal the predominant occurrence of an even number of teeth as in the case of deciduous teeth. The first tooth erupted in either sex at the earliest age of four years. No teeth were observed in certain children till as late as seven years while all the teeth erupted in certain others by 15 years age.

Table 1

Mean ±S.E. (sample size) of teeth erupted in Gulbarga (India) children by age and sex

Age groups (completed years)	Males	Females	Males and Females
3	0.0±0.00 (65)	0.0±0.00 (65)	0.0±0.00 (130)
4	0.3±0.16 (95)	0.2±0.08 (69)	0.3±0.17 (164)
5	1.6±0.26 (120)	1.7±0.35 (70)	1.6±0.48 (190)
6	2.7±0.38 (66)	3.8±0.46 (58)	3.2±0.59 (124)
7	6.4±0.63 (55)	7.2±0.47 (55)	6.8±0.79 (110)
8	10.5±0.69 (42)	10.6±0.56 (70)	10.5±0.89 (112)
9	13.2±0.74 (55)	13.5±0.36 (99)	13.4±0.74 (154)
10	16.4±0.75 (67)	16.8±0.64 (82)	16.6±0.98 (149)
11*	18.4±0.72 (60)	22.8±0.65 (65)	20.7±1.04 (125)
12*	23.1±0.65 (57)	25.6±0.50 (68)	24.5±0.84 (125)
13	26.0±0.46 (58)	27.4−0.26 (48)	26.6±0.54 (106)
14	26.9±0.35 (72)	27.9±0.10 (44)	27.3±0.46 (116)
15	27.9±0.15 (57)	27.9±0.11 (61)	27.9±0.18 (118)
16	28.0±0.11 (54)	27.9±0.14 (61)	28.0±0.18 (115)
17	28.7±0.20 (46)	28.3±0.15 (60)	28.5±0.25 (106)
18	29.3±0.21 (53)	28.9±0.22 (47)	29.1±0.31 (100)
19	29.8±0.22 (54)	29.4±0.25 (50)	29.6±0.36 (104)
20−24	30.3±0.11 (264)	29.9±0.19 (101)	30.2±0.18 (365)
25+	30.7±0.36 (26)	31.2±0.22 (25)	30.9±0.43 (51)

* Difference between sex is statistically significant ($P < 0.05$).
Not significant elsewhere.

Table 2

Mean±S.E. (sample size) of teeth erupted in Gulbarga (India) children by age and economic status

Age (completed years)	Upper income group	Middle income group	Lower income group
3	0.0±0.00 (21)	0.0±0.00 (70)	0.0±0.00 (39)
4	0.1±0.09 (44)	0.4±0.23 (56)	0.3±0.14 (64)
5	0.5±0.43 (11)*	1.3±0.26 (107)	2.2±0.38 (72)*
6	4.5±0.87 (18)	2.8±0.52 (42)	3.1±0.38 (64)
7	7.1±0.92 (27)	6.6±0.67 (43)	6.8±0.51 (40)
8	11.3±0.88 (21)	10.9±1.04 (32)	10.2±0.51 (59)
9	12.4±0.82 (16)	13.5±0.66 (53)	13.5±0.47 (85)
10	17.7±1.31 (23)	16.7±0.80 (51)	16.2±0.70 (75)
11	20.9±1.05 (28)	19.4±0.89 (39)	21.4±0.79 (58)
12	26.1±0.45 (27)*	24.7±0.67 (49)	23.3±0.75 (49)*
13	27.1±0.56 (22)	26.2±0.50 (50)	26.9±0.31 (34)
14	27.3±0.51 (28)	27.6±0.20 (34)	27.1±0.38 (54)
15	28.1±0.14 (31)	27.8±0.12 (47)	27.8±0.19 (40)
16	28.0±0.07 (34)	28.0±0.14 (56)	27.8±0.24 (25)
17	28.5±0.20 (30)	28.1±0.14 (44)	29.0±0.28 (32)
18	29.2±0.26 (42)	28.9±0.21 (39)	29.0±0.36 (19)
19	29.7±0.27 (42)	29.7±0.28 (36)	29.4±0.32 (26)
20−24	30.3±0.15 (143)	30.3±0.15 (131)	30.0±0.19 (91)
25+	30.9±0.39 (17)	30.6±0.53 (11)	31.0±0.28 (23)

* Difference between economic groups is statistically significant ($P < 0.05$). Not significant elsewhere.

Table 1 shows the eruption of higher mean numbers of teeth in females than males at five to 14 and 25+ years of age ending in an equal number at 15 years, and the difference ranging between 0.1 tooth at five and eight years and 4.4 teeth at 11 years. At four and 16−24 years, the male means precede the female ones, the difference being 0.1 and 0.4 teeth respectively. Between five and 13 years age, the number of teeth erupted increases rapidly in either sex (M: 1.7−4.7, F: 1.5−6.0) while from 14 years and above the increase is negligible but consistent (M: 0.1−0.9, F: 0−1.3). The mean number of teeth in either sex fluctuates between 25 and 30 during a long period of 12−24 years. The onset of eruption though occurred at the same age (four years) in either sex, the time of their completion appears to be earlier in females than males.

The data when examined by economic status as in Table 2 reveals the prevalence of higher mean number of teeth in upper income group children than in those of other groups at all ages but 4−5 and 9 years; the intergroup difference being 0.2 to 1.7 teeth. However, the yearly increase in teeth eruption rate and the period with maximum number of teeth erupted are the same in different income group children as in sex. The times of onset as well as completion of eruption are nearly the same in all economic groups.

Age at eruption

Tables 3 and 4 show eruption ages by sex and economic status at 25th, 50th and 75th percentiles. The combined figures of sexes as in table 3 indicate earlier eruption ages for mandibular lateral incisors and third molars at all percentiles,

Table 3
Age (years) at eruption of teeth by sex — 25th, 50th and 75th percentiles

Type of Tooth	Percentile	Upper Jaw						Lower Jaw					
		Male		Female		Total		Male		Female		Total	
		R	L	R	L	R	L	R	L	R	L	R	L
Central incisor	25th	5.50	5.75	5.50	5.50	5.50	5.50	5.25	5.25	5.50	5.00	5.25	5.00
	50th	6.25	6.50	6.75	6.25	6.50	7.00	7.00	7.00	6.75	6.75	6.75	6.75
	75th	8.00	7.25	7.75	7.25	7.75	7.25	8.50	8.75	8.50	8.75	8.50	8.75
Lateral incisor	25th	6.25	6.50	6.25	6.50	6.25	6.50	6.00	5.75	5.75	5.75	5.75	5.75
	50th	8.25	8.00	8.00	8.00	8.00	8.00	7.25	7.00	6.75	7.00	7.00	7.00
	75th	9.25	9.25	8.50	8.75	8.75	9.00	8.25	8.00	8.00	8.25	8.00	8.25
Canine	25th	9.00	9.75	9.00	9.75	9.00	9.75	9.50	9.50	8.75	8.75	9.25	9.00
	50th	11.25	11.25	10.25	10.50	10.75	10.00	10.00	10.75	10.00	10.00	10.50	10.50
	75th	12.00	12.00	11.00	11.25	11.50	11.75	11.50	12.25	10.75	11.00	11.50	12.00
First premolar	25th	9.00	9.00	9.00	9.25	8.75	9.00	9.25	9.50	9.25	9.25	9.25	9.25
	50th	9.75	10.25	10.25	10.00	10.00	10.00	10.75	10.50	10.00	10.00	10.50	10.25
	75th	11.25	11.25	10.75	10.50	11.00	10.75	11.75	11.75	11.00	11.00	11.50	11.50
Second premolar	25th	10.00	10.00	9.75	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
	50th	10.75	11.25	11.25	10.75	11.00	11.00	11.75	11.75	11.00	11.00	11.50	11.50
	75th	12.00	12.00	11.50	11.75	11.75	11.75	12.50	12.75	11.50	11.50	11.50	12.00
First molar	25th	5.50	5.25	5.50	5.00	5.25	5.50	5.00	5.25	5.50	5.25	5.50	5.50
	50th	5.75	5.75	5.75	5.75	5.75	5.75	5.50	5.50	5.50	5.50	5.50	5.50
	75th	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Second molar	25th	11.25	11.00	10.00	10.00	10.25	10.50	10.50	10.25	10.00	9.75	10.00	10.00
	50th	12.00	12.25	11.00	11.00	11.50	11.50	12.00	12.00	10.75	10.50	11.00	11.25
	75th	13.00	13.00	12.00	12.00	12.50	12.50	12.75	12.75	11.75	11.75	12.50	12.50
Third molar	25th	17.50	18.00	18.00	19.00	17.50	18.50	17.00	17.25	18.00	18.25	17.00	17.50
	50th	20.25	20.00	22.00	22.00	21.00	2.00	19.00	19.00	20.75	20.00	19.75	19.25
	75th	25.75	25.00	26.00	25.75	27.50	26.00	26.25	25.50	25.00	24.75	25.25	25.50

R = Right L = Left

Differences in the mean number of teeth erupted between sex, region (Upper/Lower) and side (Right/Left) are not significant ($P < 0.05$) as shown by the 'F' test.

Table 4

Age (years) at eruption of teeth by economic status — 25th, 50th and 75th percentiles

Type of Tooth	Percentile	Upper Jaw						Lower Jaw					
		Upper income group		Middle income group		Lower income group		Upper income group		Middle income group		Lower income group	
		R	L	R	L	R	L	R	L	R	L	R	L
Central incisor	25th	5.25	5.25	6.00	5.75	5.75	5.50	5.00	5.00	5.50	5.25	5.00	5.00
	50th	6.00	6.25	6.50	6.75	6.50	6.50	6.00	6.25	6.75	6.25	7.00	6.25
	75th	7.25	7.00	8.25	7.75	8.00	7.50	7.00	7.00	8.50	7.00	8.50	7.25
Lateral incisor	25th	6.25	6.00	7.25	7.25	6.75	6.50	5.50	5.50	5.75	6.00	6.00	5.75
	50th	7.50	7.25	8.50	8.50	8.75	8.00	6.50	5.75	7.00	6.25	7.00	6.00
	75th	9.00	9.00	9.00	9.00	9.00	9.00	7.50	8.00	8.50	8.50	8.25	8.25
Canine	25th	9.50	9.50	9.75	9.75	10.00	10.00	9.25	9.25	9.00	9.00	9.00	9.00
	50th	10.50	10.50	10.75	11.25	11.25	10.75	9.75	10.00	10.25	10.25	10.25	10.25
	75th	11.75	11.75	11.75	12.00	11.75	12.00	11.00	10.75	11.25	11.50	11.50	11.25
First premolar	25th	8.75	9.50	9.00	9.25	9.00	9.50	9.50	9.25	9.50	9.25	9.50	9.50
	50th	10.50	10.00	10.00	10.00	10.00	10.00	9.75	9.75	10.25	10.25	10.25	10.50
	75th	11.50	10.75	11.00	11.00	11.00	11.00	11.25	11.00	12.25	11.50	11.75	11.75
Second premolar	25th	9.50	9.75	9.75	10.00	9.00	10.25	9.50	9.75	10.25	10.00	10.00	10.00
	50th	10.25	11.00	11.50	11.25	9.75	10.75	11.25	11.00	11.50	11.25	11.00	11.00
	75th	11.50	11.75	12.75	11.75	12.50	12.50	11.75	11.50	11.75	12.00	12.00	12.75
First molar	25th	5.50	5.25	5.00	5.00	5.50	5.25	5.50	5.50	5.75	5.25	5.50	5.50
	50th	6.00	6.00	6.50	6.50	7.25	6.00	7.25	6.25	6.50	6.75	6.00	7.00
	75th	7.25	7.00	9.50	7.75	8.75	7.50	9.75	8.25	8.75	9.25	8.75	8.75
Second molar	25th	10.25	10.50	11.00	11.00	10.25	10.50	10.50	10.25	10.25	10.00	10.00	10.00
	50th	11.50	11.50	12.00	11.75	12.00	12.00	11.50	11.25	11.50	11.25	10.75	10.75
	75th	12.00	12.25	12.50	13.25	13.00	13.00	12.25	12.00	12.50	12.50	12.50	12.25
Third molar	25th	17.50	18.00	18.00	18.75	17.75	19.25	17.25	17.50	18.25	17.75	16.75	17.00
	50th	20.25	19.50	21.50	21.25	21.50	21.75	20.25	19.75	20.25	18.75	20.25	19.75
	75th	27.25	25.25	27.25	27.50	27.25	26.00	24.75	24.00	26.00	24.25	26.50	24.50

R = right L = left

Differences in the mean number of teeth erupted between economic status, region, (Upper/Lower) and side (Right/Left) are not significant ($P < 0.05$) as shown by the 'F' test.

second molars at 25th and 50th percentiles, and first molars at 50th percentile respectively than their counterparts in the maxilla. Among the rest, maxillary central incisors show earlier eruption ages at 50th and 75th percentiles, first premolars at all percentiles and second premolars at 50th percentile respectively, while the canines present inconsistent figures. There are differences in eruption times at all percentiles between the homologous male maxillary central incisors and third molars, and mandibular lateral incisors, and female maxillary canines, first and second premolars, and mandibular third molars respectively. The only teeth without any differences are female mandibular first and second premolars and maxillary second molars while the rest vary at different percentiles. Teeth with earlier eruption values than their counterparts at all percentiles consist of the mandibular lateral incisors and second molars of either sex, male mandibular canines and maxillary first premolars, female maxillary second premolars and mandibular third molars. Earlier eruption times have also been shown at 25th and 50th percentiles by female maxillary central incisors, and male mandibular canines, and at 50th and 75th percentiles by the first and third molars respectively. The rest of the teeth show very negligible differences. In general the female teeth of either jaw erupt earlier than the male ones excepting the male maxillary first premolars and third molars. The female teeth advanced over the male at all percentiles are second molars in either jaw, maxillary central and lateral incisors, and mandibular canines and first premolars. In the remaining teeth the magnitude of difference in eruption times between the sexes is negligible.

As could be seen from Table 4, children of different economic groups present interside differences in eruption time at all percentiles for the following teeth: central incisors of either jaw of middle income group, maxillary first premolars of upper income group, second premolars of either jaw of upper and middle income groups, maxillary first molar of lower income group and its counterpart of mandible of middle income group and third molars of either jaw of all the economic groups. The other teeth either show differences at different percentiles or not at all. Considering the eruption times by jaw and sex, we find earlier eruption values at all percentiles for the mandibular lateral incisors and canines in children of all economic groups, and second and third molars in those of middle and lower income groups while mandibular first premolars in midde and lower income groups and first molars of upper and middle income groups erupt later than their counterparts. The centile values of the rest of the teeth are inconsistent. When the data in either jaw have been viewed by economic groups, we find earlier eruption trend at all percentiles for most teeth of children of upper income group which can be clearly seen in the central incisors of either jaw, mandibular lateral incisors, maxillary canines, mandibular second premolars and maxillary third molars respectively. The trend is inconsistent in other teeth.

Median eruption ages

In the median eruption ages by sex, the magnitude of differences between the individual members of the tooth pairs on the right and left sides of either jaw is negligible; it ranges between 0.25 years in a number of teeth of either jaw and sex and 1.50 years in the maxillary first premolars. In males, the upper and lower lateral incisors, lower first premolars and upper third molars of the left segment have precedence over the right, while the upper central incisors, second premolars and second molars, and lower canines of the latter side precede the former. The rest of the teeth show the same eruption values. In females, the upper central incisors, lower lateral incisors, first and second premolars, and lower second and third molars of the left side show precedence over the right ones. Right preceding the left side is found only in upper canine. The rest of the teeth present no differences at all. The most frequent range of difference in either jaw of either sex is 0.25 years.

Excepting the maxillary central incisors of either sex, and male first and second premolars which erupt earlier than their mandibular counterparts, and female second molars whose eruption values are the same in either jaw, all the teeth erupt earlier in mandible than in maxilla. The median eruption time between the male homologous teeth ranges between 0.25 to 1.25 years and in females between 0.25 and 2.00 years which occurs in the left third molars.

In either jaw, male medians are larger than the female ones for lateral incisors, canines and second molars, while the females show larger values with respect to only third molars. The other teeth with larger values are male mandibular and female maxillary central incisors, first premolars and female mandibular third molars. The intersex maxillary difference lies between 0.25 and 2.00 years and mandibular difference between 0.25 and 1.75 years. First molar is the only tooth that presents no sex difference in either jaw, while in all other teeth but the central incisors and third molars, the dental development of girls is advance of boys. The pooled values of the sexes reveal that all mandibular teeth excepting the central incisors and first premolars show earlier eruption than maxillary ones. The teeth that erupt earlier than others irrespective of sex, side and jaw are central and lateral incisors among the front teeth and first molars among the posterior teeth. The analyses of variance carried out showed that the effect of sex, region and side are statistically not significant indicating the superficial nature of differences given above.

Viewing the data by economic status, we find median eruption time differences between all teeth of the right and left segments of either jaw and all economic groups, excepting the maxillary central incisors, and first premolars, mandibular canines and second premolars and second molars of either jaw of lower economic group children; maxillary lateral incisors, and first molars, mandibular canines, and first premolars of either jaw of middle income group children; and maxillary canines, first and second molars and mandibular first premolars of upper income group children, where the eruption times are the same. In the rest of the teeth irrespective of economic groups, the left side precedes the right in eruption. The mandibular lateral incisors, canines and second molars erupt earlier in children of all income groups. The other mandibular teeth erupted earlier are central incisors of middle income group, first premolars of upper income group, first molars of lower income group and third molars of middle and lower income groups. The rest of the teeth erupt later than their maxillary counterparts excepting central incisors in upper income group, and second premolars in middle income group which erupt simultaneously in either jaw. The effects of economic status, region and side were found to be statistically not significant when the analysis of variance was done.

Order of eruption

The order of eruption abridged from the median eruption time shows that the mandibular right and left molars were the first to erupt simultaneously earlier in females than in males, while the maxillary ones emerged simultaneously in either segment of either sex about 0.3 years later than the former. The maxillary central incisors which erupted almost at the same age in either sex come next in order followed by mandibular and maxillary lateral incisors respectively. Then the maxillary first premolars erupted followed by the mandibular ones and canines. After about 0.4 years have elapsed, the maxillary second premolars following which the mandibular ones and second molars erupted. The last to erupt after a long period of about 8—9 years were mandibular and maxillary third molars. The order of eruption in maxilla and mandible of both sexes is shown separately and together as below.

ORDER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Males:	$\overline{6}$	$\underline{6}$	$\underline{1}$	$\overline{1}$	$\overline{2}$ —	$\underline{2}$	$\underline{4}$	$\overline{3}$	$\overline{4}$	$\overline{5}$	$\underline{3}$	$\overline{5}$	$\overline{7}$	$\underline{7}$	$\overline{8}$	$\underline{8}$
Females:	$\overline{6}$	$\underline{6}$	$\underline{1}$	$\overline{1}$	$\overline{2}$	$\underline{2}$	$\overline{3}$ =	$\overline{4}$	$\underline{4}$	$\overline{7}$	$\underline{3}$	$\underline{\overline{5}}$ =	$\underline{7}$	$\overline{8}$	$\underline{8}$	
Combined:	$\overline{6}$	$\underline{6}$	$\underline{1}$	$\overline{1}$	$\overline{2}$	$\underline{2}$	$\underline{4}$	$\overline{4}$	$\overline{3}$	$\underline{3}$	$\underline{5}$	$\overline{7}$	$\overline{5}$ =	$\underline{7}$	$\overline{8}$	$\underline{8}$
Simply:	6	>	1	>	2	>	4	>	3	>	5	>	7	>	8	

Discussion

The eruption patterns of teeth in our as well as other samples are given in Tables 5 to 7. In Table 5 the mean number of teeth erupted at given ages in Gulbarga children is compared with that of only New Zealand children for whom data are available. The first teeth erupted as early as 4 years in children of either sex of our sample unlike in New Zealand children. The mean numbers

Table 5

Number of teeth erupted at specified ages in children of New Zealand and Gulbarga (India)

Age in years.	New Zealand (Leslie 1951)				India (Present study)			
	Males (1427)		Females (1335)		Males (1366)		Females (1198)	
	Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.
4	—	—	—	—	0.3	0.16	0.2	0.08
5	0.27	1.90	0.64	1.52	1.6	2.88	1.7	2.94
6	2.96	2.65	3.78	3.95	2.7	3.05	3.8	3.47
7	7.56	2.93	8.83	2.26	6.4	4.70	7.2	3.47
8	10.52	2.34	11.59	1.55	10.5	4.46	10.6	4.67
9	12.33	2.29	13.86	3.19	13.2	5.52	13.5	3.62
10	14.95	4.14	17.52	4.61	16.4	6.15	16.8	5.83
11	19.26	5.04	22.14	4.85	18.4	5.56	22.8	5.26
12	23.03	4.75	25.16	3.57	23.1	4.93	25.6	4.12
13	25.76	2.98	26.78	1.93	26.0	3.48	27.4	1.82

of teeth present at specified ages are more or less the same in both samples, although children of certain ages of either sex and population tend to show higher means than their counterparts with the exception of 5 years group

Table 6

Comparison of eruption ages (in years) by economic status

Teeth	Jaw	America (HELLMAN 1923)				Whites	
		Males		Females		Males	
		Wealthy	Poor	Wealthy	Poor	Wealthy	Poor
I1	U	7.41	7.45	6.80	7.37	7.12	7.40
	L	6.48	6.77	6.05	6.48	6.23	6.37
I2	U	8 76	8.99	8.21	8.62	8.10	8.51
	L	7.68	7.90	7.15	7.65	7.34	7.54
C	U	12.02	12.16	11.15	11.13	11.12	11.45
	L	11.04	11.17	9.98	9.80	10.46	10.61
PM1	U	10.91	10.37	10.52	9.91	10.67	10.63
	L	11.26	11.33	10.54	10.70	10.57	10.79
PM2	U	12.06	11.25	11.47	10.69	11.30	11.17
	L	12.03	12.07	11.57	11.29	11.53	11.47
M1	U	6.77	6.50	6.14	6.47	6.24	6.47
	L	6.89	6.35	6.39	6.23	6.35	6.36
M2	U	12.84	12.69	12.48	12.31	12.52	12.45
	L	12.52	12.07	12.09	11.65	11.98	12.05

which shows a markedly higher mean in both sexes of our samples than the New Zealanders. However majority of the teeth have erupted in children of either sample by 13 years age.

Table 6 provides eruption ages of different teeth by economic status in the children of Gulbarga in relation to those of America and Whites and Blacks. All the front teeth in either jaw show earlier eruption ages in wealthy children of all the populations including ours excepting the upper central incisors of Blacks, upper lateral incisors of Whites, and canines of either jaw of Americans which erupt slightly earlier in poor. The eruption pattern of the posterior teeth is inconsistent. The upper first and second premolars erupt earlier in the poor children of our sample as in Americans and Whites, while the lower first premolar erupts earlier in the wealthy individuals as in American and White males. The lower second premolars show earlier times in poor children as in Whites, and poor American and Black females. The upper first and second molars erupt earlier in wealthy children of our sample as in Whites, and American and Black males while lower ones erupt earlier in the poor as in Americans and Blacks of either sex.

Table 7 gives the comparison of eruption ages of teeth in different populations with those of our sample. A careful examination of the data reveals that in none of the populations including ours the sequence of eruption of teeth is common to both sexes excepting the New Zealand children. The comparison of the sequences indicates certain variations between our sample and others. As in majority of the populations studied earlier, in either sex of our sample too the lower first molars are the earliest to erupt followed by the upper ones the exceptions being the Kuluis, British, Americans, New Zealand children and Chinese girls. In the case of central incisors, our sample shows precedence in American, white, black and Gulbarga children

Garn et al. 1973		Blacks Garn et al. 1973				India, Present study	
Females		Males		Females		Males	Females
Wealthy	Poor	Wealthy	Poor	Wealthy	Poor	Wealthy	Poor
6.77	7.02	6.79	6.96	6.77	6.75	6.13	6.50
5.92	6.29	5.56	6.11	5.66	5.87	6.13	6.63
7.99	7.95	7.74	7.97	7.26	7.64	7.13	8.38
7.05	7.15	6.82	6.98	6.82	6.55	6.13	6.50
10.49	10.78	10.42	10.97	10.28	10.66	10.50	11.50
9.69	9.84	10.21	10.38	9.01	9.81	9.88	10.25
10.23	10.18	10.20	10.45	10.05	10.06	10.25	10.00
10.15	10.15	10.43	10.40	9.41	10.09	9.75	10.38
10.83	10.87	10.82	11.22	10.69	10.73	10.63	10.25
11.07	10.96	10.73	11.18	10.93	10.75	11.13	11.00
6.30	6.35	6.12	6.25	6.61	5.95	6.00	6.63
6.13	6.15	5.89	6.10	6.57	5.67	6.75	6.50
12.01	12.01	12.59	12.32	11.71	11.61	11.50	12.00
11.49	11.50	12.38	11.96	11.25	11.21	11.38	10.75

of the upper ones over the lower unlike in many populations excepting the above population groups and a few others such as the girls of America, Gambia and Bantu. The lower lateral incisors precede the upper ones as in all populations excepting the U.P. Gurungs, Kuluis, and the girls of South India, China, Gambia and Bantu. In the males of Gulbarga the upper first premolar precedes the canine as in their counterparts of Lahore, Chandigarh, Britain, America, Gambia and girls of China. In the females of our series, both the lower canine and first premolar erupt at the same age as the male upper first premolar unlike in all the other series. In the boys of our study, the lower first premolar precedes the upper second premolar as in their counterparts of U.P. Gurung, America, Britain and Gambia and unlike in all other populations. In females on the other hand, the upper first premolars precede the lower second molars unlike in children of all other samples. In the eruption of the upper canine preceding the lower second premolars the males of our sample agree with those of U.P. Gurung, and Gambia unlike in most other populations. In the boys of our study the lower second molars precede the upper ones as in majority of the populations, whereas in girls the upper second molars, although have precedence over the lower third molars as is expected, they erupt at the same time as the upper and lower second premolars. This trend is comparable to that found only in Chandigarh girls. On the whole the order of eruption of teeth in either jaw and sex is nearly similar to that noticed in all other populations studied earlier.

Considering the eruption status of the different teeth of our series in relation to those from other parts of India and abroad, we find that the eruption ages of Gulbarga children are compatible with those of Bantus for female maxillary central incisors, male maxillary lateral incisors, mandibular canines,

Table 7

Comparison of eruption ages (in years) of teeth

Teeth Studies:	1	2	3	4	5	6	7
		Males					
Upper jaw.							
I1	7.01	7.27	7.33	7.49	7.26	7.36	6.90
I2	8.18	8.39	8.42	8.62	8.32	8.60	8.10
C	11.46	11.33	11.50	11.80	11.40	11.03	10.70
PM1	10.41	10.34	10.33	10.42	10.01	9.83	10.00
PM2	11.52	11.02	11.08	11.18	11.74	10.67	10.90
M1	6.11	6.22	6.33	6.64	6.47	6.27	5.40
M2	11.97	11.90	12.16	12.70	12.47	12.12	11.30
M3	—	—	—	—	—	—	—
Lower jaw.							
I1	6.08	6.50	6.25	6.50	6.38	6.51	5.80
I2	7.30	7.66	7.58	7.64	7.42	7.37	6.90
C	10.51	10.42	10.66	10.70	10.78	10.38	10.30
PM1	11.35	10.80	10.58	10.75	11.34	10.04	10.20
PM2	12.32	11.88	11.33	11.45	12.18	11.02	11.00
PM1	6.14	6.12	6.16	6.44	6.46	6.04	5.40
M2	11.41	11.64	11.66	12.20	11.89	11.33	11.20
M3							
			Females				
Upper jaw.							
I1	6.62	6.94	7.08	7.20	6.83	7.23	6.50
I2	7.82	8.04	8.00	8.15	7.86	8.19	7.70
C	10.67	10.72	11.08	11.05	10.82	10.26	10.20
PM1	9.79	10.04	9.92	10.00	10.52	9.47	9.60
PM2	11.06	10.91	10.92	10.82	11.24	10.48	10.30
M1	5.94	6.12	6.16	6.54	6.38	6.29	5.30
M2	11.49	11.68	12.08	12.40	12.20	11.80	10.80
M3	—	—	—	—	—	—	—
Lower jaw.							
I1	5.77	6.17	6.08	6.19	6.19	6.28	5.80
I2	7.01	7.35	7.25	7.31	7.16	7.13	6.40
C	9.41	9.60	9.66	9.85	9.74	9.51	9.50
PM1	10.53	10.26	10.08	10.20	10.54	9.55	9.60
PM2	11.63	11.25	11.08	11.00	11.73	10.44	10.70
M1	5.84	5.97	6.00	6.12	6.30	5.85	5.10
M2	11.18	11.35	11.42	11.90	11.36	10.95	10.50
M3	—	—	—	—	—	—	—

1: British, CLEMENTS et al. 1953; 2: British, MILLER et al. 1965; 3: American, CATTELL 1928; 4: American, KLEIN et al. 1938; 5: New Zealand, LESLIE 1951; 6: Chinese, LAU 1971; 7: Bantu, McKAY—MARTIN 1952; 8: Gambia, BILLEWICZ—McGREGOR 1975; 9: South India,

and first premolars of either jaw; those of U.P. Magars for male maxillary lateral incisors; those of Chandigarh for male maxillary lateral incisors, and male mandibular second premolars; those of Britain for female maxillary lateral incisors, and male maxillary second premolars; those of Americans of Gulbarga children with other series*

8	INDIA						
	9	10	11	12	13	14	K (P. S.)
7.38	7.34	6.87	7.36	7.30	7.08	7.10	6.38
8.59	8.34	8.56	8.12	7.57	8.13	8.60	8.13
11.33	11.13	11.02	11.78	11.54	10.97	11.90	11.25
10.37	10.59	10.44	10.48	10.30	10.47	6.20	10.00
11.25	10.52	11.11	11.18	11.45	11.48	12.70	11.00
5.99	6.63	6.06	6.42	6.30	6.41	3.40	5.75
11.93	12.37	11.91	12.84	12.66	12.02	12.90	12.13
—	—	—	—	—	—	—	20.13
6.22	7.13	6.79	6.72	6.57	6.61	6.30	7.00
7.47	7.86	8.11	7.72	7.00	7.59	7.20	7.13
10.58	11.22	10.45	10.72	10.30	10.71	11.90	10.38
10.73	10.88	10.48	10.67	10.78	10.97	5.20	10.63
11.39	11.76	13.18	11.60	11.90	11.75	12.20	11.75
5.71	6.59	5.92	6.00	5.90	6.17	5.20	5.50
11.62	12.08	11.34	12.66	12.30	11.18	12.60	12.00
							19.00
7.11	7.27	—	—	—	6.92	6.70	6.50
8.10	7.51	—	—	—	8.13	7.20	8.00
10.53	10.87	—	—	—	10.47	11.40	10.88
9.79	10.55	—	—	—	10.23	5.90	10.13
10.59	11.47	—	—	—	11.22	10.80	11.00
5.78	6.91	—	—	—	6.03	5.30	5.75
11.18	11.86	—	—	—	11.22	11.80	11.00
—	—	—	—	—	—	—	22.00
6.08	7.23	—	—	—	6.46	6.40	6.75
7.07	7.54	—	—	—	7.59	7.80	6.88
9.70	10.52	—	—	—	9.77	10.20	10.00
9.95	10.07	—	—	—	10.47	5.40	10.00
10.66	11.42	—	—	—	11.22	10.90	11.00
5.48	6.81	—	—	—	5.82	5.10	5.50
10.93	11.59	—	—	—	10.72	11.90	10.63
—	—	—	—	—	—	—	20.38

SHOURIE 1946; 10: Lahore, SHOURIE 1946; 11: U.P. Magar, AWASTHI—KHARE 1978; 12: U.P. Gurung, AWASTHI—KHARE 1978; 13: Chandigarh, KAUL et al. 1975; 14: Kuluis, BHASIN et al. 1977; K (P.S.): Karnataka, *Present study.*

for female maxillary lateral incisors and mandibular second premolars; those of Chinese for male mandibular canines, and second molars; those of south Indians for female maxillary canines; those of U.P. Gurung for male mandibular first premolars; and those of Gambia for female first molars of either jaw.

Among the remaining teeth, it is only the maxillary central incisors of either sex of our sample that are found ahead of all the populations excepting the Bantu females. In the case of all other male maxillary teeth and mandibular lateral incisors, canines and first molars the eruption ages of Gulbarga children are earlier than those of most of the foreign and some Indian populations such as U.P. Magars with respect to either jaw and children of South India, Lahore and Chandigarh with respect to mandible only. The eruption ages of the mandibular teeth for the boys of our study are somewhat retarded as compared to those of other populations. In the females, barring the mandibular central incisors, canines of either jaw and maxillary first and second premolars, all the other teeth of either jaw of Gulbarga children show earlier eruption ages than those of majority of the Indian and foreign populations.

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HUMAN PHYSIQUE AND CLIMATE

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Abstract: The analysis of the geographic distribution of human body height and body weight, as well as that of the anthropometric parameters correlated with it, reveals, without a doubt, clear distribution patterns: In all of the main racial groups — with the notable exception of the Negroids — the populations of cooler biotops are characterized by taller, heavier, thus, in general, bulkier somatotypes, while within populations of warmer biotops, a smaller lighter (thus generally more slender) somatotype predominates. So far the wellknown Bergmann rule can be regarded as being valid also for man. Nevertheless, on account of still lacking satisfying evidence it seems to be rather problematic to interpret these associations as the result of selective acting forces leading to different thermoregulating adaptations to the various climatic conditions present on earth, though, of course, certain differences between somatotypes in their response to climatic stress are quite known. Considering the results of the modern growth research, it seems to be much more likely to recognize these climatic associations in the geographical distribution of anthropometric variables (like body height, etc.) in connection with the geographical distribution of nutritional factors, in particular with geographical differences in protein and calorie supply during childhood and adolescence. It remains an open question, however, whether merely selective adaptations to gross insufficient food supply are alone responsible or whether both qualitative and quantitative food deficiencies during the growth period effected long-lasting modifications. In addition, it is quite possible that the anthropometric differences found in various populations may also be dependent upon still-to-be-defined genetic variations concerning different growth capacities as well as the degree of socio-economic development of a population.

Key words: Human physique, climate, height, weight, Rohrer-index, weight/surface ratio, surface/weight ratio, mean annual temperature, protein intake, nutrition, adaptation.

It is a well documented fact that numerous anthropometric, dermatoglyphic, serological and biochemical variables of man are not distributed inhomogeneously all over the world, but are showing more or less characteristic distribution patterns or gradients, which are in many cases clearly connected with particular environmental factors such as climate, altitude, infectious diseases, etc. A detailed discussion of all these distribution patterns and its possible causes has been given by Walter (1974a), to which it may be referred here. As for blood group polymorphisms, haemoglobin variants or skin pigmentation it is relatively easy to explain the present distribution patterns of gene or phenotype frequencies as the results of genetic adaptation processes via natural selection. Thus the ABO gene distribution is without doubt influenced by selection via smallpox and plague, some haemoglobin variants like Hb S and Hb C proved to be of considerable advantage in malaria burdened areas, and, last but not least, dark skin colour seems to be an effective protection against high doses of ultraviolet radiation as they are found in tropical and high mountain areas. Against that, it is much more difficult to give a plausible explanation for the likewise apparent coherencies between human physique (respectively the anthropometric variables by which it is composed), on the one hand, and certain environmental factors on the other hand. Without any doubt there are e.g. associations between human physique (and its components) and climate, which has been pointed out first by Rensch (1935), and insofar the wellknown Bergmann (1847) rule can be regarded as being valid also for man. However, at the present stage of research it seems to be not admissibe to explain these associations between human physique and climate too decidedly as the result of selectively controlled genetic adaptation to various climatic conditions on the earth, as it was pointed out by Roberts (1952, 1953, 1960, 1973) or Schreider (1950, 1951, 1963, 1966). It seems that these authors have not considered sufficiently the fact that all the anthropometric variables composing human physique are not only controlled by genetic factors, but are also influenced essentially by a good number of non-genetic factors, among which nutrition is playing an important role.

Thus in the following the problem "human physique und elimate" should be discussed again. By this, and by offering an own hypothesis to explain the association between human physique and climate, further research should be stimulated in order to approach to a more satisfying solution of this problem than it has been possible up to now. — For methodological details see Walter 1974b, 1976.

From Figs 1—5 it is seen that body height, body weight, Rohrer-index, weight/surface ratio and surface/weight ratio — some major components of human physique — are not distributed inhomogeneously over the world, but are showing clear distribution patterns. Generally one can state from these

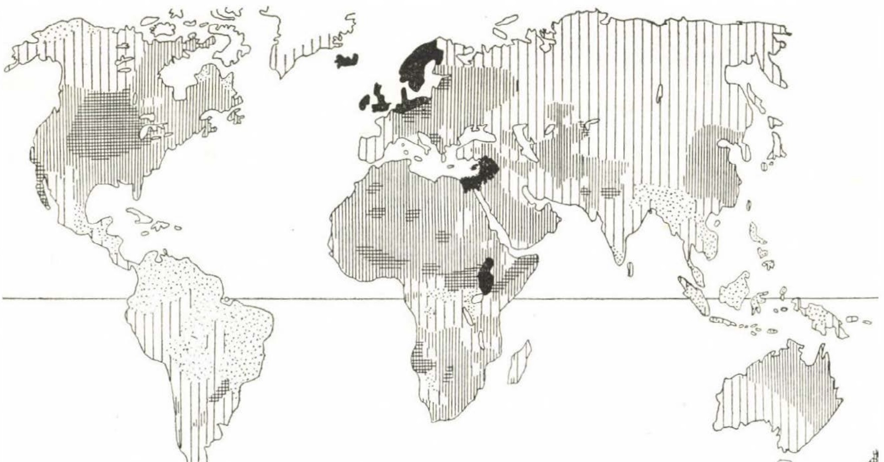

Fig. 1. Geographical distribution of body height

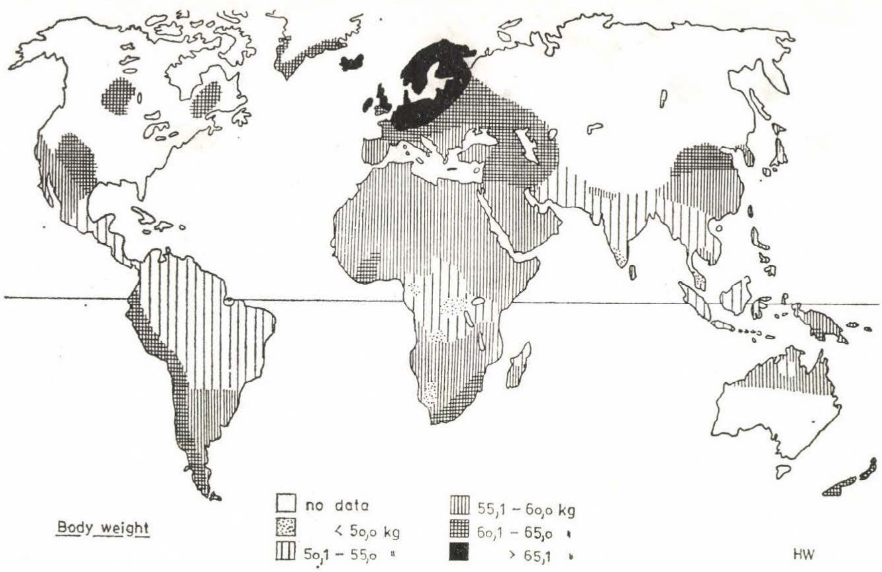

Fig. 2. **Geographical distribution of body weight**

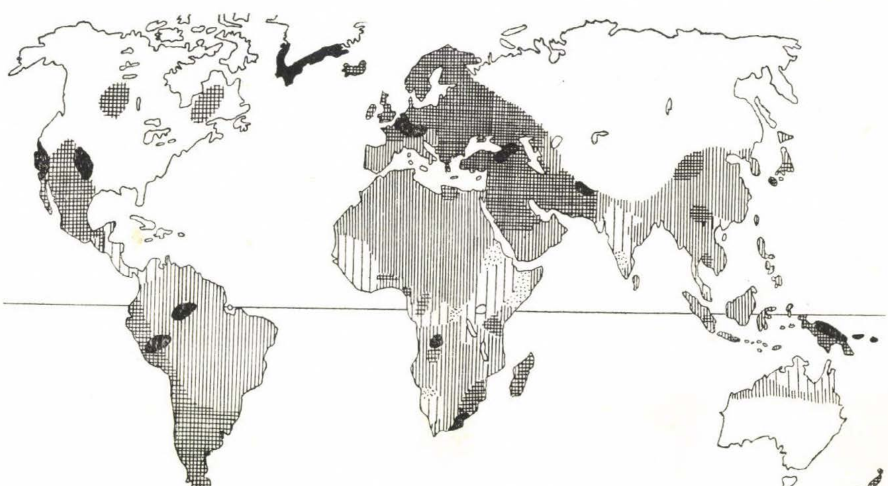

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Fig. 3. **Geographical distribution of Rohrer-index**

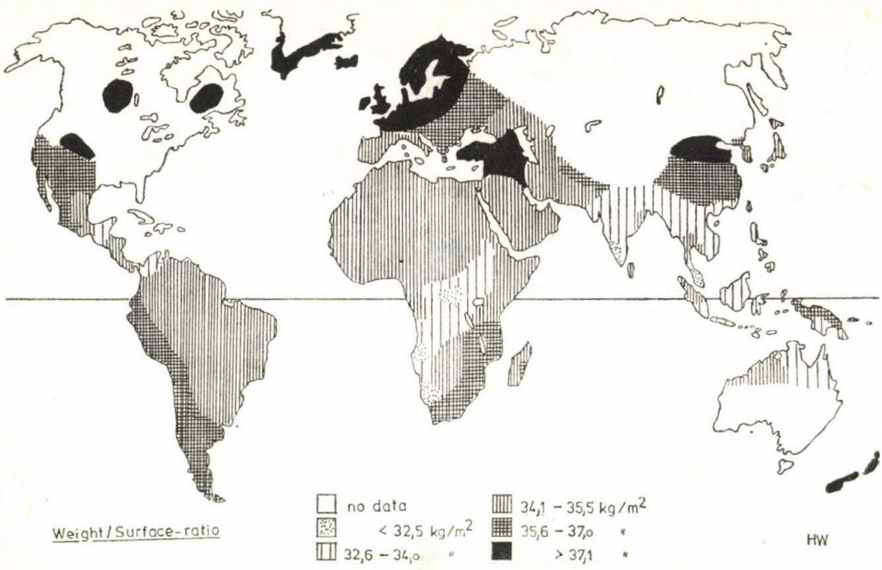

Fig. 4. **Geographical distribution of weight/surface ratio**

Fig. 5. **Geographical distribution of surface/weight ratio**

distributions patterns: Populations living in the warmer tropical and subtropical regions of the earth are averagely smaller, lighter, thus having generally more slender somatotypes as compared to those living in the cooler regions, who are characterised by generally taller, heavier and bulkier somatotypes. As the geographical distributions of weight/surface ratios and surface/weight ratios are also showing obvious relations to climatic conditions, one can say that *Bergmann's rule* — body size decreases as we progress from temperate regions towards the equator — holds true in man, too. The same can be said with regard to the *Allen rule.* As among the climatic factors the mean annual temperature is of considerable importance, body height, body weight, Rohrer-index, weight/surface ratio and surface/weight ratio of Caucasoid, Mongoloid and American Indian populations have been correlated with this climatic parameter. The results of these computations are shown in Figs 6—10. It is seen from these figures that in all these three racial groups mean body height, body weight, Rohrer-index and weight/surface ratio are decreasing with increasing mean annual temperature, whereas the surface/weight ratio is showing an opposite tendency. Thus human physique as a whole is without doubt anyhow related with climate. But how can this be explained?

The "classical" hypothesis runs as follows: Tall, heavy and bulky organisms with a for that reason relatively small surface are in cooler climates in advantage, because they have a greater heat production ability combined with a lesser heat loss. Small, light and more slender organisms with a for that reason smaller surface are in warmer climates in advantage, because they produce only relatively little heat combined with an effective heat loss because of a greater body surface. By this, life perilous effects of hypothermy and hyperthermy, respectively, would be avoided. Having such biological advantages

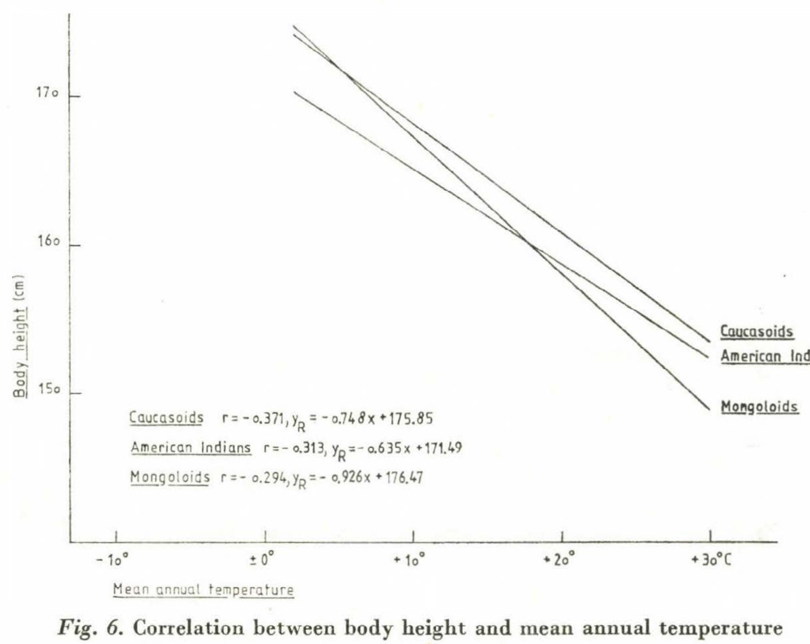

Fig. 6. Correlation between body height and mean annual temperature

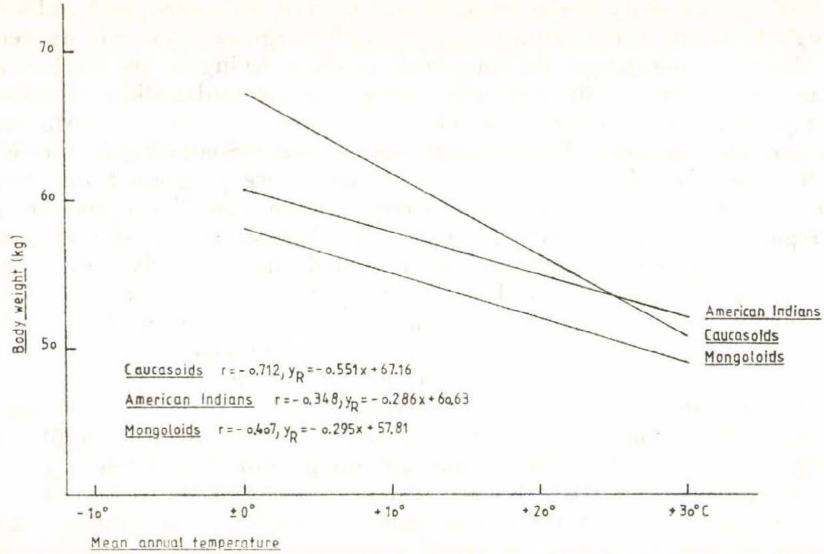

Fig. 7. **Correlation between body weight and mean annual temperature**

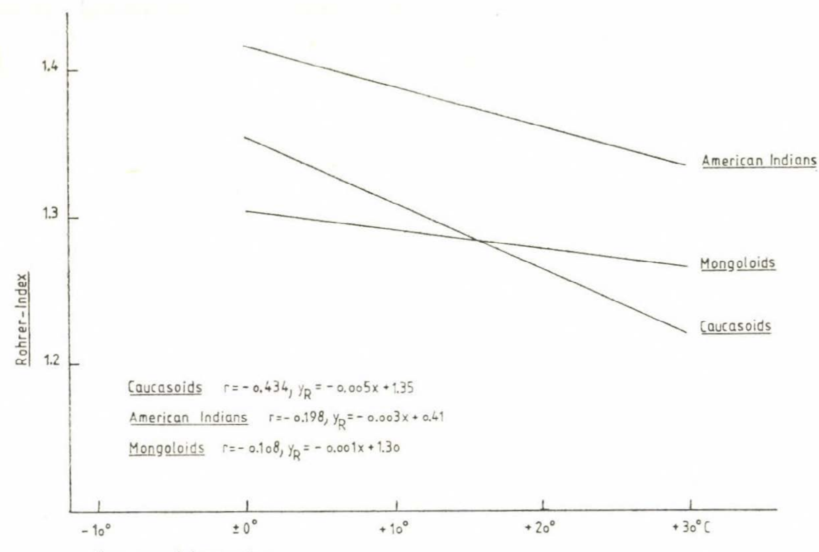

Fig. 8. **Correlation between Rohrer-index and mean annual temperature**

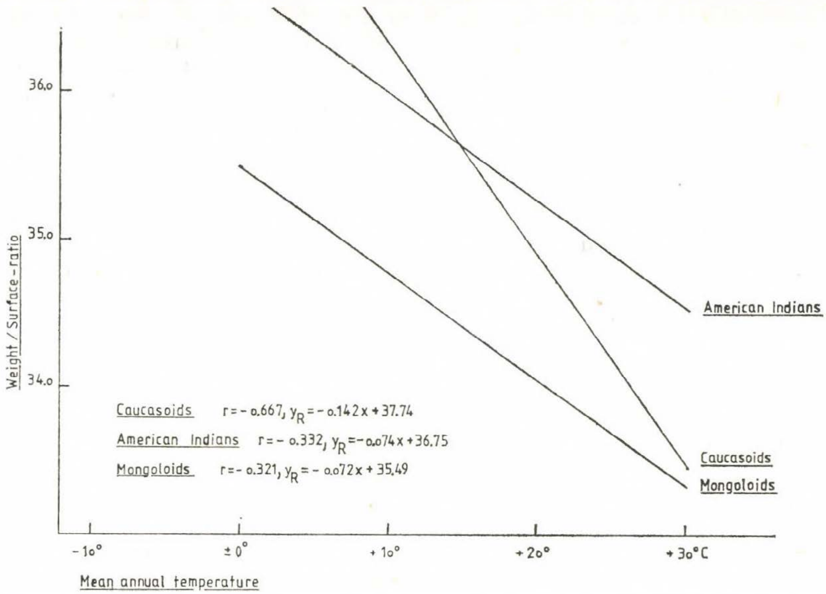

Fig. 9. **Correlation between weight/surface ratio and mean annual temperature**

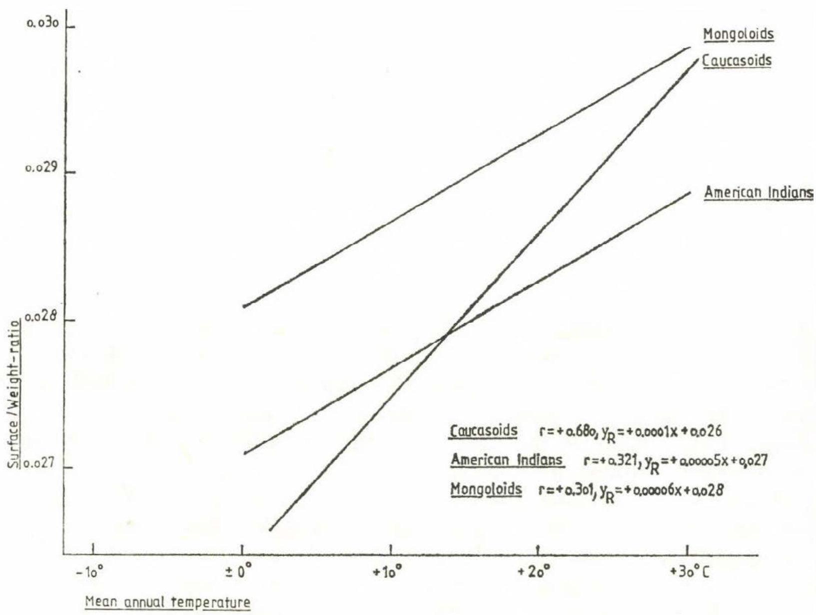

Fig. 10. **Correlation between surface/weight ratio and mean annual temperature**

the climate-related distribution of these somatotypes is supposed to came about in the course of man's evolution via natural selection.

Without doubt, this assumption appears to be plausible. However, is there any reliable evidence for that? None, as far as one can see. It rather has to be doubted considering the following questions:

1. Does the external form of human physique actually play the decisively role with regard to the thermoregulation of the human organism? As far as known up to now, no convincing evidence has ever been presented showing any climatic advantage or disadvantage of any somatotype. It rather has to be assumed that various physiological mechanisms independent from anthropometric factors are actually responsible for thermoregulation in man (and other mammals). This has also been emphasized by RÖHRS (1968), BRIGGS (1975), R. W. NEWMAN (1975b) and STEEGMAN JR. (1975).

2. Are there any indications showing that under specific climatic conditions specific somatotypes would have an effectively selective disadvantage, which must result in higher mortality rates of the non-adapted somatotypes before and during their reproductive phase? This is not the case. And furthermore it must be mentioned in this context that, up to now, all climate-associated variations of anthropometric variables were only seen in males, but never in females (SCHREIDER 1963)! And finally, hitherto no attempt has been made to study climate-associated variations of anthropometric variables on adolescents. R. W. NEWMAN (1975) points out in this connection: "Although a height/weight gradient in children from the tropics to temperate climates is well known, the influence of nutrition is so well established in subadult growth that it would be very difficult to correct for inequalities in nutritional background in a size-temperature comparison. Yet it is the subadult portion of a population that would have to be the prime target of selective pressure through differential mortality. Adult males represent a sample that has largely passed the screening process from a genetic standpoint. The emphasis on the adult surface/mass relationship ignores the fact, that every individual undergoes a remarkable change in its relationship from birth to adulthood. The ratio of surface area to mass changes threefold over this time because the mass increases twenty-fold, while the surface areas increase only sevenfold. Expressed another way, SCHREIDER (1963), who uses the reverse ratio (mass/surface), shows a total average ratio range of nine units from samples with the least mass per area (Bushmen and Semang) to samples with the most mass per area (Germans and Eskimos); this range is the same as that experienced by most individuals, at least in the United States, while maturing from age 2 to adulthood. The change is from a preponderance of surface area (heat adaptation?) to a preponderance of mass (cold adaptation?)". As these changes, without doubt, hold true for all human populations, even the subadult individuals living in cooler climates would be disadvantaged with respect to their thermoregulation, if anthropometric factors would actually be the most important ones. And this would be a biological absurdity.

3. Is it admissible to base the explanation of climate associations of human physique on a strong genetic control of its components as SCHREIDER (1966) does, writing: "The most plausible hypothesis is that these ecological gradients are the produce of natural selection. Nutritional habits cannot explain the gradients if they influence them. The wide differences revealed by the figures do not admit of this interpretation, as many gradients like the average body

mass of the populations are linked in the first place to the very marked variations in average sizes and anatomical proportions, which are largely, if not exclusively, hereditary."? This statement must be questioned, however, as it is known from many investigations that body height, body weight and thus all anthropometric parameters linked with them, are influenced to a not inconsiderable degree by environmental factors of different kind. In this context the secular changes of body height should be mentioned, which could be observed in Europeans (BACKMAN 1948, LENZ 1949, TANNER et al. 1966), in Japanese (SHIMAZONO 1973), and even in Bushmen (TOBIAS 1972). From all these studies it is known that growth and development in man are controlled by a great number of non-genetic factors, among which nutrition and also chronic diseases caused by infectious agents and parasites are playing a major role. How much under- and malnutrition, chronic diseases and especially the permanent combination of these growth disadvantaging factors can influence the whole body development, and how much they even can have "long lasting effects" until adulthood, could be demonstrated evidently by DUBOS et al. (1966).

Considering all these facts, especially those just mentioned, one should suppose an association between human physique and its anthropometric components, respectively, on the one hand, and the total of non-genetic growth controlling factors, on the other hand. Among these factors, without doubt, the daily protein intake is playing an important role. Fig. 11 is showing the world distribution of the average protein intake per capita and day, as it is known from FAO data. Comparing Fig. 11 with Figs 6—10 it becomes evident that populations living in areas with a high protein intake are generally taller, heavier, having also higher Rohrer-indices and higher weight/surface-ratios as compared to those living in areas with a low protein intake. The close

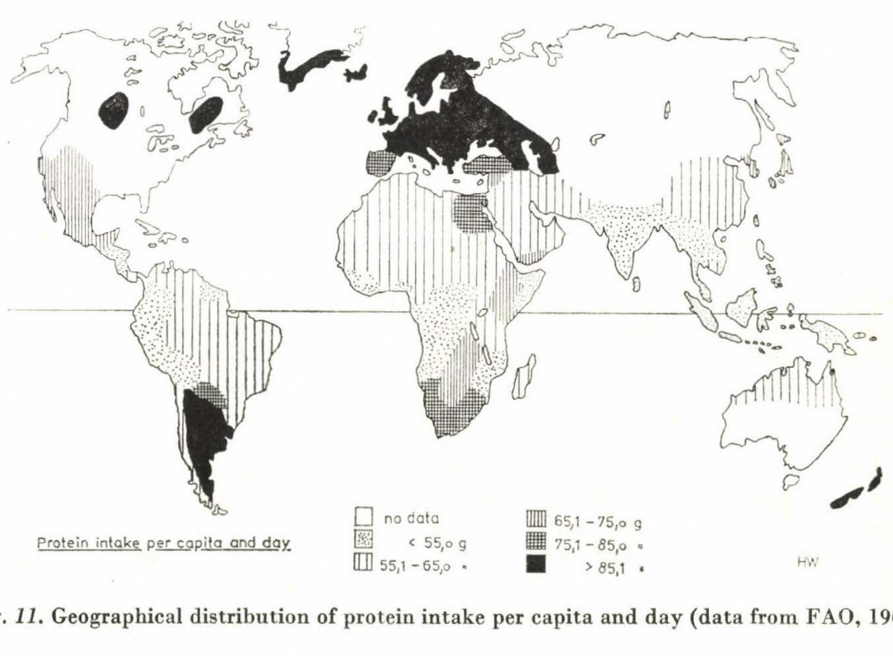

Fig. 11. Geographical distribution of protein intake per capita and day (data from FAO, 1964)

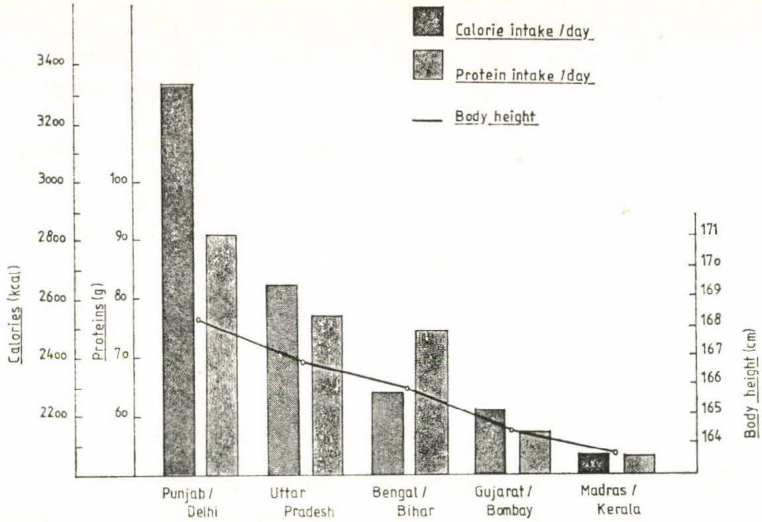

Fig. 12. **Nutrition and body height in India (20 year-old males; data from Malhotra, 1966)**

coherencies between protein and calorie supply and the average body height are also seen from Fig. 12, which is based on data from India. Further examples on the close coherencies between nutrition and anthropometric parameters such as body height and body weight have been given by Malhotra (1966) and M. T. Newman (1975a).

As for the geographic distribution of the aver age protein intake, it is striking that the highest values are generally found in temperate and cool climatic zones, against that the lowest values are mostly seen in the warm and hot zones of the tropics and subtropics. According to Frisch and Revelle (1969) the same geographic distribution pattern is present regarding the caloric supply. Considering now the fact that protein and caloric supply during the human growth period are of high importance for the expression of anthropometric parameters even in adulthood, one can suppose that the climatic associations of body height, body weight as well as that of these parameters derived from them (Rohrer-index, weight/surface-ratio, surface/weight-ratio), are rather indirect ones. That means that these associations are to be seen less as the results of selection processes related to thermoregulation, for which at present no convincing evidence is in hand, but would rather reflect geographic differences in production and consumption of growth-important foodstuffs.

Are hence geographic differences in the distribution of somatotypes consequence of geographic differences in the facilities of production and thus consumption of growth important foodstuffs? And would the anthropometric parameters, in particular body height and body weight, increase on a world-wide scale if a global nutrition improvement would happen as it has been the case in Europe since about 100 years, in Japan since about 50 years, and even in Bushmen since about 1935? Consequently, is it admissible to regard these geographic differences in body height etc. as modification effects, which would say that genetic endowments responsible for growth and development could be realized in part only? Or might it be possible that the prevalence of smaller and lighter samototypes in the tropics and subtropics could be a result of selective adaptation to the chronic shortage of food being met here as compared to other climatic zones, in particular those of temperate climate? Such a hypothesis has been discussed already repeatedly, e.g. by THOMSON (1968) or by MALCOLM (1970). They argued as follows: In populations living for long periods under the conditions of mal- and undernutrition those individuals were in selective advantage who had a small genetic growth potential and hence a presumable small need of food, whereas individuals with a larger genetic growth potential and a consequently greater need of food are supposed to have been in selective disadvantage. Thus gene combinations effecting small and light somatotypes could spread in areas short of food, by which in the course of time climate associated distribution patterns came about. However, up to now, there is no conclusive evidence for such a hypothesis.

Without doubt, it is well a documented fact that anthropometric variables such as body height, body weight, Rohrer-index, weight/surface-ratio and surface/weight-ratio are associated with climatic conditions, in particular with the mean annual temperature. Insofar one can say that the geographic distribution patterns of all these variables are compatible with the so-called *Bergmann rule*. Against that, all attempts to explain these distribution patterns by selection, either via thermoregulation or via adaptation to chronic shortage of food, cannot satisfy, as they are starting from completely unproved assumptions.

After all, it seems that the geographic distributions of body height, body weight, etc. are associated only indirectly with climatic conditions, indirectly insofar as these conditions might be of significant influence on those environmental factors, which are growth advancing or disadvancing, respectively. These factors are quantity and quality of food as well as growth stunting chronic diseases caused by infectious germs or parasites. These are particularly found in tropical and subtropical areas, in which very frequently at the same time persistent shortage of caloric and protein rich foodstuffs is at hand. Hence one can point out, that possibly primarily the total of growth advancing or disadvancing factors, respectively is correlated with climate, whereas the climate associations of anthropometric variables would be of secondary importance, being so to speak indicators for the nature of those non-genetic factors, which are controlling human growth. How far the geographic differences in the distribution of anthropometric variables can be regarded as "long lasting effects" of unfavourable life conditions during childhood and adolescence or at least in part as the results of specific adaptation to chronic mal- or undernutrition, is for the time being not to be decided with certainty. There are at any rate many reasons to believe that the first assumption is more correct, last but not least the considerable increase of the body height among Europeans within the last century, which was without doubt caused by the improvement of the life conditions in particular, however, by the qualitative and quantitative improvement of the nutrition.

Summing up, it is not denied that the anthropometric differences seen among the various human races and populations are also caused by genetic factors. But this — in its extent unknown — genetic portion of these differences must not necessarily be considered as a climate associated genetic adaptation via selection. It is to be supposed that these differences are to a not inconsiderable degree indicators of the total of growth conditions, which vary with the natural environment, but in addition to it also with the socio-economic situation, and this is generally in tropical and subtropical areas much more unfavourable as compared to that in temperate and cooler climates. Further investigations on the geographic and racial distribution of human physique and its components should consider therefore more than hitherto the impact of non-genetic factors for the coming about of these differences.

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SOCIAL CLASS DIFFERENCES IN BODY HEIGHT AND MENARCHEAL AGE IN POST-WAR POLAND

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Abstract: Massive data on body height and menarcheal age, collected by Polish anthropologists between the mid-1950's and late 1970's, yield a picture of marked socio-economic contrasts. Secular changes have been substantial in both characters. Some contrasts in menarcheal age have declined, but no such tendency appears in the data on body height. Clear-cut social gradients exist both within the urban and within the rural population. Attention is drawn to the particularly low position of peasants. Social class differences in nutrition, perhaps also in morbidity, physical work load, and psychological stresses, are probably responsible for the maintanance of social gradients in physical growth. The possibility that such gradients have a genetic component is briefly considered.

Key words: height, menarcheal age, social class differences, nutrition, selective social mobility.

Massive data on school-children and military conscripts, collected by Polish anthropologists in the mid-1950's, mid-1960's, and late 1970's, indicate that social class differences in body size and maturation rate have been marked in Poland throughout the post-war period. In what follows, a summary will be given of the results of several recent studies of social gradients in body height and menarcheal age in Poland; detailed accounts of these findings, with documentation and references, are currently being prepared for publication, or are already in press, in several journals.

1. Body height

An analysis of variation of body height among 13 thousand military conscripts, all born in 1957 and examined in 1976, shows that body height decreases regularly (monotonically) with A. decreasing occupational-educational status of the father, B. decreasing size of the city or town of residence, and C. increasing number of sibs. A three-factor analysis of variance shows that each of these 3 environmental factors has a significant effect on body height after the effects of the other two factors are partialled out. Factor B has the strongest effect, factor A the weakest (though statistically significant). In conscripts who are big-city dwellers, have college-educated fathers, and have no more than one sibling, mean height is 176.6 cm; in rural conscripts whose fathers are farmers and who have 5-or-more sibs, mean height in 170.4 cm. The difference between these two socio-economic extremes is thus 6.2 cm and is equal exactly to 1.0 SD of height in the total sample (BIELICKI, SZCZOTKA and CHAR-

ZEWSKI 1981). The difference would be even larger if the "uppermost stratum" were represented by boys from one-or-two-children families of the Warsaw intelligentsia who in 1978 were found to average 178.5 cm at the age of 18 years (CHARZEWSKI 1981). One of the striking results of the analysis of the material of conscripts is the very low position on the body height scale of rural conscripts from peasant families: even when sibship size is held constant — sons of peasants turn out to be shorter than e.g. sons of small-town semi-skilled manual workers, and shorter even than sons of rural unskilled manual workers. It has been shown by analysis of variance that — in terms of main effects — the condition of being a peasant reduces mean height more than the condition of being a rural dweller, and also more than the condition of being a member of a 6-or-more-children family.

A similar picture emerges from analyses of a sample of 24 thousand school-children examined in 1978. At all age classes from 7 through 18 years, and in both sexes, children from Warsaw, Łódź, and Wrocław (the three largest Polish cities, each with a population of well over 0.5 million) are taller than children from small towns in the ca. 10 thousand inhabitants category, and the latter are taller than their age-mates from villages surrounding these small towns (WALISZKO et al. 1980). What makes the above pattern noteworthy is the fact that the difference in height between small-town children and children from neighbouring villages are of similar magnitude as the corresponding differences between small-town children and their big-city age-mates.

Social class contrasts in height prove greatest at adolescence. At the age of 14 years sons of college-educated fathers from big cities and from one-or-two-children families were, in 1978, on average 11 cm (!) taller than their rural age-mates from peasant families with four-or-more children. The 11 cm difference equals nearly 1.4 SD of height among big-city boys of that age.

Secular increases of body height have been marked in postwar Poland. For the age range 7—18 years such increases were of the order of 2.0—3.0 per dacade during the period between 1955 and 1978. Yet a detailed comparison of the 3 post-war mass surveys of school-children (1955, 1966, and 1978) leads to the surprising conclusion that urban-rural differences in height have shown little or not tendency to decline during that period: in boys at ages 7 through 14 years the differences between big cities and small towns, as well as those between small towns and the countryside were in 1978 somewhat larger than in 1966, and in 1966 they were larger than in 1955, i.e. they have actually increased! (BIELICKI, WELON and WALISZKO 1981). If differences in body height between social groups within an ethnically homogeneous population are any indication at all of unequalities in living standards — then the above findings can be taken as evidence that social policies in post-war Poland have failed to achieve one of their main declared goals, that of reducing the gap in living standards between urban and rural families.

2. Menarcheal age

A similar comparison of the data of the three post-war national surveys suggest that social distances in menarcheal age, unlike those in body height, have shown a tendency to decrease. During the period 1955—1978 mean age at menarche declined from 14.3 to 13.4 years in rural girls, from 13.9 to 13.2 years in small-town girls, and from 13.4 to 12.8 years in big-city girls. However, urban-rural differences are still marked; rural girls in 1978 had a mean (13.4) years which big-city girls had already attained in the mid-1950's; rural girls from Suwalszczyzna (North-East Poland), examined in 1978, had a mean of 13.7 years, almost a year above the 1978 Warsaw mean (ŁASKA—MIERZEJEWSKA 1981).

Clear-cut social gradients in menarcheal age exist in Poland among urban and among rural girls. In two studies carried out in 5 counties in 1968 and again in 1978 a consistent pattern emerged: menarche was earliest in daughters of rural non-farmers, intermediate in daughters of "part-time farmers" (men who combine small-scale farming with a salaried job in industry) and lowest in daughters of full-time farmers (peasants); it is important to note that this order of means persists also when father's education and number of sibs are held constant (ŁASKA—MIERZEJEWSKA 1971, and unpublished data). Thus, the more a rural family relies on farming as a source of income — the more delayed the daughters' sexual maturation!

Studies of menarcheal age carried out in two Polish cities, Warsaw, and Wrocław (population 1.5 and 0.6 million, respectively), collected in 1966 and again in 1976 (sample size ca. 6000 school-girls in each case) show a typical increase of mean ages with decreasing occupational and educational status of parents, and with increasing family size (MILICEROWA 1968, WALISZKO, unpublished). Both cities have shown the same amount of secular change during that decade: in Warsaw the general mean declined from 13.0 to 12.8, and in Wrocław from 13.2 to 13.0, so that the difference between the two populations has not changed. However, some contrasts seem to have declined since the mid 1960's. E.g. in Warsaw in 1976 no difference was found in menarcheal age of daughters between college-educated and high-school-educated parents (MILICEROWA and PIECHACZEK, unpublished). In Wrocław during the 1966—1976 decade menarcheal age decreased, generally speaking, more in the lower than in the upper social groups; the result, again, was some attenuation of social contrasts. E.g., in the group "both parents unskilled manual workers" the mean declined from 13.5 to 13.0 years, in the group "both parent not more than elementary education plus basic vocational school" it declined from 13.3 to 13.0 years, while in the group "father high-school or college education" the mean (12.9 years) has not changed (BIELICKI, WELON and WALISZKO 1981).

Discussion

It is evident that none of the "factors" in terms of which anthropologists usually describe socio-economic stratification, and which have been shown to have a statistical effect on body size or maturation rate — i.e. neither the educational or occupational status of parents, nor family size, nor the degree of urbanization of the place of residence, nor even annual income per member of household — can affect physical growth directly. Rather, such "factors" must be viewed as influencing growth via some other environmental stimuli with which the factors are correlated. Four types of such stimuli can be considered: nutrition, disease, physical work load, and growth-influencing psychological stresses. Of these, by far the best documented is the role of nutrition; and though socio-economic stratification in Poland (as in many other countries) probably involves differences in all four aspects of the child's environment, it is possible that the existence of social gradients in body size and maturation rate is ultimately due primarily to differences in nutrition. E.g., rural children in Poland often participate in work on the farm, and often have to walk several kilometers to school, so that their average work load is probably significantly greater than that of their urban age-mates; however, there is no evidence that intense physical work can affect growth independently of nutrition, e.g. that it can stunt growth or delay menarche in *adequately nourished* children.

Data on social class differences in nutrition in Poland are not extensive. Official statistics published in the 1970's by G.U.S., the Central Statistical Office, and based on analyses of family budgets in a stratified sample of ca. 8000 households , indicate that per capita consumption of food items which are principal sources of animal protein, calcium, and vitamins (meat, eggs, butter, cheese, fruits, and vegetables) decreases markedly with decreasing annual income per person in the household and with increasing number of persons in the household. Also, the system of food distribution has consistently favoured the big cities over medium and small towns; e.g., it has recently been disclosed that during the second half of the 1970's the 8 largest urban centers, accounting for a little over 20 per cent of the population of Poland, were receiving as much as 50 percent of the total meat supply distributed by the government for domestic consumption. The above facts seem to support the presumption that such factors as parental education and occupational status, number of siblings, and degree of urbanization influence growth to a large extent via nutrition. On the other hand, analyses of the G.U.S. data fail to show any inferiority of peasant households compared to households of salaried workers with regard to per capita consumption of the most valuable food items; in fact, one of the recent studies indicates that during the period 1973–1976 average daily per capita intake of animal protein, plant protein, carbohydrates, calcium, iron, and vitamins A, B_1, B_2, and C was for each of these nutrients actually *higher* in peasant households than in households of salaried workers (SEKUŁA et al. 1980). This result is intriguing; if the shorter stature and delayed maturation of peasant children and youth is *not* caused by poorer nutrition — then by what is it caused?

It should be stressed that the population of post-war Poland (unlike that of pre-war Poland) is ethnically highly homogeneous, with practically no racial, linguistic or religious minorites. It seems therefore logical to assume that the above-described social gradients in body size and maturation rate are a result of inequalities in living conditions rather than a reflection of inter-group genetic differences resulting from some association between socio-economic status and ethnic origin. However, the possibility cannot be discarded a priori that some of the observed social class differences do have a genetic component: it should be kept in mind that genetic differences between social classes can arise, and be maintained, even in an ethnically homogeneous society — for example as a result of *selective social mobility*. If e.g., tall individuals were for some reason more likely than short ones to move upward on the socio-economic scale, or more likely to migrate from villages to cities, then the observed social gradients in stature, or the urban-rural differences in stature, might in part be genetic rather than purely phenotypic. A few studies carried out in Scotland, West Germany, Belgium, and Poland suggest that body height in those populations may indeed be subject to this sort of selection. It is tempting to try to interprete in terms of this hypothesis the above-noted fact that in post-war Poland social class distances in menarcheal age seem to have declined, whereas analogous distances in body height have not. Perhaps maturation rate, a "transient" and "less visible" phenotypic character of an individual, is neutral from the point of view social selection whereas height is not; hence class differences in menarcheal age are "free to decline" in response to a reduction of economic contrasts within the society, whereas a similar tendency in body height is counteracted by selective social mobility.

The possibility of differential social mobility of certain genotypes is *not* proposed here as an alternative explanation of the existence of social class differences in growth. It remains the present writer's conviction that if "genetics" (in the above sense) plays any role at all in the emergence and maintenance of social gradients in body size and maturation rate, its role is of minor importance as compared with the role of the "plastic response" of the growing organism to certain kinds of environmental pressures. That is the gradients described in the present paper are primarily (perhaps exclusively) "economic" in origin: they are direct consequences of the fact that environments provided to children by families belonging to different socio-economic strata differ markedly in the degree to which such environments inhibit the full realization of the genetically programmed "growth potential" of a child. To use J. M. TANNER's expression (TANNER 1978, p. 114) — data on children's growth can serve as an excellent, quantitative measure of *classlessness* of a society. Viewed in this perspective, Poland — unlike, for example, Norway or Sweden — appears to be still very far from the "classless" condition.

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GROWTH IN DUTCH CARAVAN-CAMP CHILDREN*

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Abstract: One of the minority groups in The Netherlands consists of Dutch caravan-camp dwellers. Part of them stays more or less permanently on one caravan camp, others prefer to wander around from one camp to the other. Recently, their primitive dog-carts, horse-carts, and tilt-cars are exchanged for — often rather well-equipped — living-wagons and caravans. Yet, the overall hygienic and nutritional conditions clearly lag behind the average Dutch standards.

During 1978—1980 anthropometric data were collected to evaluate the health conditions of about 400 caravan-camp children of Dutch origin of 3—15 years of age. Their height and weight for height were compared with national Dutch growth standards. The caravan-camp children have proved to be significantly smaller, yet heavier than the average of Dutch children. Improvement of the overall camp environment should be further stimulated.

Key words: Caravan-camp children, Dutch children, height, weight for height.

Introduction

In 1975 in The Netherlands 20 000 Dutch caravan-dwellers were living on about 170 centra and camps (VERNOOY 1977). These are frequented exclusively by these caravan-dwellers and, incidentally, small groups of authentic gypsies and have not to be confused with tourist camping sites. Part of the caravan-dwellers stays more or less permanently on one caravan-area, others prefer to wander around from one camp to the other. The history of the caravan-dwellers of Dutch origin — who like to name themselves "travellers"— dates back to generations of rambling ancestors. At first, during their rambling around they spent the night in barns or cheap taverns. In the second half of the former century and the beginning of this century the "travellers" started to get their own means of transport, like dog-carts and horse-carts, also used for passing the night. Later, they used covered wagons, while nowadays they possess — often rather well equipped — caravans. In former days the contact with the rest of the society was good; the "travellers" were appreciated for bringing the latest news from other villages. When they did not longer nightly mix among other citizens, they lost more and more contact with their countrymen with fixed abode. Today, they are rather distrustful towards civil society.

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The occupation of male caravan-dwellers used to be pedlar, hawker, chair-mender, tinker, or scissors-grinder. At present, they often claim to be merchant, i.e. in most cases scarp-iron or junk-dealer; their camps — mostly situated at the outskirts of town — can be recognized from a distance by huge piles of old cars. Part of them used to work as a peat digger, while nowadays small part of them work as casual labourers on farms or factories. Others are musicians. Especially during summer, they like to travel to surrounding countries to play at fairs and festivities. Many of the caravan-dwellers are unemployed or rejected for labour as medical unfit.

Because of the deviating lifestyle of the caravan-dwellers, also resulting in different attitudes towards hygiene and diet, they can be considered as a separate sub-population of the Dutch nation.

Children of caravan-dwellers grow up under comparatively unfavourable conditions as compared with other Dutch children. Prenatal care leaves much to be desired; often the pregnant mother only consults a district-nurse just before delivery. Child mortality is higher than in the rest of the country. Though at present almost all children in the camps get the usual vaccinations, it is hard to instruct the mostly suspicious and often illiterate mothers. Infants, toddlers and schoolchildren often have alimentary disorders, and a high percentage suffers from asthma and bronchitis. These facts have been mentioned in reports concerning the status of health of this minority-group, but so far are not yet quantitatively evaluated.

For some time volunteers, mostly priests, tried to improve the conditions in the camps. Later, civil servants of the government started health care among the caravan-dwellers. At present, in the larger centres water-supply and sewage are provided for, while there is a building with room for a health clinic for infants and toddlers. Often, there is a small school, visited by the school doctor for inspection of the children according to the schedule that applies for all Dutch children of school age. School doctors included reports on their experiences with caravan children in their yearly reports, but until now no national survey was performed. It was thus considered a good opportunity to collect data on children of the above described sub-population during the third nation-wide Dutch survey on growth.

Methods

During the third nation-wide biometric survey in The Netherlands (1980) data on height and weight of about 40 000 boys and girls of 0—19 years of age were collected. The actual measuring and registration was done by teams of health clinics and school doctors during their regular inspection of the children. Through personal visits to all cooperating teams strict instructions about measuring techniques were given, and the measuring instruments verified. A small number of school doctors proved to be in the position to gather as well measurements of caravan children. Thus, data on 201 boys and 199 girls, 3—15 years of age, from 11 camps spread all over the country could be collected. The material did include some children of non-Dutch origin, mainly gypsies, but these have been excluded from the analyses.

Height was noted down in centimeters and millimeters, weight in kilograms and hectograms. It is the intention to compare the Dutch caravan children with their simultaneously measured counterparts. However, while preparing this paper, the final results of the recent nation-wide survey on growth were not yet available. Hence, it was decided to compare the Dutch caravan children with the results of the second nation-wide survey on growth of 1965 (VAN WIERINGEN 1972). This study was performed according a similar layout as the one of 1980. For each caravan child its standard deviation score (SDS = (attained height — mean height)/standard deviation was calculated, mean height and standard deviation being the 1965 values for each particular age. Moreover, for each child weight for height was calculated, expressed as percentage of the Dutch median values of weight for height of 1965.

Results

Height. As standard deviation scores are independent of sex the SD-scores of boys and girls were combined. Per age group the average SD-score and its standard deviation are given in Table 1. Table 1 shows that at all ages the caravan children have negative SDS values, thus being smaller than the average height of their Dutch contemporaries of 1965. Preliminary results of the nation-wide survey of 1980 indicate that for both boys and girls at subsequent ages the standard deviations do not differ from those of 1965, while the mean values of height of 1980 positively deviate from the 1965 values. The increase of height being roughly about half a cm for both boys and girls at the age of five, about 2 cm in boys and 3 cm in girls at the age of ten, and about 3 and 2 cm, respectively, at the age of fifteen. This leads to the conclusion that the caravan children will prove to be even smaller, when compared with their contemporaries measured in the same period around 1980.

Table 1

Standard deviation scores ($\bar{x}$ and s.d.) (height) in caravancamp-children in 1980, as compared to Dutch P50 values of 1965

Age in years	N	s. d. score	
		$\bar{x}$	s. d.
3	13	−1.02	0.82
4	14	−0.69	0.96
5	35	−0.47	1.00
6	37	−0.77	0.75
7	34	−0.30	1.15
8	48	−0.35	0.88
9	54	−0.54	1.03
10	50	−0.36	0.87
11	47	−0.23	1.17
12	30	−0.21	1.54
13	18	−0.37	1.43
14	4	−0.16	—
15	3	−1.70	—

Weight for height. Of the caravan boys 61.2 per cent and of the caravan girls 70.3 per cent proved to have a weight for height value above the median

Table 2

Weight for Height % ($\bar{x}$ and s.d.) in caravancamp-children in 1980, as compared to Dutch P50 W/H — values of 1965

Camp	♂ ♂			♀ ♀		
	N	$\bar{x}$	s. d.	N	x	s. d .
A	26	106.6	17.2	29	111.2	18.2
B	12	125.5	36.0	19	119.6	21.6
C	31	101.2	7.8	43	105.5	10.5
D	26	105.1	14.2	18	113.7	15.8
E	14	102.7	9.3	8	98.5	8.7
F	13	106.6	11.2	15	110.3	13.5
G	9	103.7	18.3	14	112.1	12.1
H	19	106.7	9.9	11	104.9	13.9
I	30	111.5	15.0	20	102.5	11.2
J	20	105.0	18.4	20	104.4	24.6

of 1965. In Table 2 per camp the mean weight for height percentage and its standard deviation are listed. This Table shows that on the average both caravan boys and girls surpass the 1965 values. In camp B extra high values were found. On the registration card the doctor was asked for his subjective impression of stature and weight of the child in terms of small, average, or tall, and thin, average, or fat, respectively. For camp B supplementary remarks were given such as "adipositas", "incredible fat", or "remitted for diet instructions". This makes it reasonable that in most cases the overweight of the caravan children is due to a surplus of fat.

A nation-wide survey on eight years old schoolchildren (DE WIJN *et al.* 1979) and the Nymegen Growth Study on 4—14 years old ones (ROEDE 1979) reported that since 1965 there hardly has been an increase in weight in Dutch children. Support for this phenomenon is given by preliminary results of the nation-wide survey on growth of 1980. On the average the Dutch child became taller but more slender. Accordingly, it may be expected that when the caravan children will be compared with the final weight for height standards of 1980, they will be found to be even more heavy than their contemporaries, measured in the same period of time. In this respect children of caravan dwellers with their in many ways deviating life-style resemble most children of the lowest social groups of their countrymen with fixed abode. At present in The Netherlands these have overweight, according to skinfold measurements, due to fat (DE WIJN *et al.* 1979).

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SEASONAL VARIATIONS IN CHILDREN'S WEIGHT GROWTH RATES

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Abstract: The growth rates of 1583 children in 8 day care centers in Paris weighed from 1 to 4 times every months were analyzed for the presence of seasonal patterns.

In the age range 3—36 months there are seasonal variations of weight velocities for both sexes which at least partly may be accounted for by the patterns of the children's attendance at the centers.

Regardless of seasons boys but not girls show an acceleration of weight in their third year.

Key words: Seasonal variations, weight growth rates.

Introduction

Seasonal variations in growth rates have been reported in West European children For example Bransby (1945) observed that children grew faster in stature during spring than during autumn and winter. Marshall (1975) however found maximum mean growth rates to occur at midwinter. Few researchers have included age in the analysis of seasonal patterns of growth. Since findings are conflicting and sufficient data on the interaction of age and seasons lacking the present study was carried out to investigate the effects of seasons on the change of growth velocity in children at different ages.

Subjects and Methods

Health surveillance in day care centers includes routine weighing of children by trained nurses. For this study, four day care centers in Paris, located in the 11th, 13th, 14th an 17th wards were selected where access to the weight records was provided to us from the opening day of these centers. Children from age 1 month up to 40 months are enrolled on the basis of availability of places so that the age of entering and leaving the centers varies as well as the length of stay: Thus the data are typically mixed longitudinal and involve 1583 children (844 boys and 739 girls). On a regular schedule, the children are weighed without clothes in the morning upon their arrival. Weights are noted and filed in the medical records. The demographic elements of the Paris day care centers (PDC) growth data are shown in Table 1.

Table 1

Demographic features of the PDC data

	Number of children enrolled in day care center					Mean age (months)		Mean duration (months)	
	1	2	3	4*	all	entering	leaving	stay	between 2 weighings
Boys	288	247	232	77	844	9.63	26.38	17.00	0.61
Girls	232	216	204	87	739	9.07	26.21	17.35	0.59
all	520	463	436	164	1583				

Day care center	1	2	3	4
Years of data recording	1961—77	46—77	61—77	62—79

* Due to technical problems not all children from this day care center are included

Let $a(t)$ denote the age of a child at the calendar time t. Weight velocity $v_{a(t)}$ at age a and time t is computed as the rate of weight change

$$v_{a(t)} = \frac{w_{a(t+1)} - w_{a(t)}}{a(t+1) - a(t)}$$

where $w_{a(t)}$ is the weight at age $a(t)$.

Thus $a(t)$ is classified into seasons and 8 age classes of 3 months length each centered at 3, 6, 9, 12, 18, 24, 30 and 36 months. In each age class mean weight velocity is computed for each season and ranks are allocated to seasons in increasing order of mean velocities. We test the null hypothesis of no seasonality of weight velocity in the whole age range 3—36 months by using Kendall's coefficient of concordance of the rankings of seasons at all ages.

Results

In Table 2, the 3-monthly means of weight velocities are given with their standard errors for successive ages. The number of measurements presents a mode at age 18 months and is consistently the lowest in summer due to the one-month vacations taken by the children. Changes in velocity are perhaps better expounded by graphics. Figure 1 shows the mean weight velocities for the four seasons for boys and girls separately. Figure 2 expresses the difference between boys and girls in growth velocities at each season.

Boys show a constant decrease in weight growth velocity until age 24 months in winter and summer and age 30 months in spring and autumn followed by an increase afterwards. Weight growth velocity in girls decrease constantly in the studied age range 3—36 months.

Except in summer, boys grow faster than girls before age 12 months, drop to a lower growth rate until age 30 months and catch up again at 36 months. At age 3 months weight velocity in summer is lower for boys than for girls

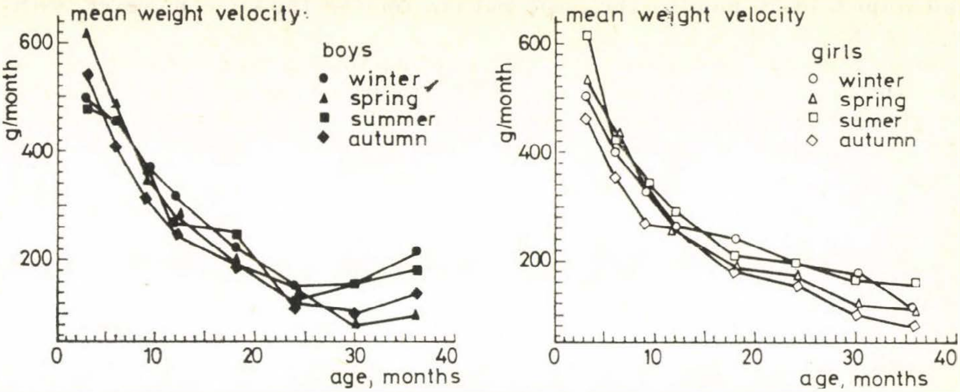

Fig. 1. **3-monthly mean weight velocities for the four seasons. 1/a: Weight velocity for boys, 3-monthly means plotted at successive ages; 1/b: Weight velocity for girls, 3-monthly means plotted at successive ages**

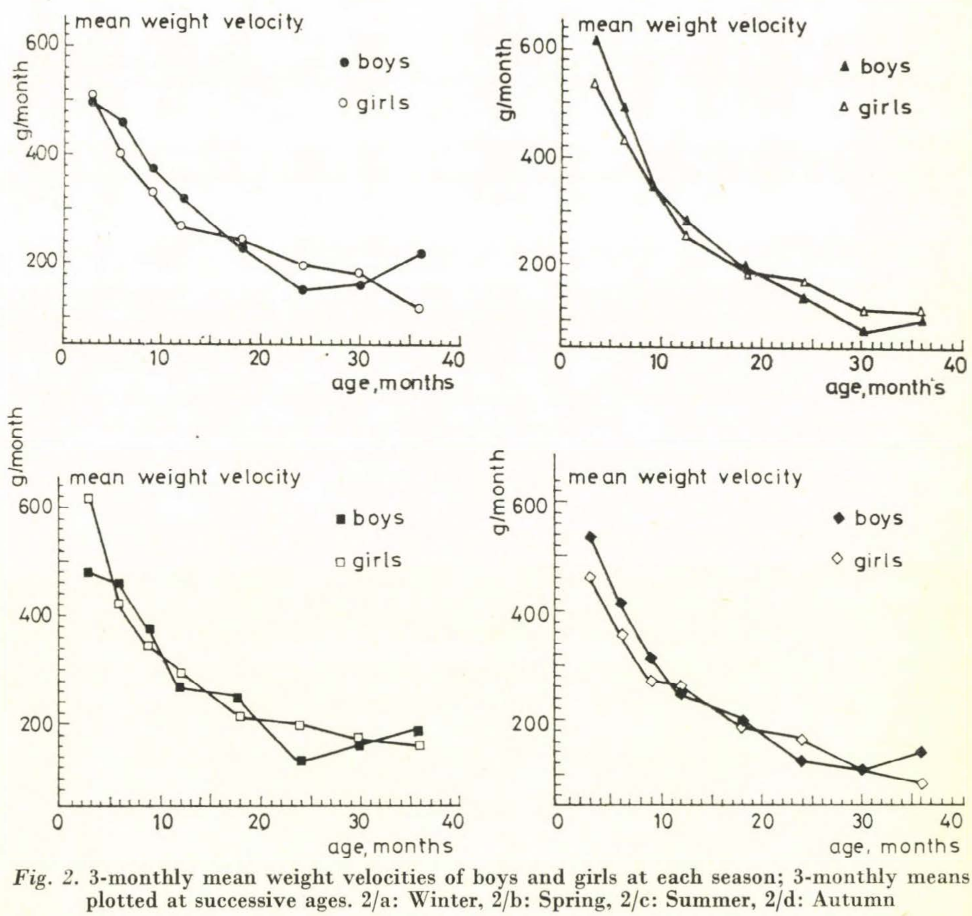

Fig. 2. **3-monthly mean weight velocities of boys and girls at each season; 3-monthly means plotted at successive ages. 2/a: Winter, 2/b: Spring, 2/c: Summer, 2/d: Autumn**

and from 6 to 36 months the basic pattern remains the same, however, with greater irregularity.

Mean velocities are more dispersed in spring than in other seasons. Mean velocities in spring spread on the range 81—621 g/mo for boys and 114—536 g/mo for girls while the next largest range is 99—537 g/mo for boys and 156—618 g/mo for girls in summer. (Compare also Figure 2 to Figures 1—3—4 in Table 3).

Table 2

Weight velocities, PDC data

Age Months		Winter			Spring			Summer			Autumn		
		N	Mean	SE	N	Mean	SE	N	Mean	SE	N	Mean	SE
		G/MO											
BOYS	3	217	495	37	248	621	39	150	480	79	163	537	58
	6	646	456	34	836	489	34	581	456	22	767	411	11
	9	778	369	21	782	351	17	613	372	12	933	312	22
	12	830	318	28	789	270	23	601	279	26	864	246	20
	18	1255	225	17	1366	195	15	953	243	23	1243	195	19
	24	848	150	15	795	147	14	549	126	15	900	120	13
	30	764	156	15	735	81	30	430	159	23	724	99	23
	36	475	216	15	505	102	25	278	183	27	459	138	23
GIRLS	3	208	504	35	272	537	35	181	618	73	145	462	35
	6	640	399	25	882	435	20	569	423	30	766	354	35
	9	775	327	17	737	345	19	592	342	29	770	267	19
	12	881	258	18	788	264	25	476	291	25	838	258	21
	18	1202	240	23	1249	189	18	864	210	18	1111	183	17
	24	774	195	21	794	117	16	475	165	17	691	102	21
	30	700	177	21	642	117	16	475	165	17	691	102	21
	36	499	114	20	476	114	19	217	156	24	356	78	15

There is a significant agreement in the ranking of seasons at all ages for both boys ($W = .61$, $p < .001$) and girls ($W = .68$, $p < .001$). Based on the statistics of the sums of ranks, estimates of the true ranking of winter, spring, summer and autumn in this order are also given in Table 3. In increasing order of mean weight velocities they are (4, 2, 3, 1) for boys and (2.5, 2.5, 4,1) for girls. For the latter, the estimated ranks of winter and spring are tied and given the midvalue 2.5.

Table 3

Coefficients of coherence and ranks estimates

	W	P	Seasons sequence	Estimate of the true ranking
Boys	.61	<.001	(W, Sp, Sm, A)	(4, 2, 3, 1)
Girls	.68	<.001	(W, Sp, Sm, A)	(2.5, 2.5, 4, 1)

W: Winter, Sp: Spring, Sm: Summer, A: Autumn
1: Slowest growth, 4: fastest growth

Discussion

BACKMAN (1934) suggested that the "infantile growth" reached its peak velocity in the third year. The question of the existence of "waves" of growth realized as successive growth spurts is still an open one. Except for the relatively well documented adolescent peak velocity phenomenon and the less well investigated mid growth spurt at about 7 years, other spurts are of a more speculative nature since "hard" data are lacking to document their existence. Backman's study dealt only with heights in boys. With an acceleration of weight growth in boys but not girls in the age range 30—36 months, our PDC data support BACKMAN's claim.

MARSHALL (1975) reported that children reached their maximum growth rate in mid-winter. From 3 to 30 months, the PDC children weight velocities show seasonal variations with particularly maxima occurring in autumn and high values in summer. An alternative explanation for this seasonality may be that during the one-month vacation in summer children experience different conditions including a full time care by their parents. They resume their attendance at the centers in autumn.

That boys gain weight the fastest in winter may also just well be a rebound after the relative deceleration in autumn. Such an interpretation does not at least contradict another consistent finding about the greater susceptibility to environmental influences in boys than in girls. This argument stands also to account partly for the irregularity for boys mean velocities in summer and their low summer rate of weight growth at age 3 months.

According to some authors including DÁLEN (1975), season of birth exerts an influence on health. The greater dispersion of mean weight velocities in spring suggests an interaction with the season of birth since children born in winter attain age 3 months in spring. Further investigation on an eventual interaction between the season of birth and the season of growth will be carried.

The observations reported in this paper lead to the conclusion that in the interpretation of seasonality of growth, besides light and atmospheric variations (MARSHALL 1975), attention should also be given to the seasonal rhythmicity of the living.

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THE INDICES OF THE PHYSIQUE AND THE SOCIO-ECONOMIC FACTORS BASED ON A GROWTH STUDY IN BAKONY GIRLS

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Abstract: The author examined the connection between three components of the somatotypes of 1313 10—14 years old girls — determined with *Heath—Carter's method*—as indices of the physique and the socio-economic status. When characterizing that status, she founded herself on the father's profession, on the size of the family, on the number of siblings and on the earnings per capita.

The results of her monofactorial examination show that the socio-economic factors have a rather significant part in the manifestation of linearity. Between the components of fatness serving for characterizing endomorphy and the size of the family, as well as the number of siblings a negative, between the said component and the earnings per capita a positive correlation could be demonstrated. On the other hand, with the daughters of fathers of an intellectual profession endomorphy was less marked than with the ones of physical workers. The IInd component of the somatotype, the characteristic of robustness of the bones and muscles did not display significant differences on the various social levels.

Key words: Physique, somatotype, socio-economic factors influencing growth, father's profession, size of the family, number of siblings, earnings per capita.

There are many factors that exert an influence on the pace of development. The hereditary components influence physiological maturation from early youth on, on the other hand, the effect of the environmental factors upon development is more dynamic in compliance with the changes in the environment (TANNER 1955, JOHNSTON et al. 1980). The effect of the physique — as of a quality determined in high measure hereditarily — on physiological maturation was examined by numerous researchers, and they unambiguously demonstrated a relationship between the two (ROBERTS 1969, KRALJ—ČERČEK 1956, BODZSÁR 1975, BORMS et al. 1977). At the same time, several examinations called attention to the important part played by one of the groups of the environmental factors, by the socio-economic ones in the attainment of an optimum development (KRALJ—ČERČEK 1956, BODZSÁR 1975, EIBEN 1972). Naturally, the direct effect of the factors influencing development is rather difficult to demonstrate on account of the multidirectional interferences of the various external and internal elements. For example, physique as a qualitative property is in fact greatly determined genetically, however, the environmental factors contribute in a quite considerable degree to its phenotypical formation. Founded upon the trends of the various measurements and upon those of their interrelations to one another the manifestation of physique can be followed.

The question arises whether the development of the components determining the physique is affected by the socio-economic factors in an identical measure.

In the present paper the author intends to report the results of her examinations on the relationship between the three components of physique as determined HEATH and CARTER's anthropometric somatotyping method (CARTER 1975), and the socio-economic factors.

Material and Methods

In 1978 we conducted a more detailed anthropological survey of the growth of 7—14 year old children in one of the ethnic regions of Hungary, in the Bakony Hills. To this surveyed sample belonged those 1313 girls of 10—14 years of age among whom we examined the relationship between the three components of the somatotype each as an index of physique (the Ist component is the index of fatness and fullness, respectively, the IInd one that of the robusticity of the bones and muscles, the IIIrd one that of linearity) and the social factors. The socio-economic status was characterized by the fathers' occupation, by the size of the families, by the number of siblings and by the earnings per capita.

The indices of the physique of the girls living on different social levels but being of the same age were compared by means of *Student-Fischer's t-test.*

Results and Discussion

According to the *occupation of the fathers* we distinguished three groups: the intellectuals, the physical workers, and the one not be to be ranged with in these two categories. The girls belonging into the latter mentioned category were not taken into consideration further on. The mean values of the Ist component are in each group lower among the children of the intellectual workers (Table 1). The development of the bones and muscles of daughters of the intellectual workers falls behind that of those of physical workers, but the difference is not significant. On the other hand, as regards the component

Table 1

Somatotype components of the Bakony girls according to their father's occupation

Age group (years)	Ist component				IInd component				IIIrd component			
	intellectual workers		physical workers		intellectual workers		physical workers		intellectual workers		physical workers	
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
10	3.59	1.17	4.21	1.84	3.67	1.97	3.42	2.01	3.77	2.17	3.42	2.30
11	3.16	1.24	3.58	1.61	3.48	2.01	3.60	2.14	3.98	2.08	3.68	1.97
12	3.19	1.47	3.52	2.00	3.35	1.87	3.35	1.95	4.56	2.40	3.55	2.70
13	4.09	2.01	4.56	2.17	3.40	1.97	3.47	2.07	3.85	2.19	3.47	2.40
14	3.84	1.61	3.89	1.84	3.19	2.01	3.31	2.12	4.18	2.30	3.55	2.12

Table 2

Somatotype components of the Bakony girls according to number of their siblings

Age group (years)	First group		Second group		Third group	
	according to number of siblings					
	x	s	$\bar{x}$	s	$\bar{x}$	s
			Ist component			
10	3.17	2.10	2.98	1.42	2.95	1.97
11	3.62	1.87	2.87	1.92	2.84	1.64
12	4.00	1.97	3.45	1.65	3.20	2.10
13	4.49	2.01	3.88	1.83	3.21	1.98
14	4.23	2.50	3.99	1.17	3.31	1.40
			IInd component			
10	3.19	1.17	3.65	1.30	3.44	1.40
11	3.44	1.82	3.74	1.99	3.50	1.87
12	3.39	1.64	3.43	2.10	3.41	2.40
13	3.37	1.91	3.56	1.87	3.41	1.98
14	3.02	1.42	3.41	1.68	3.35	2.01
			IIIrd component			
10	3.98	2.17	3.55	1.88	3.50	1.77
11	4.21	2.71	3.61	2.23	3.10	1.94
12	4.19	2.40	3.58	1.91	3.19	1.87
13	3.70	1.98	3.36	2.11	3.29	2.00
14	3.63	2.01	3.58	2.03	3.31	2.11

of fatness, the daughters of the physical workers significantly surpass those of the intellectual workers, excepting the 14 year old age-group. Similarly, the difference between the mean values of the IIIrd component is significant in each age-group. Based on these we can say that, considering their stature, the daughters of the physical workers are heavier, their skeleton are broader and their muscles are thicker.

According to the *number of siblings* and the *size of the family* we separated our sample into three groups. As to the number of siblings we ranged with the first group the girls who had no and/or only one sibling, the second group was formed by those who had two, and the third one by those who had three or more sisters and/or brothers. According to the number of the members of the families we distinguished among girls who lived in families of 4, 5, 6 or more members.

When comparing the groups by the number of siblings and the size of the families a similar tendency can be observed (Table 2, 3). The mean values of the fatness component decrease with the growth in the number of the siblings and/or members of the family. The difference in the number of siblings between the Ist and IInd groups is significant at the ages of 11, 12 and 13 years, that between the IInd and IIIrd ones at the ages of 13 and 14 years. The mean values of the Ist component of physique of the girls living in families of 4 and/or 5 members are significant in the 12, 13 and 14 year-old age-groups. Although in none of the age-groups the difference between the second and

Table 3

Somatotype components of the Bakony girls according to size of the family

Age group (years)	First group		Second group		Third group	
	according to size of the family					
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
			Ist component			
10	3.27	1.70	3.08	1.60	2.95	1.67
11	3.42	1.73	3.17	1.74	3.10	1.58
12	3.70	1.90	3.25	1.11	3.15	1.41
13	3.81	1.87	3.30	1.47	3.17	1.80
14	4.18	2.40	3.60	1.67	3.31	1.91
			IInd component			
10	3.25	1.17	3.34	1.30	3.55	1.40
11	3.34	1.82	3.47	1.99	3.68	1.87
12	3.39	1.64	3.43	1.87	3.47	1.72
13	3.37	1.42	3.56	1.24	3.58	1.65
14	3.42	1.58	3.78	1.77	3.80	1.90
			IIIrd component			
10	3.97	2.11	3.60	1.97	3.30	1.77
11	4.19	2.41	3.61	1.88	3.09	1.99
12	4.21	2.27	3.59	2.01	3.01	2.13
13	3.80	1.49	3.26	1.58	3.20	1.69
14	3.73	1.67	3.49	1.79	3.31	1.52

third groups according to the size of the families was significant, with increase in number of the members of the families the component of endomorphy displays a decreasing value.

In the robusticity of the bones and muscles there is not significant difference among the groups separated according to the number of siblings and to the size of the families. With an increase in number of the members of the families a minimal growth in the mean values of the index of robusticity can be demonstrated. Out of the three groups separated according to the number of siblings, the development of the bones and muscles of those who have two siblings is the most marked. The mean values of the first groups, representing those living in a so-called "better social milieu" are the lowest.

The decrease of the ratio index with the growth in number of siblings and members of the families, respectively, can be clearly proved. The smaller the number of members of the family (1 child or 2 children) the more linear is the build of the girl's body, ti weighs less as compared to her stature.

On the average, all the three components of physique of the groups separated according to the income per capita display higher values than those of the daughters of families of higher income (Table 4). In the indices of endomorphy and ectomorphy these differences are significant, — in the index of robusticity, although statistically the differences are not significant, if expressed in absolute values the means by age-groups are the lowest in the worst social group.

Summing up the results, one can find that the better social conditions have a significant part in bringing about linearity. In the development of the robust-

Table 4

Somatotype components of the Bakony girls according to earnings per capita

Age group (years)	First group		Second group		Third group	
	according to earnings per capita					
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
			Ist component			
10	3.27	1.77	3.08	1.65	2.85	1.49
11	3.72	1.81	2.97	1.71	2.84	1.71
12	4.10	2.27	3.55	1.81	3.10	1.90
13	4.49	2.07	3.98	1.97	3.21	1.89
14	4.33	2.13	4.09	2.19	3.31	1.89
			IInd component			
10	3.75	1.72	3.54	1.42	4.08	1.97
11	3.84	1.64	3.60	1.71	4.21	1.99
12	3.53	1.91	3.51	1.84	4.17	2.02
13	3.66	1.88	3.51	1.91	3.68	2.11
14	3.51	1.62	3.41	1.52	3.65	1.72
			IIIrd component			
10	4.08	2.17	3.55	1.79	3.40	1.82
11	4.21	2.03	3.57	1.82	3.10	1.70
12	4.17	1.97	3.58	1.75	3.08	1.81
13	3.68	1.89	3.37	1.99	3.19	2.00
14	3.65	1.91	3.47	1.79	3.21	1.82

icity of the bones and muscles there is no essential difference among the examined social groups. Between the fatness component serving for characterizing the manifestation of endomorphy and the better social conditions a positive relationship can be demonstrated, with the exception of the social groups distinguished relying on the occupation of the fathers. The most obvious explanation of this inconsistency and, at the same time also its resolution should be sought for in the different nutritional habits of the physical and intellectual workers.

Founded on the results of these monofactorial examinations, we can not draw, of course, far-reaching conclusions, since the factors determining the socio-economic status are also connected with each other. For a more complete disclosure of the relationship between the physique and the socio-economic factors an examination of the joint effect of these factors, a multifactorial survey is needed.

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ON SOCIAL AND NATURAL FACTORS EXERTING INFLUENCE ON MATURATION OF GIRLS

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Abstract: Analysing the menarche data of about, 50,000 Hungarian girls showed that maturation is a function composed partly of biological and partly of sociological factors. The observations concerned, however, in the first place, changes in the median but the factors influencing it were not thoroughly examined. To draw clear-out conclusions is rather difficult as the observations were made by different authors, between 1958 and 1978 and so the results are loaded with the possible influence of acceleration, too. A representative investigation would necessarily over the whole country and take into consideration all the possible factors.

Key words: Menarche, social factors, natural factors.

Introduction

One of the most reliable indicators of the maturing of girls is the appearance of the first menses that is menarche. The importance of this criterion is indicated also by the fact that in the relevant literature, especially more recently an increasing number of papers has been published dealing with this problem. There is practically no country where researchers investigating children's growth have not touched the maturing of girls.

The investigations in Hungary were initiated by Prof. SEMMELWEIS, in 1860, who was among the first to establish the age at the first menses (DARÁNYI 1941). However, from this time on up to the end of the Second World War there are only three papers to be found in the Hungarian anthropological literature mentioning this phenomenon. Since 1948, but in particular since 1958, several publications have dealt with this question. As the relevant Hungarian literature has been reviewed recently (EIBEN 1968), we dispense with giving such details as number of cases, the year of sampling of data and the medians found.

In this communication, our present knowledge about the age of girls at the menarche will be summarized partly on the basis of these articles and partly on the bases of our own investigations.

Up-to-date data on first menstruation of about 50,000 girls, between 10 and 18 years, were collected by several authors. It must be added, however, that only parts of the country were involved in the sampling. On the Figure 1 one can see the places of the settlements from which our data had originated.

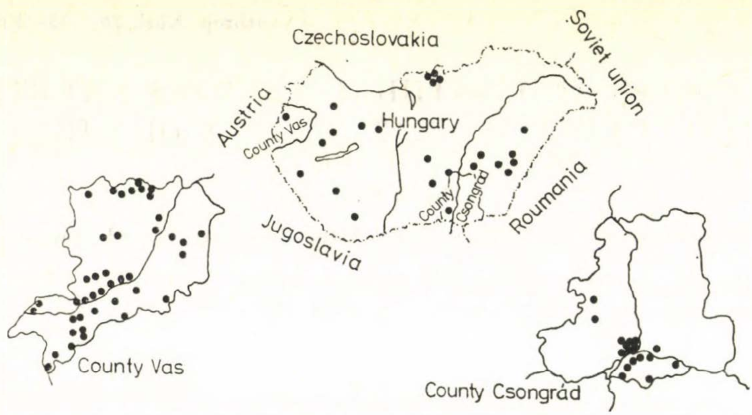

Fig. 1. The places of the settlements in Hungary from which the menarche data had collected

The collection of data took place almost entirely using the technique of status-quo. Probit analysis was employed by most of the authors to evaluate the results.

Results and Discussion

Acceleration

According to an evaluation made in 1963, the menarche-median was 13,23 years in Hungary (Bottyán et al. 1963). This value, as compared to earlier values (Semmelweis; Jankovich 1941, Véli 1956) is lower, but the comparison is rendered difficult by the fact that the processing of the data was carried out using different techniques. Anyway, investigations made since that time prove that existence of acceleration also in this connection. This fact is supported by observations made in Szeged (South Hungary) in the years 1958–1959, 1961 and 1966–1967. According to these investigations the medians vary from 13.2 to 12.73 year in the course of 8 years. which corresponds to an annual decrease of 0.08–0.1 year in the last decade.

One reason, in the case of Hungarian girls, is the massive increase in the standard of living over the last few years.

Succession of birth and age at menarche

Changes in the age at menarche might have genetical reasons. Eiben investigating 15,229 girls in Western Hungary found that within one family the value of the menarche-median increases according to their numerical position as siblings (Eiben 1972). This value was 12.96 year for first-borns, 13.26 year for fifth-borns and 13.44 year for eighth-borns.

Anyway, it is our impression that the older a girls among her siblings the later she becomes adult. The median for third-borns corresponds to that of the average Hungarian value.

Family size and menarche-median

According to the above mentioned collection of data from West-Hungary made by EIBEN (1972) the median parallel increases with family size, that is the bigger the family the later the girls reach physiological maturity. In the case of a family consisting only of two members, 50 per cent of the girls become adult at the age of 12.99 year (a widow and one girl), the Hungarian average median is exhibited by families with six members (13.21 years), this value increases and even further, for instance, it is 13.5 years in families of 10 members.

Anyway the Hungarian data support the observations of others showing a positive correlation between family size and menarche median.

Occupation of parents and menarche-median

There is a further correlation between the occupation of parents and the menarche-median of their daughters. This was established by analyzing the observations made between 1958 and 1978 in a way that the parents were divided according to the following categories:

a) manual or physical worker (industrial, agricultural, other),

b) brain worker or intellectual (higher and secondary school education separately),

c) homemaker (in the case of mothers),

d) pensioned parents,

e) dead parents.

It is apparent that the menarche-median varies according to the occupation of the parents (Table 1). A relationship seems to exist between the parent's education and the menarche median. In general, the daughters of manual workers reach maturity later than those of the brain workers.

Table 1

The menarche-median of girls according to the occupation of their parents

Parent's occupation	The menarche median (year) of girls according to the occupation of their father and/or mother	
Industrial manual worker	13.58	13.01
Agricultural manual worker	13.37	13.41
Other manual worker	13.16	13.29
Brain worker (university education)	12.92	12.81
Brain worker (secondary school ed.)	12.54	12.94
Pensioned	13.00	—
Dead parent	13.17	—
Homemaker	—	13.62

Settlement size and menarche

We compared the menarche-medians in settlements with a differing number of inhabitants (Table 2). It is clear that the smaller a settlement is the later the girls living there become adult.

Table 2

The menarche-median of girls according to the size of settlements

Number of inhabitants on the settlement	Menarche-median (year)
Over 200,000	12.86
Between 100,000 and 200,000	12.95
Between 50,000 and 100,000	13.02
Between 10,000 and 50,000	13.11
Between 500 and 10,000	13.28

Altitude above the sea level and menarche

In Hungary there are no appreciable differences in altitude above sea level in the different settlements. No direct investigations were carried out to establish whether there is a correlation between the two phenomena. However, subsequent analysis of the preexisting data showed that there is still a correlation of 95% probability between the menarche-median and the altitude above sea level of the settlement. From the Table 3 it is probable that with increasing altitudes the maturation of girls is delayed.

Table 3

The menarche-median of girls according to the altitude above the sea level of settlements

Average altitude above the sea level of the settlement (m)	Menarche-median (year)
239	13.35
119	13.06
104	12.87

Meteorological factors and menarche

The question, whether there is a correlation between meteorological data and the menarche-median, was investigated in the case of 16 settlements. We found the strongest correlation ($r = -0.76$) between the number of sunlight hours and the menarche-median. The probability was over 99 per cent. The correlation was negative: with an increasing number of sunlight hours the menarche-median decreased. Comparable correlations were demonstrated for the average temperature, for the average annual yearly precipitation (expressed in the percentage of the average annual cloudy days), and even for the lowest average precipitation. From these calculations the conclusion can be drawn that in smaller geographical areas the physiological processes leading to the maturation of girls respond to meteorological factors such as temperature and illumination.

Seasonal changes in menarche

Several data show that the first menses in 49% of the cases occurs in the winter season (November, December, January, February). Thus roughly 50 per cent of the girls experience their first menses in winter while the other 50 per cent are distributed over the remaining two-thirds of the year. However, the distribution is uneven also in this latter case as menarche these frequency is higher in August, than in the other months. Superimposed on these seasonal changes is the geographical effect. Taking all these factors together it can be stated that there is a seasonality in the menarche the winter and summer months being the most important determinants, while the spring and autumn months are only secondary in importance.

Coincidency between the month of birth and month of menarche

The above-mentioned observations made on West Hungary the coincidency is 11.46 per cent and the same is the case in other regions of the country.

These observations are in agreement with those made in other Central European countries and suggest that the coincidence of the month of birth and the menarche is a real, but at present not fully understood fact. Its practical importance is, however, great, especially in medical superintendency of schools.

Correlation between physical development and the menarche

Data on the relationship between the physical development and the menarche its acceleration have been published by VÉLI (1956). He compared data collected in 1947 and 1962 and from these a good correlation between the physical and physiological development of girls of different ages is evident, and clear that it is also an accelerating phenomenon (VÉLI 1968).

An increase is observable not only in average body height and body weight in each age group, but also in the frequency of menstruating girls.

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ON THE QUESTION OF SECULAR ACCELERATION IN JENA SCHOOL CHILDREN

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Abstract: The changes in the course of growing up and development in schoolchildren in Jena during the past hundred years followed up.

A statement may be made on the present level and the extent of acceleration on the basis of examinations carried out in 1975 on children from Jena (nearly 1100 boys and girls in each case) 7 to 15 years of age.

Hereby changes in body height, body weight and menarcheal age conditioned by acceleration since 11 years are especially examined.

The developmental differences between the schoolchildren of town and county at present will be examined.

It will be made a statement about growth and developmental trends of some body measures and proportions in children aged from 7—15 years.

Key words: Jena school children, body height, body weight, menarcheal age, secular changes.

Introduction

Anthropological investigations of schoolchildren have been carried out in Jena at more or less regular intervals from 1880 onwards. Therefore we have at our disposal the longest investigation series of school-age children ever made. Cross-sectional studies of schoolchildren were also initiated in various German towns (Leipzig, Stuttgart, Augsburg, Hamburg, a. o.) at the end of the past century. Unfortunately these series were mostly interrupted in the fifties or sixties of our century, and did not have the continuity of the studies made on schoolchildren from Jena.

The first surveys in Jena and elsewhere essentially aimed at providing the doctors with reference figures according to which an assessment of the particular individual developmental and nutritional condition of children was possible.

But the range of characteristics of the investigation was restricted to a few only (stature, weight; more seldom: width of chest). Although the mentioned characteristics give quite a good insight into the growth and development process changed by secular acceleration in children and adolescents, they do not permit any statements to be made on possibly occurring proportional shifts, earlier menarche or earlier onset of the 1st and in particular of the 2nd dentition. The range of characteristics for the respective investigation programmes has been continuously extended in Jena from 1964 onwards (Table 1).

Material and Methods

The results reported here are based on an investigation carried out by the Institute of Anthropology and Human Genetics of the Friedrich-Schiller University of Jena in 1975. In planning this investigation we felt that such a comprehensive survey (some 1100 boys and girls each aged between 7 and 15 years were covered) which at any rate involves a high effort both in terms of staff and time should not only include the clarification of a few individual questions, but also the treatment of extensive complexes of subjects, as far as possible. For this reason,

Table 1

Investigations of schoolchildren in Jena 1880–1980

Year of investigation	Number of probands	Number of characteristics			
		metric	morphological	physiological	functional
1880	1295	2 (+3)	—	—	—
1921	6186	8	—	—	—
1932/33	122–323 ♂* 104– 205 ♀*	3	—	—	—
1944	4868 (2259 ♂; 2609 ♀)	7	2	—	—
1954/55	2110 (1022 ♂; 1088 ♀)	5	—	1	—
1964	2517 (1269 ♂; 1248 ♀)	9	—	1	—
1975	2115 (1062 ♂; 1053 ♀)	50	29	1	—
1980	1057 (540 ♂; 517 ♀)	62	65	1	4

* for each semi-annual group

— the examination of children from the Jena countryside was included in the Jena investigation programme of 1975 to reveal possibly existing differences between town and countryside;

— the anthropological investigation programme was considerably expanded with regard to the individual parameters recorded as compared to former ones (to altogether 30 metric, morphological and physiological data);

— the anthropological investigation was linked with a relatively comprehensive one (50 characteristics) carried out by stomatologists (Department of Orthopedic Stomatology of the Stomatological Clinic and Polyclinic of the Friedrich-Schiller University of Jena) and being ancillary to the general objective.

The principal aim of the material evaluation was to find out the age- and sex-specific variability of the corresponding metric and morphological data in children. It is also intended to use the values obtained as a basis for the preparation of standard (norm) tables for our research area (Thuringia). The clarification of the present state of acceleration both in case of the individual characteristics and in the proportions of the body and the influence of selected factors on the development of the body we regarded as another task. Moreover, questions of correlations of the characteristics which might play a role in the diagnosis of diseases will be of interest. Some remarks on the secular acceleration of selected dimensions of the body between 1880 and 1975 will be made in the following.

Results and Discussion

Body height

For *boys* the acceleration-conditioned increase in the height of body between 1880 and 1975 is about 14.4 cm on an average (the average of all semi-annual classes) (Table 2).

This means that the boys of 1975 aged between 7 and 14 are about 14.4 cm taller than the pupils of 1880 of the same age, on an average. We speak of

Table 2

Overall differences in body height and body weight in Jena schoolchildren aged between 7 and 14 years (1880/1975)

Age (years)	Boys		Girls	
	Body height (cm)	Body weight (kg)	Body height (cm)	Body weight (kg)
7	13.4	6.6	11.7	4.9
7.5	13.5	5.9	10.9	4.8
8	13.5	5.3	12.7	6.0
8.5	13.4	6.5	11.5	6.3
9	14.1	6.8	13.1	6.4
9.5	12.7	5.5	13.2	6.5
10	13.2	5.0	13.2	8.1
10.5	11.3	6.8	13.1	7.4
11	14.2	8.5	13.9	8.3
11.5	13.4	7.6	14.0	9.7
12	12.5	9.9	16.1	12.8
12.5	15.9	10.9	13.7	10.3
13	17.9	14.0	15.6	12.3
13.5	17.7	12.4	10.4	10.7
14	19.7	14.6	14.7	11.3
Overall difference	14.4 cm	8.4 kg	13.2 cm	8.4 kg

'about 14.4 cm' intentionally as the results published for 1880 to 1932/33 are based on an age classification of the boys under test (n minus 6 months) that differs from the one used for the subsequent studies (n$\pm$3 months) and consequently an exact statement cannot be made. Starting from this overall period of time, the mean height of body increases by 1.5 cm on an average within 10 years in case of boys (minimum: 1.2 cm for those aged 10.5; maximum: 2.1 cm for those aged 14).

Considering the mean difference in body height calculated for all semi-annual classes together between 2 investigations in immediate succession (likewise converted to decades), this (Table 3) ranges between 0.6 cm (1932–1944) and 3.0 cm (1921–1932). The medium 2.8 cm increase in body height observed in the past eleven years (1964–1975) suggests an increased acceleration in Jena schoolchildren and among other things conforms with the result of the Brunswick longitudinal-section studies made by KURTH and MAY (1977).

The mean semi-annual increase in height of body (Table 4) ranges between 2.1 cm (1921) and 2.7 cm (1975) for boys – 2.44 cm on an average.

Table 3

Mean differences in body height in Jena schoolchildren aged between 7 and 14 years

Year of investigation	1880/1921 cm	1921/1932 cm	1932/1944 cm	1944/1954 cm	1954/1964 cm	1964/1975 cm
Boys	4.7 (1.2)	3.0	0.6	1.2	1.1	2.8
Girls	3.9 (1.0)	2.9	−0.6	2.4	1.0	2.7

Table 4

Mean semi-annual increases in body height and body weight in Jena schoolchildren aged between 7 and 14 years

Year of investigation	1880	1921	1932	1944	1954	1964	1975
Boys							
Body height	2,2 cm	2,1 cm	2,5 cm	2,4 cm	2,6 cm	2,6 cm	2,7 cm
Body weight	1.1 kg	1.2 kg	1.7 kg	1.4 kg	1.7 kg	1.7 kg	1.7 kg
Girls							
Body height	2.5 cm	2.5 cm	2.6 cm	2.6 cm	2.5 cm	2.6 cm	2.7 cm
Body weight	1.4 kg	1.6 kg	1.8 kg	1.6 kg	1.8 kg	1.9 kg	1.8 kg

Taking the last mentioned value and the overall body height difference between 1880 and 1975 (approximately 14.4 cm) as a basis for an assertion of the state of development of the body height, it can be stated that the boys of 1975 reach the values of body height of the pupils of the same age of 1880 roughly three years earlier on an average (14.4 : 2.44). The variation width of this developmental acceleration of the body height ranges between 2 years, 3 months (in case of 10.5-year-olds) and abt. 4 years (in case of 14-year-olds). To find out in which age stage of the infantile ontogenesis the obvious developmental advance in the past 95 years occurred, it is helpful to compare the mean values of the body height of 7-year-olds (as the youngest age class studied) and of the 14-year-olds (as the eldest age class studied) of 1880 and 1975 each. It can be seen that the mean differences in body height of the 7-year-olds of the mentioned years of investigation are 13.4 cm and those of the 14-year-olds 19.7 cm (Table 2). This means that the differences already existing in the initial group (7 years) only increase by 6.3 cm (= 32%) in the span of age between 7 and 14 years, whereas 68% of the difference in body height are already reached below the age of 7.

This indicates that the secular increase in body height observed over the past 100 years must have essentially taken place before the 7th year of age (about two thirds according to our results) and is in accordance with the results obtained by other authors (OEHMISCH 1970, WALTER 1978, KNUSSMANN 1980).

The body heights of the *schoolgirls* of 1880 and 1975 calculated for all semi-, annual classes differ by altogether 13.2 cm approximately on an average (Table 2), corresponding to an about 1.4 cm increase of the values of body height (minimum: 1.1 cm in case of 13.5-year-olds; maximum: 1.7 cm in case of 12-year-olds) within a 10-year interval. Considering the overall differences between 2 consecutive series (Table 3) on the other hand, these range between minus 0.6 cm (1932—1944) and plus 2.9 cm (1921—1932) at the respective time intervals.

The average semi-annual increase in body height (Table 4) ranges between 2.4 cm (1921) and 2.7 cm (1975) in girls from Jena — mean 2.56 cm. Using the last mentioned value and the overall mean difference of body height for schoolgirls of age 7—14 years between 1880 and 1975 (approximately 13.2 cm) as a basis to give information on the developmental acceleration, it can be said that the schoolgirls of 1975 are ahead of the girls of 1880 of the same age by 2 years, 7 months as to their development of body height (minimum: 2 years; maximum: abt. 3 years, 1 month).

The essential increase in body height due to acceleration in girls is found at the age below 7 years (abt. 80%), this is similar to what we have already noted for the boys. The remaining 20% of the overall difference are added up to the age of 14.

According to the investigation results of the body height it can be said that a further increase due to acceleration can be detected. This increase has still grown in intensity in our region, compared to most of the former studies of schoolchildren (Table 3 and 6).

Body weight

The increase in weight both for boys and girls between 1880 and 1975 amounts to about 8.4 kg on the total average (Table 2), this means about 0.9 kg converted to one decade.

A mean of 1.5 kg (minimum: 1.1 kg 1880; maximum: 1.7 kg 1932, 1954, 1964, 1975) was calculated from all 7 investigations made for the average semi-annual increase of body weight in *boys* (Table 4). Starting from the overall difference (8.4 kg) between 1880 and 1975 and the average semi-annual increase in weight (1.5 kg), this denotes that the boys of 1975 reach the values of body weight of pupils of the same age of 1880 about 2 years, 9 months earlier, on an average (minimum: 1 year, 7 months in case of 10-year-olds; maximum: 4 years, 8 months in case of 14-year-olds). Unlike the body height where the increase due to acceleration substantially takes place before the age of 7, the secular rise of the body weight is more intensely (about 55%) shifted to-

Table 5

Mean differences in body weight in Jena schoolchildren aged between 7 and 14 years

Year of investigation	1880/1921 kg	1921/1932 kg	1932/1944 kg	1944/1954 kg	1954/1964 kg	1964/1975 kg
Boys	2.2 (0.6)	2.3	−0.7	1.1	0.7	1.9
Girls	2.6 (0.7)	2.1	−1.3	2.4	0.7	1.0

Table 6

Acceleration of "Body weight- and Body height-age"

	Average differences		Acceleration of "Body weight- and Body height-age"	
	♂	♀	♂	♀
1. *Body height*				
1880−1975	14.4 cm	13.2 cm	abt. 3 years, —	abt. 2 years, 7 months
1964−1975	2.8 cm	2.7 cm	abt. — , 6 months	abt. — , 6 months
2. *Body weight*				
1880−1975	8.4 kg	8.4 kg	abt. 2 years, 10 months	abt. 2 years, 6 months
1964−1975	1.9 kg	1.0 kg	abt. — , 7 months	abt. — , 3 months

wards the age stages between 7 and 14 years (essentially between 11 and 14 years).

The mean semi-annual increase for the entire period of 95 years in *girls* is 1.69 kg (Table 4). According to this figure, in 1975 the schoolgirls reach the values of body weight of the 1880 girls of the same age earlier by roughly 2 years, 6 months, on an average (minimum: 1 year, 4 months in case of 7.5-year-olds; maximum: 3 years, 8 months in case of 12-year-olds).

The increase in body weight connected with the acceleration in the age classes between 7 and 14 is also stronger in the girls (about 57%) as compared to the period between 0 and 7 years (Table 5). In all it can be stated that the acceleration of the body weight increased in the past 11 years compared to most of the other time intervals. However, the body weight did not increase to the extent of that of the body height as it is expressed in the increase in body weight (kg) per centimetre of body height increase (boys: 1 cm: 0.7 kg; girls: 1 cm: 0.4 kg) (Table 6).

Chest breadth

Apart from the body height and body weight we also have at our disposal the means of the width of chest of Jena boys of age 7 to 14 years from 1880. Since the data of girls are incomplete (merely the 7 to 9.5-year-olds were examined in 1880), they will not be compared here with the values from 1975. For that reason we restrict our statement to the mean chest widths of boys. This characteristic was recorded and evaluated in altogether 5 investigations of schoolboys from Jena between 1880 and 1975 (1880, 1921, 1932/33, 1954, and 1975).

The chest widths in *boys* calculated for all semi-annual classes of 1880 and 1975 differ by altogether 3.8 cm on an average, corresponding to a mean 0.4 cm increase of the width of chest values per decade. On the one hand this means (starting from the above mentioned total differences) that the secular acceleration does not make itself felt as strongly as this happens for body height and weight. On the other hand, also the relative differences, for example 6.0% for the width of chest in the male sex (between 1880 and 1975) are clearly below the percentage increases for body height (11.2%) and weight (31.0%).

The average semi-annual differences amount to 1.06 cm of all studies. Taking this figure and the total difference (3.8 cm) as a basis, this means that the 1975 boys on an average reach the values of chest width of the 1880 boys of the same age earlier by about 1 year, 9 months. What is striking in our results is that the means of 1975 are below those of 1954 in the majority of age classes, that is to say the width of chest declined both in boys (mean: -0.4 cm) and girls (mean: -0.8 cm) in the past 20 years.

This fact and the proof that the width of chest is not subjected to secular acceleration to the same degree as the other discussed dimensions of the body are suggesting that children and adolescents nowadays are slimmer than those of former times.

We hope to be able to make a contribution to the influence of acceleration on various dimensions of the body and the related proportional shifts by the evaluation of other characteristics. This could close part of the gap in our knowledge because according to KNUSSMANN (1980) it is still unclear today whether and to what extent all dimensions of the body undergo secular acceleration.

Menarche

As this characteristic was not included in former studies of schoolchildren in Jena, only the results of the 1954 investigation for the occurrence of menarche are available for comparison. While the mean menarcheal age was still 15.49 years (WINTER 1962) in Germany at the beginning of this century, GRIMM (1966) could indicate a mean menarcheal age of 14.5 years for his studies made in Halle between 1947 and 1948. The investigations carried out in Jena in 1954 revealed a mean menarcheal age of 13 years, 6.5 months. A mean menarcheal age of 12 years, 8 months was calculated for the 1975 questioning of girls. The mean menarcheal age of 12 years, 3 months indicated by RICHTER (1976) for Görlitz is not yet reached by our data, but this among other things may be attributable to the different recording of this characteristic. While RICHTER undertakes longitudinal-section studies — i.e. questioning of the girls being possible immediately after the occurrence of menarche — the retrospective method we used is liable to certain error sources (e.g. girls whose answers were not precise).

The earlier menarcheal age is substantially due also to a decline of the portion of late menstruating girls (also cf. WINTER 1962, a. o.).

Summary

To summarize it is noted again that acceleration of growth and development goes on in our region. The investigation results of body height and (with restrictions) body weight permit the conclusion that the intensity of increase due to acceleration has still grown compared to most of the former investigations of schoolchildren undertaken in our region of research (Thuringia). The described development of the width of chest can possibly interpreted in this direction, but this requires the inclusion of other characteristics to confirm it.

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PHYSICAL FITNESS AS RELATED TO BIOLOGICAL MATURITY

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Abstract: In the present overiew the relative importance of skeletal maturity in explaining body measurements and motor fitness components is reported.

The data result from the "Leuven Growth Study of Belgium Boys" as well as from pilot-studies of the "Leuven Growth Study of Flemish girls". The importance of skeletal maturity in explaining body measurement and motor fitness results was investigated by means of regression analyses and comparisons between maturity groups. In girls maturity groupings were also made according to the age at menarche.

In boys the relative importance of skeletal maturity reaches a maximum at 14—15 years and a fairly high percentage in body dimensions (± 50% for stature) is explained by skeletal age. For the motor fitness components the interaction of chronological age and skeletal age as such or in combination with height and/or weight have the highest predictive value although the explained variance is rather low ranging from 0% to 17%, except for static strength for which the explained variance ranged from 33% to 38%.

Skeletaly more mature and average maturing girls of 12 through 14 years have larger body dimensions than retarded girls. For the motor fitness components no clear differences were found except for static strength for which more mature girls obtained better results than the retarded girls. The observed differences between pre- and postmenarcheal 11 to 13 year old girls are in the same direction as the maturity-performance relationships for boys.

However, with increasing age these relationships are somewhat reversed resulting in a better performance for late maturing girls at ages 16—18 years.

Key words: Physical fitness, biological maturity, "Leuven Growth Study of Belgian Boys", "Leuven Growth Study of Flemish Girls", body measurements, motor fitness, skeletal age, menarche.

Introduction

Before going into detail of the relationship between different aspects of physical fitness and biological maturity it seems indicated to define more precisely what is meant by physical fitness and biological maturity.

Let us first consider the definition of *biological maturity*. Already in 1908 Crampton observed that the chronological age does not represent truthfully how far an individual has progressed along its road to biological adulthood. According to Tanner (1962) there are mainly four systems in use to assign a developmental age; these are:

— sexual characteristics
— morphological characteristics
— dental development
— skeletal development

In the present account we will not consider the different techniques presently used to estimate these biological maturity criteria. Overviews of the different techniques currently used are given by DEMIRJIAN (1978), MARSHALL (1978), and ROCHE (1978).

As was clearly shown by MARSHALL (1974) and further illuminated in an overview by MALINA (1978), no single maturation system provides a complete description of the growth and the maturation during adolescence but the somatic, sexual and skeletal indices of growth and maturation are sufficiently interrelated to indicate the developmental level of a group of children or populations.

Furthermore, DEMIRJIAN (1978), after reviewing the relationship between dental emergence or calcification and other maturity criteria, concluded that dental maturation is substantially independent from the other criteria. Although different systems are in use, and are to some extent independent of each other, several authors (see e.g. MARSHALL 1977, TANNER 1978) agree that the development of the skeleton provides one of the most useful indices of maturity.

Secondly the concept of *physical fitness* will be discussed. Definitions of physical fitness can be found in textbooks on measurement and evaluation in physical education (CLARKE 1976, CURETON 1947, LARSON and YOCOM 1951, SAFRIT 1973). According to SAFRIT (1973) two definitions seem to be most commonly used. From a medical point of view, physical fitness is defined as the capacity to adapt and recover from strenuous exercise, in other words cardio-respiratory fitness. A more general definition considers physical fitness as: "The ability to carry out daily tasks with vigor and alertness, without undue fatigue, and with ample energy to engage leisure time pursuits and to meet the above average physical stresses encountered in emergency situations (ANON, 1979)". This definition has now been endorsed by the American Academy of Physical Education, and is a somewhat modified version of the definition proposed by CLARKE (1976, p. 12).

In the LEUVEN GROWTH STUDIES on Belgian boys (OSTYN, SIMONS, BEUNEN, RENSON, and VAN GERVEN 1980) and on Flemish girls (BEUNEN, SIMONS, OSTYN, RENSON, VAN GERVEN, CLAESSENS, VANREUSEL, COLLA and SCHUEREMANS 1980) we interpreted physical fitness in this broad sense and

Table 1

The basic dimensions of motor fitness in boys and girls and the selected tests for the Leuven growth study on Belgian boys and on Flemish girls

Basic dimensions	Test Boys' study	Test Girls' study
Eye-hand coordination	Stick balance	—
Balance	—	Flamingo balance
Flexibility	Sit and reach	Sit and reach
Speed of limb movement	Plate tapping	Plate tapping
Running speed	Shuttle run	Shuttle run
Static strength	Arm pull	Arm pull
Explosive strength	Vertical jump	Vertical jump
Functional strength	Bent arm hang	Bent arm hang
Trunk strength	Leg lifts	Leg lifts
Endurance	1' step test	1' step test
		500 m schuttle run
		Bicycle ergometer test

for this reason body measurements, body type and biological maturation were measured together with a battery of motor fitness components and sport participation. In most studies on motor fitness the total concept is broken down into subcomponents. In the above mentioned studies the basic dimensions of the motor fitness domain of growing boys and girls could be identified more accurately through factor-analyses of the results of each age group between 12 and 19 years (SIMONS, BEUNEN, OSTYN, RENSON, SWALUS, VAN GERVEN, WILLEMS 1969, SIMONS, OSTYN, BEUNEN, RENSON, VAN GERVEN 1978).

In Table 1 the extracted factors together with the tests measured in the study on Belgian boys and on Flemish girls are given.

With regard to the relationship between skeletal maturity and physical fitness we will concentrate on the relationship in boys starting from the boys' study although some preliminary results will be presented on the relationship in girls based on a few pilot studies.

Material and Methods

The boys' study is a mixed longitudinal study of the physical fitness of Belgian school boys (OSTYN, SIMONS, BEUNEN, RENSON, and VAN GERVEN 1980). This growth study consisted of a six-year longitudinal and cross-sectional study of a representative sample of Belgian school boys aged 12+ to 19+. The testing program started in 1969 and ended in 1974. A total of 21,052 examinations were made. Each year between 2500 and 4500 boys of one secondary school grade were tested beginning with the first grade. Therefore a stratified sample of schools was randomly selected taking into account the following factors:

- language group: French or Flemish speaking
- school affiliation: private (Catholic) or state schools
- type of schooling: vocational, technical schooling or humanities
- geographical distribution of the school population per province.

In each school a random sample consisting of entire classes was selected and all the boys in each class were examined. The same schools were studied throughout, which resulted in a combined longitudinal and cross-sectional study. This design, in which several birth cohorts are followed for several years with overlapping intervals, is recommended by SCHAIE (1965) and VAN'T HOF, WELS and KOWALSKI (1979) as the most efficient design for a developmental study.

In Table 2 the number of boys examined is reported classified according to the measuring period and the number of examinations. This table shows that 39% (5576) of the boys were measured twice or more with a mean of 2.2 observations. 587 boys were followed for six years, 1063 boys were followed for five years etc.

There was a considerable amount of drop-outs due to the design of the study although this drop-out was not selective over the whole study (OSTYN, SIMONS, BEUNEN, RENSON, and VAN GERVEN, 1980). All measurements were made each year during the same period from January till March with nearly exact yearly intervals. Seasonal effects on growth and development were thus limited to a minimum.

Table 2

Number of boys enrolled in the Leuven growth study of Belgian boys

Measuring period	Number of examinations						
	1	2	3	4	5	6	
1969	4282						
1970	1235	2921					
1971	1214	832	1863				
1972	1049	727	529	1177			
1973	699	674	379	366	783		
1974	312	422	482	239	280	587	
Total	8791	5576	3253	1782	1063	587	21052

Seventeen anthropometric measures and nine motor ability tests were administered, three standard photographs were taken to determine the somatotype and an X-ray of the left hand and wrist to estimate the skeletal development. Furthermore a standardized questionnaire was designed to evaluate sports participation and socio-cultural background of the subjects and their parents. All questionnaires were filled in by the parents and checked by interview with the boys. The entire testing programme was administered to each boy at each measuring period. The tests and measurements were taken by two teams of ten well-trained instructors, under the permanent supervision of the same research assistants who trained and accompanied that team throughout the entire study. Each school was visited twice at an interval of one week.

As already mentioned, a valid and reliable motor test battery was selected for boys of these age levels.

Skeletal maturity was assessed according to the methods of TANNER and WHITEHOUSE (TANNER and WHITEHOUSE 1959, TANNER, WHITEHOUSE and HEALY 1962, TANNER, WHITEHOUSE, MARSHALL, HEALY and GOLDSTEIN 1975). All assessments were made by the same observer *(G.B.)*. High intra-observer reliability (0.98) was obtained between two independent assessments (BEUNEN 1970) and no systematic difference between the means was observed. Furthermore a very good agreement was noted between the assessments made by this observer *(G.B.)* and the assessments made by experts in the method *(R. H. Whitehouse* and *N. Cameron)* (BEUNEN and CAMERON 1980).

The data in the two girls' studies are taken from two cross sectional samples of schools in Leuven.

The first sample consisted of 450 girls 12 through 16. Besides our own motor fitness test battery also the motor fitness test proposed by the International Committee on Standardisation of Physical Fitness Tests (LARSON and YOCOM 1951) were administered together with 27 anthropometric measurements. Skeletal age was also assessed according to the TW1 method by the same observer *(G.B.)*. For a more detailed description of this study see BEUNEN, OSTYN, RENSON, SIMONS and VAN GERVEN (1976). In the second sample 398 girls aged 11 through 18 were examined. Besides motor fitness tests age at menarche was recorded by means of the status quo method.

Results and Discussion

A. *PHYSICAL FITNESS – SKELETAL MATURITY RELATIONSHIPS IN BOYS* (based on publications by BEUNEN, OSTYN, RENSON, SIMONS, SWALUS, and VAN GERVEN 1974, BEUNEN, OSTYN, RENSON, SIMONS, and VAN GERVEN 1978, BEUNEN, OSTYN, SIMONS, VAN GERVEN, SWALUS, and DE BUEL 1978, BEUNEN, OSTYN, RENSON, SIMONS, and VAN GERVEN 1979, BEUNEN, OSTYN, SIMONS, RENSON, and VAN GERVEN 1981). In this overview we will consider the following questions:

– what are the age-specific relationships between skeletal maturity and physical fitness during adolescence and

– is there an evolution in the relationship?

– what part of the variability in physical fitness is accounted for by chronological age, skeletal age and for motor fitness also by size?

For all these relationships we will only consider the cross sectional analysis.

I. *Age specific relationships and evolution in these relationships*

In a first analysis correlations were calculated between skeletal age and physical fitness results at each age level. Moreover, comparisons were made between the mean results of boys of the same age but of varying degree of skeletal maturation.

Body measurements

All body measurements are fairly closely related to skeletal age (Table 3). The highest correlations are found for linear dimensions and the lowest for skinfolds. From 12 to 14 the correlations are fairly similar or increase; thereafter a significant decrease occurs first in weight, linear dimensions and bone breadth dimensions, thereafter for the other dimensions.

Motor fitness

For motor fitness results only static strength (arm pull) correlates fairly high with skeletal age at all age levels. At 13 and more clearly at 14 all motor tests are positively related to skeletal maturity. Only for eye-hand coordination (stick balance) and pulse rate at rest no significant correlations are found, and a slight negative correlation exists with pulse rate after exercise.

For static strength (arm pull) and explosive strength (vertical jump) the highest correlations are found at 14 to 15 years, thereafter the correlations decrease. For the other motor fitness components the correlations increase from 12 through 14 whereafter they remain unchanged.

II. *Percentage of variability in physical fitness accounted for by skeletal age, chronological age and size*

To answer this question two separate studies were undertaken. In the first study the relative contribution of skeletal age and chronological age was investigated in homogeneous age groups. Within each chronological age group first order partial correlations have been calculated between skeletal age and

Table 3

Correlation coefficients between skeletal age, structural measures and motor fitness components at different age levels

Test	12 years	13 years	14 years	15 years	16 years
Weight	0.573	0.615	0.650*	_0.627*_	_0.524*_
Height	0.603	0.676*	0.702*	_0.621*_	_0.405*_
Sitting height	0.521	0.664*	0.728*	_0.692*_	_0.577*_
Biacromial width	0.481	0.547	0.633*	0.631	_0.472*_
Chest width	0.404	0.469	0.544*	0.561	_0.462*_
Bicond. humerus	0.520	0.594*	_0.514*_	_0.470*_	_0.254*_
Bicond. femur	0.477	0.464	0.433	_0.320*_	_0.123*_
Chest circumference insp.	0.486	0.559*	0.622*	0.624	0.517*
Chest circumference exp.	0.478	0.510	0.592*	0.605	_0.510*_
Thigh circumference	0.464	0.434	0.497*	0.505	_0.458*_
Calf circumference	0.507	0.503	0.505	0.487	_0.366*_
Upper arm circumference	0.396	0.454	0.524*	0.539	_0.495*_
Supra iliac skinfold	0.277	0.297	0.344	0.362	0.366
Subscap. skinfold	0.280	0.257	0.316*	0.332	0.373
Triceps skinfold	0.134	0.077	—*	—	0.042
Calf skinfold	0.195	0.118	0.116	—*	_—0.062*_
Stick balance	—	—	—	—	—
Plate tapping	—	0.151	0.214*	0.178	0.167
Sit and reach	—	0.055	0.158*	0.190	0.145
Vertical jump	—	0.196*	0.319 *	0.379*	_0.321*_
Arm pull	0.430	0.553*	0.652*	0.632	_0.512*_
Leg lifts	—0.149	—0.118	0.039*	0.132*	0.188*
Bent arm hang	—0.189	—0.137	—*	0.145	0.132
Shuttle run A	—	—	0.128*	0.122	0.093
Pulse rate R.A	—	—	—	0.039	—
Pulse rate A.A	—0.103	—0.105	—0.077	—0.045	—0.082

Key: A: Sign reversed, indicating a poorer performance for an older skeletal age,
—: Correlation not significant different from zero,
*: Significant difference at 5% level between correlations of adjacent age levels after transformation into Fisher Z'-scores,
Coefficients *in italics* indicate a significant lower correlation in the older age group in comparison with the adjacent younger age group (after BEUNEN—OSTYN—SIMONS—VAN GERVEN—SWALUS—DE BEUL 1978).

the physical fitness results with chronological age partialed out and within each skeletal age group first order partial correlations have been calculated between chronological age and the physical fitness variables with skeletal age partialed out.

Since the results are fairly similar at all age levels only the partial correlations for boys of 13 (chronological or skeletal age) will be discussed.

Height, weight and static strength (arm pull) are highly related to skeletal age (Table 4). Relationships with other motor fitness components are low but differ significantly from zero, except for eye-hand coordination (stick balance) and speed (shuttle run). Trunk strength (leg lifts) and functional strength (bent arm hang) are negatively correlated with skeletal age at this age, although at 14 or 15 a positive relationship is found. Chronological age has a slight negative relationship to weight and no correlation with height.

Table 4

First order partial correlations between skeletal age (SA), chronological (CA), and physical fitness components. Data for thirteen-year-old boys

	$r_{SA\text{-}Var.CA}$	$r_{CA\text{-}Var.SA}$
Height	0.633	—
Weight	0.604	—0.086
Stick balance	—	0.126
Plate tapping	0.096	0.265
Sit and reach	—	0.063
Vertical jump	0.155	0.101
Arm pull	0.526	0.054
Leg lifts	—0.122	0.100
Flexed arm hang	—0.134	0.137
Shuttle run	—	—0.079
N	2162	1574

— partial correlation not significantly different from zero (after BEUNEN — OSTYN — RENSON — SIMONS — VAN GERVEN 1978).

Of the motor fitness items, the lowest partial correlation is found for static strength (arm pull). For the other tests the correlations are somewhat higher, especially for speed of limb movement (plate tapping).

In a second analysis stepwise multiple regression equations were derived with chronological age and skeletal age as the independent variables for body measures and with chronological age, skeletal age, height and weight, and interaction terms as the independent variables for the motor ability tests. The interactions between the variables were calculated by the product of these variables. The proportion of the variance accounted for by each of the independent variables was calculated by the product of the partial beta coefficient and the zero-order correlation.

Body mesurements

Within each age group only one or two percent of the total variance in body dimensions is explained by chronological age. For most measurements the explained variance is not significantly different from zero. Skeletal age accounts for a larger percentage of most body dimensions. A maximum is reached at 14 or 15 years, after which a rapid decline in the explained variance is observed. At the age of 18 only 0—11% of the variance is still accounted for (Table 5).

Motor fitness

In the age range 12 to 18 years eye-hand coordination (stick balance) is not related to any of the independent variables.

Only a very small percentage (0—3%) of the total variance in running speed (shuttle run) is explained by the variables considered herein. The same holds true for pulse rate at rest and after exercise. For speed of limb movement (plate tapping) and flexibility (sit and reach) the explained variance is low varying from 1 to 7%. The percentage of variance accounted for remains fairly constant for trunk strength (leg lifts) at 8—9%. For explosive strength (vertical jump) and functional strength (bent arm hang) a still higher proportion is explained 4—17%, but the highest predictive value is found for static strength (arm pull). The coefficient of determination increases from 36% at 12 years to 58% at 14 years and decreases to 30% at 18 years. From the analysis it appeared that the interaction between chronological age and skeletal age as such or in combination with height and/or weight explained the largest portion of the total variance for most of the motor fitness components (Table 6).

Table 5

Explained variance ($\beta \times r$) of structural measures accounted for by skeletal age (TW2)

Body dimensions	Explained Variance	
	12–15 years	16–19 years
Body weight	0.34–0.41	0.03–0.25
Stature	0.35–0.49	*ns*–0.14
Sitting height	0.30–0.52	0.02–0.29
Biacromial diameter	0.20–0.38	0.03–0.18
Bicondylar humerus	0.18–0.35	*ns*–0.04
Bicondylar femur	0.08–0.25	*ns*–0.01
Chest circumference inspiration	0.25–0.38	0.03–0.25
Chest circumference expiration	0.24–0.36	0.03–0.24
Thigh circumference	0.21–0.25	0.03–0.20
Calf circumference	0.23–0.28	0.04–0.13
Upper arm circumference contracted	0.17–0.28	0.04–0.23
Supra-iliac skinfold	0.09–0.14	0.02–0.13
Subscapular skinfold	0.07–0.12	0.03–0.15
Triceps skinfold	*ns*–0.03	*ns*–0.00
Calf skinfold	0.00–0.04	*ns*–0.00
Reaching height	0.32–0.46	*ns*–0.12

ns: partial regression coefficient not significantly different from zero ($\alpha = 0.01$). Adapted after BEUNEN—OSTYN—SIMONS—RENSON—VAN GERVEN (1981).

Table 6

Explained variance of motor fitness components

Test	R^2 range 12–18 years	Most important independent variables
Stick balance	*ns*–0.02	CA
Plate tapping	0.01–0.07	CA×SA×HT
Sit and reach	0.01–0.03	HT; CA×SA
Vertical jump	0.04–0.17	CA×SA×HT
Arm pull	0.30–0.58	CA×HT×WT; CA×SA×HT×WT; SA×WT; CA×SA×WT
Leg lifts	0.06–0.09	HT
Bent arm hang	0.09–0.16	WT
Shuttle run	*ns*–0.03	CA×SA
Pulse rate at rest	*ns*–0.01	WT
Pulse rate recovery	*ns*–0.04	WT; SA×WT

R^2: coefficient of determination; *ns:* R^2 not significantly ($\alpha = 0.01$) different from zero; CA: chronological age; SA: skeletal age; HT: height— WT: weight; CA×SA: interaction term chronological age and skeletal age. Adapted after BEUNEN—OSTYN—SIMONS—RENSON—VAN GERVEN (1981).

B. *PHYSICAL FITNESS – MATURITY RELATIONSHIPS IN GIRLS* (based on publications by BEUNEN, OSTYN, RENSON, SIMONS, and VAN GERVEN 1976, BEUNEN, DE BEUL, OSTYN, RENSON, SIMONS and VAN GERVEN 1978).

Here we will consider the following questions:

— what are the relationships between skeletal maturity and physical fitness in adolescent girls and do they change with age?

— what are the relationships between sexual development (age at menarche) and physical fitness and do they change with age?

Table 7

Correlation coefficients between skeletal age, body measurements and motor tests[2]

	Age 12 N = 76 skel. age	Age 13 N=129 skel. age	Age 14 N=94 skel. age	Age 15 N=86 skel. age	Age 16 N=36 skel. age
Height	0.508	0.566	—	—	—
Reaching height	0.482	0.555	—	—	—
Sitting height	0.641	0.618	0.381	—	—
Leg length	—	0.391	—	—	—
Weight	0.367	0.537	0.480	—	—
Bicond. humerus	—	—	—	—	—
Bicond. femur	—	0.359	—	—	—
Bimal. ankle	—	0.378	—	—	—
Shoulder width	—	0.334	—	—	—
Hip width	0.435	0.455	0.517	—	—
Chest width	0.364	0.333	—	—	—
Chest depth insp.	0.393	0.316	0.338	—	—
Chest depth exp.	0.390	0.379	0.342	—	—
Chest depth	—	—	—	—	—
Chest girth insp.	0.488	0.501	0.446	0.289	—
Chest girth exp.	0.477	0.517	0.452	0.313	—
Chest ampliation	—	—	—	—	—
Abdominal girth	—	0.440	—	—	—
Hip girth	0.579	0.599	0.462	0.319	—
Thigh girth	0.397	—	0.367	0.355	0.506
Calf girth	0.475	0.526	0.416	0.351	—
Upper arm girth flexed	—	0.361	0.347	0.295	—
Upper arm girth ext.	—	0.315	0.415	0.306	—
Sub-iliac skinfold	—	0.272	0.275	—	—
Sub-scapular skinfold	—	0.304	0.282	—	—
Upper arm skinfold	—	—	—	—	—
Sum three skinfolds	—	0.262	0.315	—	—
Vertical jump	—	—	—	—	—
Sit and reach	—	—	—	—	—
Leg lifts	—	—	—	—	—
Shuttle run	—	—	—	—	—
Plate tapping	—	—	—	—	—
Arm pull	0.348	0.334	0.281	0.278	—
Bent arm hang	−0.419	—	—	—	—
Dodge run	—	—	—	—	—

— correlation not significant ($\alpha = 0.01$) different from zero.

Adapted after BEUNEN—OSTYN—RENSON—SIMONS—VAN GERVEN (1976).

I. *Skeletal age — physical fitness relationships*

The skeletal age — physical fitness relationships will be treated first. From Table 7 it appears that the highest relationships are found between skeletal age and linear dimensions. Also for most breadth and girth measurements significant correlations are found. For hip width e.g. correlations between .44 and .52 are found for girls 12 through 14. The correlations for skinfolds are low and just significantly different from zero. Starting at 13 all correlations become smaller with increasing age and vanish at 15 to 16 years. For motor fitness only static strength (arm pull) is positively related to skeletal age from 12 to 15 years. At 12 a negative correlation is found for functional strength (bent arm hang). This can be explained by the negative influence of weight for this test (correlation between weight and bent arm hang equals $r = -.432$). For the other factors no significant correlations are found.

II. *Sexual maturity — physical fitness relationships*

In order to investigate the physical fitness-sexual maturity relationships, a sample of 398 girls was subdivided into maturity categories according to the age of first menstruation.

In Tables 8 and 9, the significant differences that were found between the maturity categories in each age group are indicated. For girls between 11 and, 13 years, postmenarcheal girls were taller and heavier and obtained better results for static strength (arm pull and hand grip) and equilibrium (balance test). Only slight differences occurred between the three maturity groups of 14 through 15 year-old girls. These differences were not significant except for one static strength test (handgrip) and one trunk strength test (leg raiser).

A totally different trend was found for girls 16—18 years. For trunk strength (sit up), explosive strength (standing broad jump), functional strength (bent arm hang), running speed (dodge run, shuttle run 40 m and 50 m) and speed

Table 8

Significant differences (t-test; $\alpha = 0.05$) between girls 12—15 years of different menarcheal age for height, weight and motor fitness components

Component	11—13 years pre-post menarche	14—15 years late-aver. menarche	14—15 years late-early menarche	14—15 years aver.-early menarche
Body measures	Height	—	—	—
	Weight	—	—	—
Static strength	Arm pull	—	—	—
	Handgrip	—	Handgrip	—
Equilibrium	Balance test	—	—	—
Trunk strength	—	—	—	Leg raiser
Explosive strength	—	—	—	—
Functional strength	—	—	—	—
Running speed	—	—	—	—
Speed of limb movement	—	—	—	—
Flexibility	—	—	—	—

All differences are in favor of the MORE mature girls
After Beunen—De Beul—Ostyn—Renson—Simons—Van Gerven (1978).

Table 9

Significant differences (t-test; $\alpha = 0.05$) between girls 16—18 years of different menarcheal age for height, weight and motor fitness components

Component	Late-aver.	Late-Early	Aver.-early
Body measurements	—	—	—
Static strength	—	—	—
Equilibrium	—	—	—
Trunk strength	sit up	—	—
Explosive strength	stand. broad jump	—	—
Functional strength	—	bent arm hang	—
Running speed	dodge run	—	—
	shuttle run 50 m	shuttle run 50 m	—
	shuttle run 40 m	—	—
	figure 8 duck	—	—
Speed of limb movement	1 foot tapping	1 foot tapping	—
Flexibility	—	—	—

All differences are in favor of the LESS mature girls.
After BEUNEN—DE BEUL—OSTYN—RENSON—SIMONS—VAN GERVEN (1978).

of limb movement (one foot tapping), several high significant differences were found between girls with a late menarche and girls with an early and/or average date of first menstruation. The late maturing girls always obtained better results than the average or early maturing girls.

In *summary* the results of the Leuven growth studies clearly demonstrate the contrasting maturity-performance relationships during adolescence that are apparent for boys and girls.

In an overview of the factors influencing strength and performance MALINA (1980) came to the same conclusion. The advent of adolescence brings about a marked increase in most motor performance factors (see e.g. BEUNEN, SIMONS, RENSON, VAN GERVEN and OSTYN 1980) and consequently considerable differences are found in boys of contrasting maturity status. Conversely a stagnation or even a decline in motor performance is found in adolescent girls (see e.g. ASMUSSEN 1974, ESPENSCHADE and ECKERT 1967). This contrasting maturity-performance relationship is also found in male and female athletes. In an attempt to explain these inversed relationships in girls MALINA, SPIRDUSO, TATE and BAYLOR (1978) offered a two part hypothesis:

First, the physique characteristics of late maturing females are probably more suitable for success in performance.

Second, among females the advancement in maturity may represent a performance advantage early in adolescence but with the attainment of menarche the early maturing girl is perhaps socialized away from physical performance and sports competition through a myriad of social-and-status-related motives.

Our results also indicate that the motor fitness components are rather independant of the anthropometric dimensions and biological maturity of adolescents. Since that, with the exception of static strength, skeletal age, chronological age, height, weight, neither taken separately, nor in combination with each other, explain high percentage of variance in motor fitness items.

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BODY FAT PATTERNING OF THE SUBCUTANEOUS ADIPOSE TISSUE

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Abstract: The body's fat suit lies adherent to the muscle and is covered and held in place by the skin. The suit is not of even thickness. It varies from a few millimeters to 60 or more. It is a living suit — rich in blood and nerve supply. It grows with the developing body, changing in size and thickness with age, activity and nutrition.

Measurement. The variable thickness of the fat suit can be represented by a sampling of thickness measurements in the various regions of the body. A plot of the raw score thickness values represents the absolute subcutaneous adipose tissue pattern and gives a visual graphical representation of it. When the absolute score values are converted into their Z score equivalents, pattern differences due to amount of fat are eliminated. The degree of similarity between relative fat patterns can be determined by using GARN's (1955) standard deviation of the differences in *z* scores (sigma d *z*), the correlation of the Z transforms, or by a delta vector technique developed by MACDONALD (1978).

Results. Subcutaneous adipose tissue thickness measurements were taken at 15 sites on 20 sets of twins at The University of Western Ontario anthropometrical laboratory. The patterns were assessed for similarity and were found to differ no more than a single individual could differ from himself. The genetic control over the variation was found to be extremely high.

YUHASZ (1977) has shown that male and female athletes as separate groups have patterns similar to each other and to their normal peers. However, intrasport comparison reveals dissimilar individual fat patterns among athletes in the same sport discipline. The relative fat pattern appears to be an individual characteristic, and shows a high degree of stability throughout one's adult life. Dietary restrictions or overnutrition, resulting in changes in total body fatness don't appear to influence the body fat pattern.

Key words: Body composition, fat, subcutaneous adipose tissue, athletes.

Introduction

Human beings store their energy as fat in specialized cells located internally — in the chest cavity, and externally under the skin and adherent to the fascia and muscle. The subcutaneous adipose tissue can be depicted as a close fitting body fat suit that is held in place by the skin. With gross anatomical dissection the fat suit can be dissected from the overlying muscle. The overall dimension, size and mass of the fat suit is dependent upon the body's skeletal and muscular structure.

The fat suit — unlike other clothing used as thermal insulators — is not of even thickness, but varies appreciably in the same individual. Over some body parts there is very little fat, over others there is a great deal. These fat pads — the relatively greater thickness of the subcutaneous adipose tissue in specifically isolated body regions — are common and normal. Fat pads are located on the abdomen, over the iliac crest, over the sacrum, between and below the scapulae, on the inner thigh, over the trochanter, on the calf, and elsewhere. Several variations and combinations are possible and they're not necessarily associated with sex, age, obesity or leanness, or body type. There is no fat on the eyelids, and none on the male sex organ. It is a 'living' suit, rich in blood supply and nerve, and metabolically active. It grows with the developing body, and can change in thickness from season to season, and for some month to month. The suit is bilaterally symmetrical. Its weight may be as low as 4—5% of the body weight (2 or 3 kg) and as high as 60% of the body weight (125—130 kg).

The mature male's fat suit can be differentiated from the mature female suit not only by its size and by the breasts but by the relative greater thickness of the female suit in the upper arm, and upper leg and over the gluteals, whereas the male's suit is thicker in the trunk and thinner in the arms and legs with a smaller amount over the gluteals. The thickness of the subcutaneous adipose tissue measured at 53 sites (EDWARDS 1951) and then averaged for the entire fat suit has been estimated to be 12 mm for women and 7.5 mm for men. The normal female has an average subcutaneous fat thickness approximately 1.75 times that of the normal male. EDWARDS also found that the typical fat pattern for women remains constant over a wide range of body weight and fatness.

Human adipose tissue comprises a very large share of the body's mass. Women, over 30 years of age, have average total body fat values of 32 to 36 per cent, while their muscle weight is approximately 28—30 percent and their bone weight approximately 14—15 percent when compared to their total body weight. The same age group of males will average 25 to 28 percent body fat, 40% muscle and 15 percent bone. Women have over one-half of the weight of their subcutaneous adipose tissue on their legs, about 30% on their trunk and 15% on their arms. The estimate for men differs. They have more on their trunk, approximately 60%, 30% on their legs and 10% on their arms.

The subcutaneous adipose tissue is the largest storehouse of energy. Recent cadaver analysis (ROSS et al. 1981) suggests that 75 to 85% of the total adipose tissue is located externally, and 15 to 25% internally. The percentage varies between individuals and with sex, and increases with increasing fatness. It would be unwise to assume that a constant proportion and a high relationship exists between the amount of internal and external body fat.

The amount and distribution of the subcutaneous adipose tissue has a great deal to do with one's body shape and appearance. Changes in contour of the mature body occurs predominantly because of increases in the thickness of the subcutaneous adipose tissue. In many cases, alterations in the amount and location of one's external fat is of deep concern and worry to many people. Research investigations in this area are attempting to solve some of these problems.

Measurement

In vivo measurement of the thickness of the subcutaneous adipose tissue layer has been accomplished radiographically, and more recently by ultrasound, but hasn't gained widespread use with either instrument due to equipment cost and/or safety. Specifically designed calipers such as the Harpenden caliper are simple to use, relatively inexpensive, have been validated and have gained widespread acceptance for the measurement of the subcutaneous adipose tissue. If a sufficient number of fat site locations are selected from one side and from the various regions of the body, the mass of the external fat and the variation in thickness of the fat suit can be properly represented. To satisfy these criteria, the number of measurement sites should be from 10 to 16. The site locations that have been used are the biceps, triceps, sub scapular, supra-iliac, mid axillary, pectoral or juxta nipple, umbilicus, front and rear thigh, rear and medial calf, trochanter, lower medial and upper medial thigh, pubis and forearm. The head, hands and feet are rarely, if ever, measured. The gluteal region ought to be measured but for practical and personal reasons has not been measured.

Subcutaneous adipose tissue classification by body region

The normal male and female fat pattern or conformation by body region is well recognized and easily described. Further attempts have been made at verbal or descriptive sub-classifications within these patterns with limited success. Indicating the greater relative thickness of the adipose tissue in one or more of the regions and labelling the classification is of general use at best. There are a few females who distribute their body fat like the male norm, and there are males who distribute their fat similar to the female norm. Some individuals have concentrations in the lower body region. This latter classification occurs with some frequency with women. They have exceptionally large amounts of fat on the lower and upper leg, over the gluteals, and throughout the pelvic region, with very low deposits on the trunk and lower and upper arms. Visual judgments of body fat classification have only resulted in a few gross classifications. We must rely on measurement and pattern analysis to be more precise in recognizing additional fat patterns. For example, an individual may display a typical male normal pattern, except for wide variation in the sub-scapular area, or in two areas such as the supra-iliac and the juxta-nipple sites. Are the variations sufficiently large, and do they occur with sufficient frequency to be labelled as different types?

Subcutaneous adipose tissue patterning

The distribution of the subcutaneous adipose tissue can be objectified by measuring the thickness of the adipose tissue layer at different body sites and plotting the raw score thickness values on a suitable coordinate graph; in a specific or set sequence and joining the plotted points. This visual graphical representation of the raw score thickness values represents the absolute subcutaneous adipose tissue pattern or profile. This isolated site technique allows individual or group values to be plotted and compared as to their levels of fatness as well as the shape of the pattern.

If the absolute (raw) score values are converted into their *z* score equivalents, and these measurements plotted on a suitable coordinate graph, pattern differences due solely to the amount of fat would be eliminated. Each individual measurement is expressed relative to the group mean value. The group value is the reference standard or zero pattern and when expressed graphically is a straight line parallel to the abscissa. The standard score or *z* score series of plots has been called the relative fat pattern.

GARN (1955) was the first to work with relative body fat patterns in his quest to identify and categorize human body fat patterns. He developed an objective, numerical approach to pattern comparison. The degree of similarity between an individual pattern to the normal or zero pattern was determined by finding the standard deviation of the *z* scores of the series of plots. Higher values of this index represented a more variable pattern, lower values, approaching zero represented a pattern similar to the normal pattern. As a result of this work, GARN concluded that there were more and more complicated relative fat patterns than we could conveniently forced into categories.

GARN developed another statistic to compare two relative fat patterns. The principle was essentially the same as the one just outlined. The standard deviation of the differences in *z* scores between corresponding plots of the two patterns (sigma dz) was calculated. A value of zero defined a perfect match between the *z* patterns, and values greater than 0.50 indicated dissimilarity between the patterns.

GARN's approach to provide a single index for pattern analysis was the only technique developed strictly for this purpose, but seems to be unduly influenced by crossovers and coincidental points. The product-moment correlation of the paired values would be another way to provide an index value for pattern comparison.

Objective numerical approaches to pattern analysis have and are restricted to the comparison of the shapes of two patterns or profiles at a time. The combined effect of the slopes of the lines joining one plotted point to another reveals the specific characteristics of one's body pattern. In order to compare the shapes of two patterns, one must compare the slopes of corresponding segments in sequence, and combine them. DU MAS (1946) introduced the method and MACDONALD extended and applied it to body fat patterning. MACDONALD (1978) developed the delta vector technique that combines the segment-by-segment results to provide a precise, single meaningful value describing the similarity/dissimilarity of the patterns. The cosine of the angle between the vectors of adjacent pairs of measurement in sequence will range from 1.0 to −1.0.

Genetic influence

In a study by MACDONALD and YUHASZ at the University of Western Ontario, subcutaneous adipose tissue measurements were taken at 15 sites at premarked anatomical landmarks on 20 sets of twins (nine pairs of identical and eleven pairs of fraternal). The raw score values were converted into their *z* score equivalents, and these measurements plotted on a suitable coordinate graph. Intra pair comparison of these relative patterns was made using three techniques; GARN's standard deviation of the differences in *z* scores (sigma dz), the correlation of the *z* transforms in the two patterns and a delta vector technique developed by MACDONALD. The results showed a high degree of similarity between twins, whether identical or fraternal (Figures 1, 2).

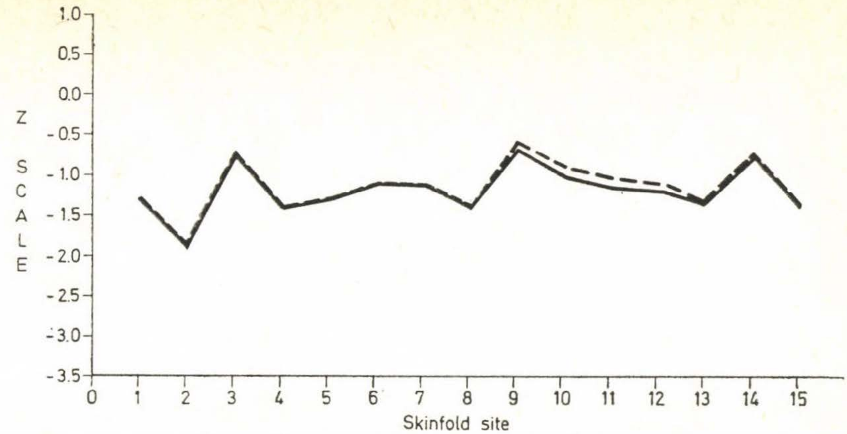


Fig. 1. **Body fat patterns of identical twins**

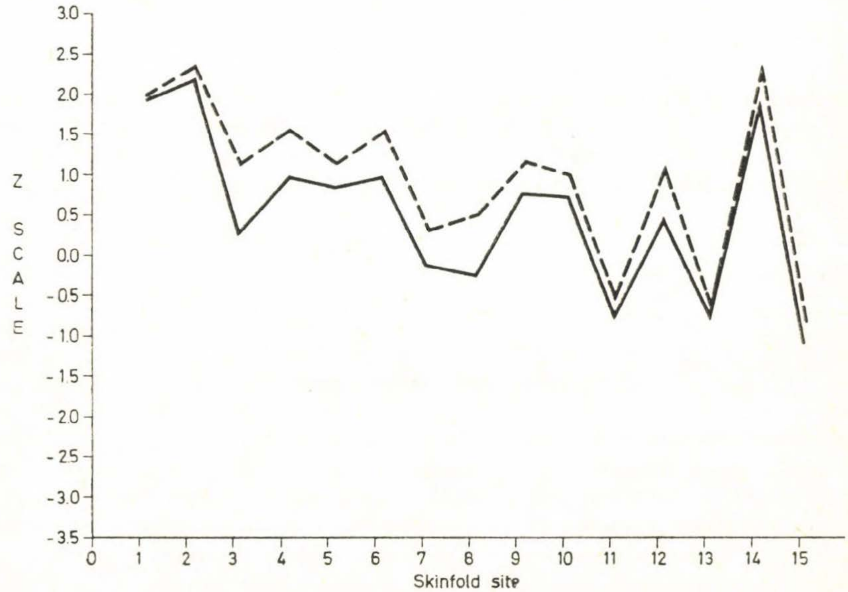


Fig. 2. **Body fat patterns of fraternal twins**

The twins' pattern plots were found to differ no more than a single individual would differ from himself. The genetic control over these values was found to be extremely high.

Athletes

Athletes, as a group, have less body fat than their peers, but their subcutaneous adipose tissue configuration parallels their reference peers (YUHASZ 1977). Male and female college athletes, in a range of individual and team

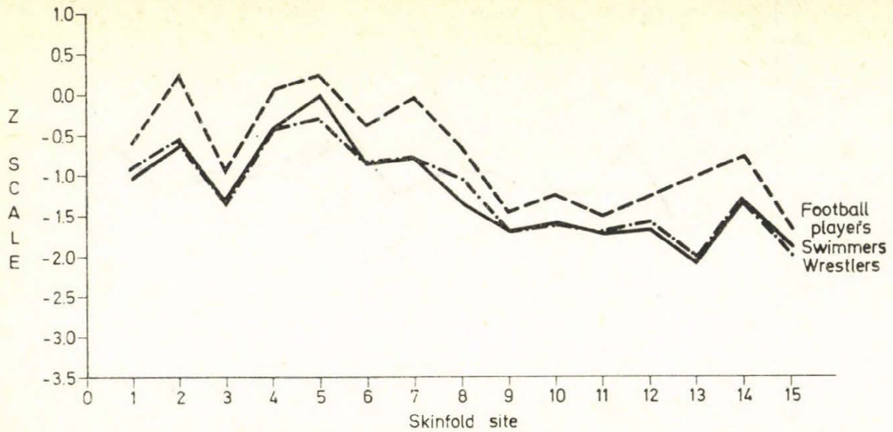


Fig. 3. **Relative body fat patterns of football players, swimmers, and wrestlers (each 8 per cent fat)**

sports such as swimming, basketball, gymnastics, rowing, wrestling and ice hockey, follow this pattern (Fig. 3). Young female athletes, gymnasts, swimmers and skaters, who have achieved a relatively high level of success in their sport at the national level are similar in body fat patterning to their normal peer group.

This also means that athletes in different sports, when compared as separate groups, will display pattern plots similar to each other — as long as the sample size is sufficiently large.

Intra sport comparison

Intra sport comparison reveals dissimilar fat patterns among the athletes in the same sport discipline. All swimmers do not have the same or similar fat patterns; nor do wrestlers, basketball players or hockey players.

In a preliminary analysis of 20 members of a university men's ice hockey team, it was found that seven of the hockey players showed pattern plots that could be recognized as similar to the normal male pattern (Fig. 4). Three others were similar to the male norm except for an extreme difference in one fat site location. The remainder appeared to be different from each other, and could not be classified (Fig. 5). When swimmers, wrestlers and football players who have the same total percentage of body fat, determined by body density techniques, are compared they often have different fat patterns (Fig. 6). When wrestlers and football players, with the same total thickness of adipose tissue are compared, they also have dissimilar body fat patterns (Fig. 7).

There appears to be no requirement for a specific body fat pattern in the sport disciplines mentioned. The athletes bring their own genetically established body fat pattern to the sport in which they participate, and it appears not to influence their performance. We should expect to see some selectivity in the adipose tissue pattern, if a specific pattern were essential to the sport.

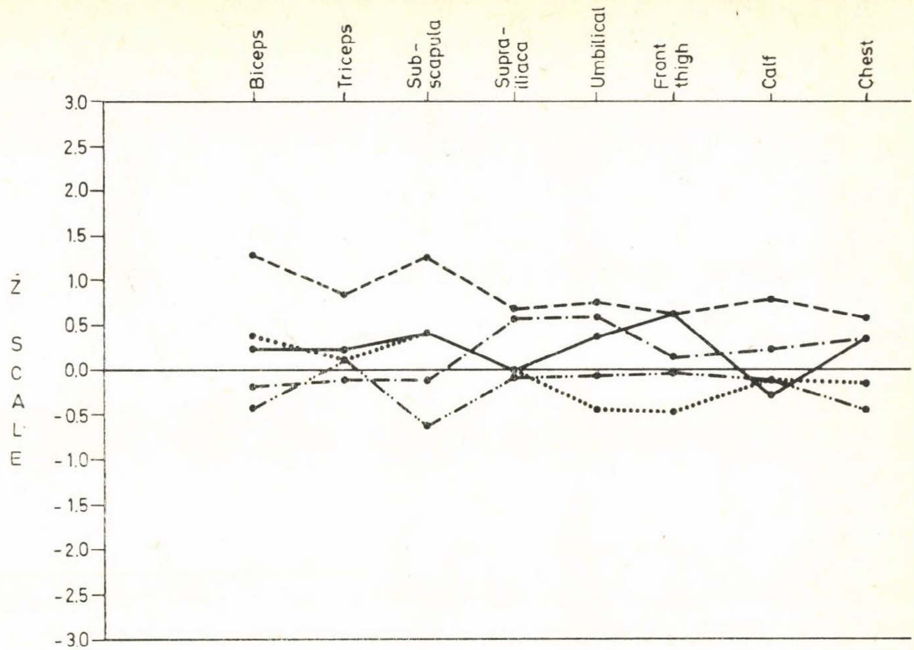


Fig. 4. **Ice hockey players normal relative fat patterns**

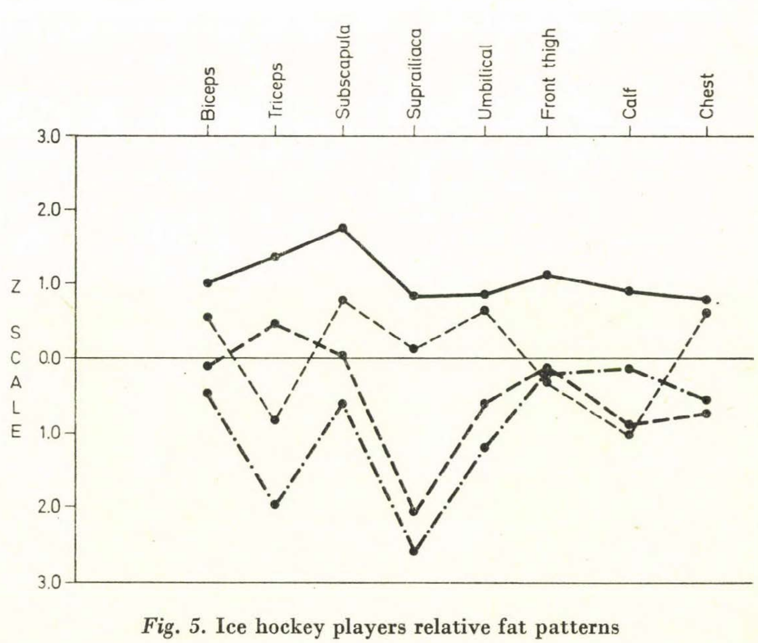


Fig. 5. **Ice hockey players relative fat patterns**

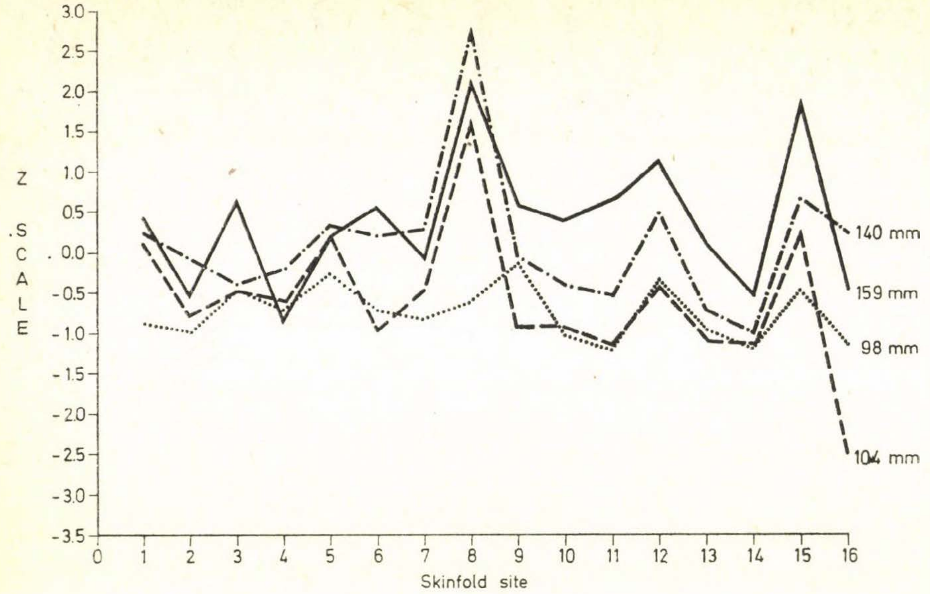


Fig. 6. **Relative body fat patterns of four wrestlers (each 4 per cent fat)**

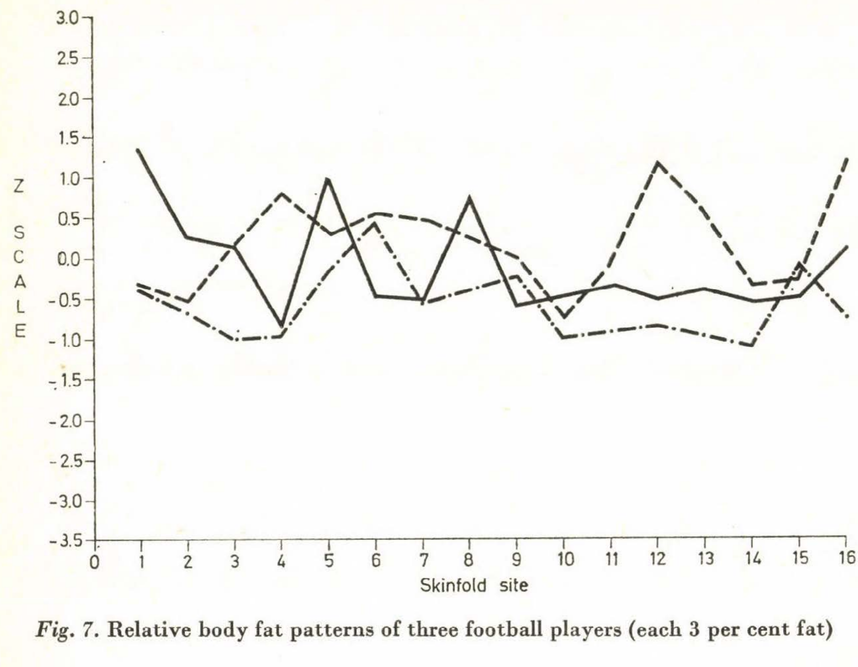


Fig. 7. **Relative body fat patterns of three football players (each 3 per cent fat)**

Effect of training and detraining

Individual male and female athletes who decrease their level of body fatness under intense training conditions in a specific sport appear to maintain their subcutaneous adipose tissue fat pattern, regardless of the specific requirements of the sport. Athletes who are measured some time after the completion of their competitive sport season, also maintain their relative fat pattern.

A female discus and shot putter who was under an intensive training program, including heavy weight training for a 12 month period decreased her body fat significantly, while her pattern maintained the same shape. When we plotted a college wrestler's fat patterns at his peak training period, and after a month of no training, we found that the subcutaneous adipose tissue pattern retained its conformation.

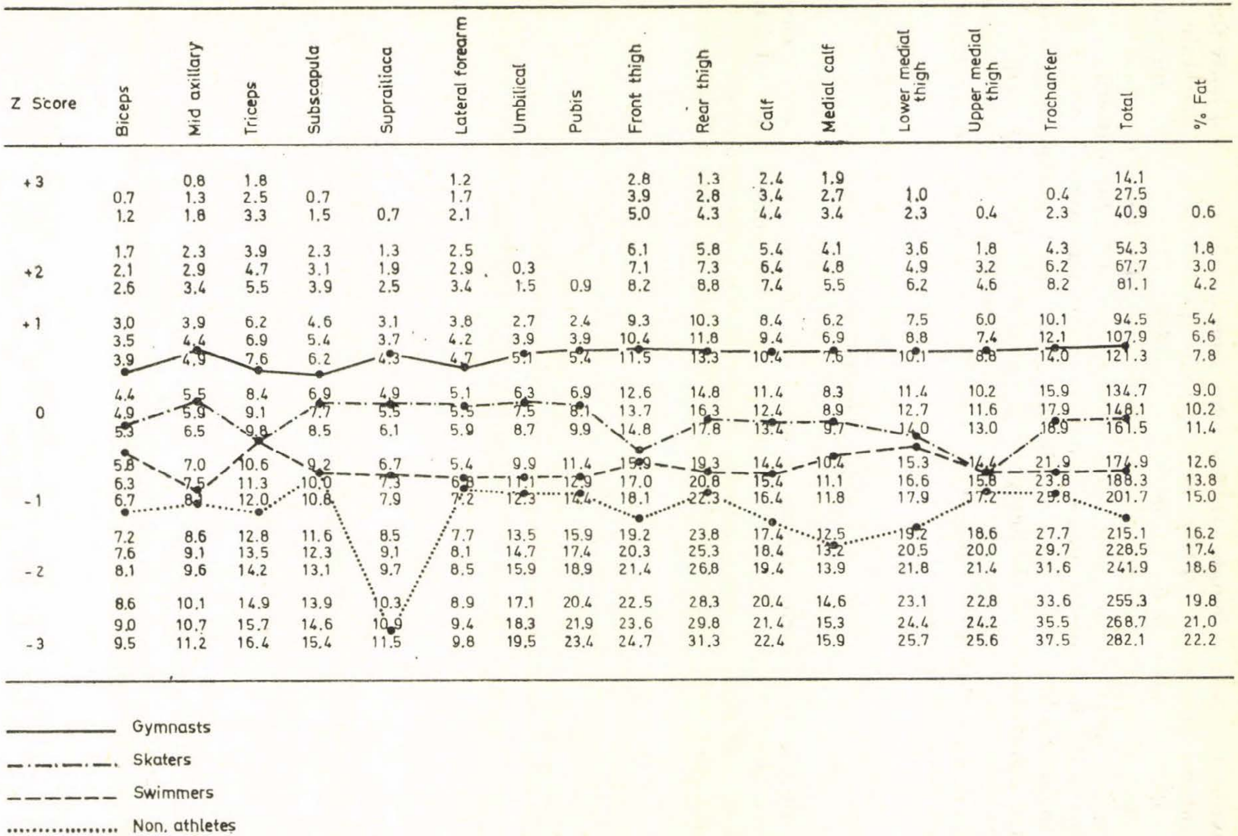
Aging effects

A group of 25 women, ranging in age from 35—54 years, were measured prior to and following a 9 month exercise training program conducted 3 times a week by the author. Subcutaneous adipose tissue measurements were made at 7 sites, and body density and % total body fat calculated. Twenty-five of

Triceps	Subscap.	Suprailiac	Umbilical	Front thigh	Rear thigh	Medial calf
0.7				8.6	1.2	1.0
2.5				10.9	4.0	2.6
4.3				13.2	6.8	4.2
6.1	1.2		2.1	15.5	9.6	5.8
7.9	3.3		5.1	17.8	12.4	7.4
9.7	5.4	1.9	8.1	20.1	15.2	9.0
11.5	7.5	3.9	11.1	22.4	18.0	10.6
13.3	9.6	5.9	14.1	24.7	20.8	12.2
15.1	11.7	7.9	17.1	27.0	23.6	13.8
16.9	13.8	9.9	20.1	29.3	26.4	15.4
18.7	15.9	11.9	23.1	31.6	29.2	17.0
20.5	18.0	13.9	26.1	33.9	32.0	18.6
22.3	20.1	15.9	29.1	36.2	34.8	20.2
24.1	22.2	17.9	32.1	38.5	37.6	21.8
25.9	24.3	19.9	35.1	40.8	40.4	23.4
27.7	26.4	21.9	38.1	43.1	43.2	25.0
29.5	28.5	23.9	41.1	45.4	46.0	26.6
31.3	30.6	25.9	44.1	47.7	48.8	28.2
33.1	32.7	27.9	47.1	50.0	51.6	29.8
34.9	34.8	29.9	50.1	52.3	54.4	31.4
36.7	36.9	31.9	53.1	54.6	57.2	33.0

——— 18 years
– – – – 29 years
.... 37 years

Fig. 8. **A woman's longitudinal relative fat patterns**



Z Score	Biceps	Mid axillary	Triceps	Subscapula	Suprailiaca	Lateral forearm	Umbilical	Pubis	Front thigh	Rear thigh	Calf	Medial calf	Lower medial thigh	Upper medial thigh	Trochanter	Total	% Fat
+3		0.8	1.8			1.2			2.8	1.3	2.4	1.9				14.1	
	0.7	1.3	2.5	0.7		1.7			3.9	2.8	3.4	2.7	1.0		0.4	27.5	
	1.2	1.8	3.3	1.5	0.7	2.1			5.0	4.3	4.4	3.4	2.3	0.4	2.3	40.9	0.6
	1.7	2.3	3.9	2.3	1.3	2.5			6.1	5.8	5.4	4.1	3.6	1.8	4.3	54.3	1.8
+2	2.1	2.9	4.7	3.1	1.9	2.9	0.3		7.1	7.3	6.4	4.8	4.9	3.2	6.2	67.7	3.0
	2.6	3.4	5.5	3.9	2.5	3.4	1.5	0.9	8.2	8.8	7.4	5.5	6.2	4.6	8.2	81.1	4.2
+1	3.0	3.9	6.2	4.6	3.1	3.8	2.7	2.4	9.3	10.3	8.4	6.2	7.5	6.0	10.1	94.5	5.4
	3.5	4.4	6.9	5.4	3.7	4.2	3.9	3.9	10.4	11.8	9.4	6.9	8.8	7.4	12.1	107.9	6.6
	3.9	4.9	7.6	6.2	4.3	4.7	5.1	5.4	11.5	13.3	10.4	7.6	10.1	8.8	14.0	121.3	7.8
	4.4	5.5	8.4	6.9	4.9	5.1	6.3	6.9	12.6	14.8	11.4	8.3	11.4	10.2	15.9	134.7	9.0
0	4.9	5.9	9.1	7.7	5.5	5.5	7.5	8.1	13.7	16.3	12.4	8.9	12.7	11.6	17.9	148.1	10.2
	5.3	6.5	9.8	8.5	6.1	5.9	8.7	9.9	14.8	17.8	13.4	9.7	14.0	13.0	18.9	161.5	11.4
	5.8	7.0	10.6	9.2	6.7	5.4	9.9	11.4	15.9	19.3	14.4	10.4	15.3	14.4	21.9	174.9	12.6
	6.3	7.5	11.3	10.0	7.3	6.8	11.1	12.9	17.0	20.8	15.4	11.1	16.6	15.8	23.8	188.3	13.8
-1	6.7	8.0	12.0	10.8	7.9	7.2	12.3	14.4	18.1	22.3	16.4	11.8	17.9	17.2	25.8	201.7	15.0
	7.2	8.6	12.8	11.6	8.5	7.7	13.5	15.9	19.2	23.8	17.4	12.5	19.2	18.6	27.7	215.1	16.2
	7.6	9.1	13.5	12.3	9.1	8.1	14.7	17.4	20.3	25.3	18.4	13.2	20.5	20.0	29.7	228.5	17.4
-2	8.1	9.6	14.2	13.1	9.7	8.5	15.9	18.9	21.4	26.8	19.4	13.9	21.8	21.4	31.6	241.9	18.6
	8.6	10.1	14.9	13.9	10.3	8.9	17.1	20.4	22.5	28.3	20.4	14.6	23.1	22.8	33.6	255.3	19.8
	9.0	10.7	15.7	14.6	10.9	9.4	18.3	21.9	23.6	29.8	21.4	15.3	24.4	24.2	35.5	268.7	21.0
-3	9.5	11.2	16.4	15.4	11.5	9.8	19.5	23.4	24.7	31.3	22.4	15.9	25.7	25.6	37.5	282.1	22.2

Fig. 9. **11—14 year-old female athletes' fat measurements**

the original 55 women were retested 8 years later. The organized exercise program had been discontinued in the intervening period. A small number of the women had remained physically active with individual programs, or with other organized exercise classes in the community but the majority had reverted to their normal inactive lifestyles. Analysis of the initial and the 8 year later body fat patterns showed that the patterns were similar in most instances. Measurements were available on 1 subject at 18, 29 and 37 years of age, which showed a relatively similar body fat pattern (Fig. 8).

Pre-pubertal girls

In a study presently under analysis in our laboratory, young female elite swimmers, gymnasts, and skaters were similar to each other and to a sample of their peers in their subcutaneous adipose tissue pattern (Fig. 9). When compared with college age swimmers and gymnasts, there appeared to be no difference in pattern.

Summary and Discussion

The location and number of fat cells are genetically influenced, while the level of fatness is environmentally controlled, under normal conditions. Concentration of fat cells in the subcutaneous adipose tissue are relatively thicker in some body regions than in others, and a typical male and female pattern has been described. Most males tend to display patterns similar to the typical male and females to the typical female pattern. The fat pattern, however, appears to be an individual characteristic that is relatively stable over time, at varying levels of thinness-fatness, and is not altered by different forms of physical activity or diet. The deposition or mobilization of fat from the cell cannot volitionally or preferentially be altered by specific forms of exercise, sport or physical activity.

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THE SOMATOTYPE OF HUNGARIAN MALE AND FEMALE CLASS I PADDLERS AND ROWERS

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Abstract: The paper reports on the body build of paddlers and rowers. Al of them are qualified at least as class I athletes, some of them are members of national teams. The report contains the respective characteristics of a physically active group of young adults. The height of the female paddlers is similar to the average Hungarian values. Their larger weight seems to be related to strength training. Of the males rowers are the tallest. Body composition being similar in all studied group of males rowers' greater weight is largely explained by their taller stature and the mentioned training effect.

Key words: Physique, somatotype, paddlers, rowers.

Kayak and canoe belong even today to the successful sports in Hungary. Our national teams generally take part in the finals of the continental or world championships and often win placing, too. Unfortunately, similar statements cannot be made in respect of the national teams of rowers. Few of the Hungarian rowing competitors or crews reach international standards.

Material and Methods

The present paper reports on the body build of Hungarian paddlers and rowers. All of them are qualified at least as national class I athletes, some of them are members of the national teams. As a basis of comparison, the report contains the respective characteristics of a physically active group of young adults. This group consists of students aged 18 to 19 who passed the entrance examination of the Hungarian University of Physical Education in the recent years. The distribution of the subjects is summarized in Table 1.

Table 1

Distribution of subjects

Group	Male	Female	Total
Paddlers	26	30	56
Rowers	15	17	32
Physical education freshmen	819	831	1650

Body build and composition will be characterized by referring to the components of the Heath—Carter's somatotype (CARTER—HEATH 1971) and to the means and variability of body weight and stature.

Results and Discussion

Means and standard deviations of body height and weight of the reference group are denoted by full bars, those of the paddlers by open bars and the ones referring to the rowers by the heavily lined bars (Fig. 1). Stature in the competitive females does not differ from that of the physically active reference women. Bot hfemale paddlers and rowers are of the same weight, but they are heavier than the female freshmen. Of the males the rowers are the tallest exceeding both paddlers and freshmen who do not differ in height. Rowers

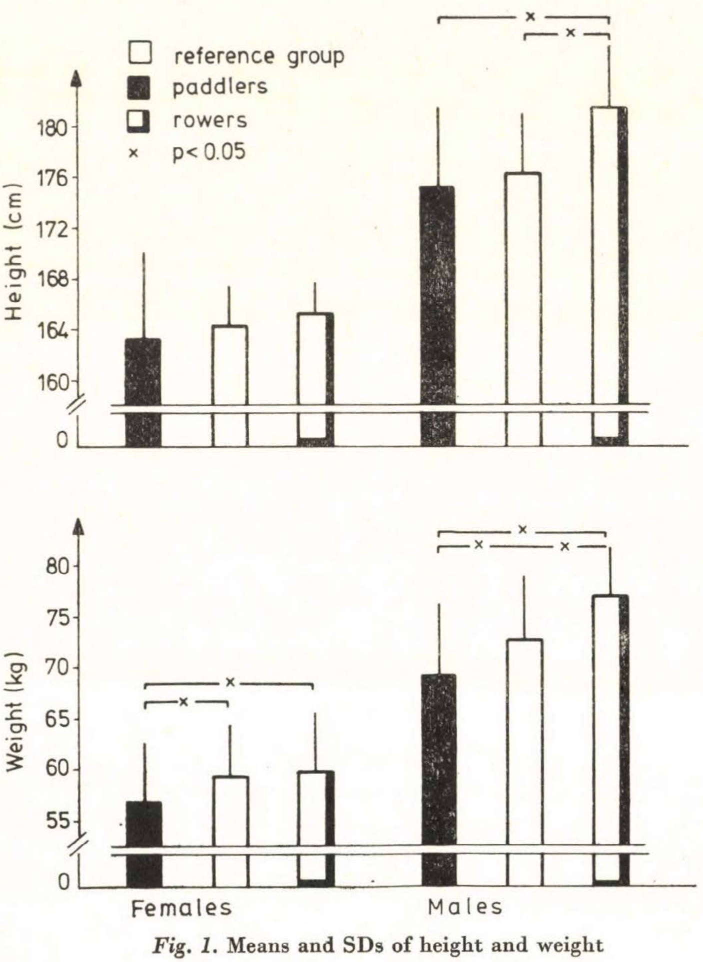

Fig. 1. **Means and SDs of height and weight**

are also the heaviest, but in this variable paddlers too exceeded the reference group.

Figure 2 demonstrates the somatotypes of the females. The full circle refers to the mean of the reference group, the open ones to the paddlers and the squares belong to the rowers. No statistical analysis was made to compare the somatotypes. Components differing by more than half a unit were regarded as different. The first component of the two competitive groups is strikingly

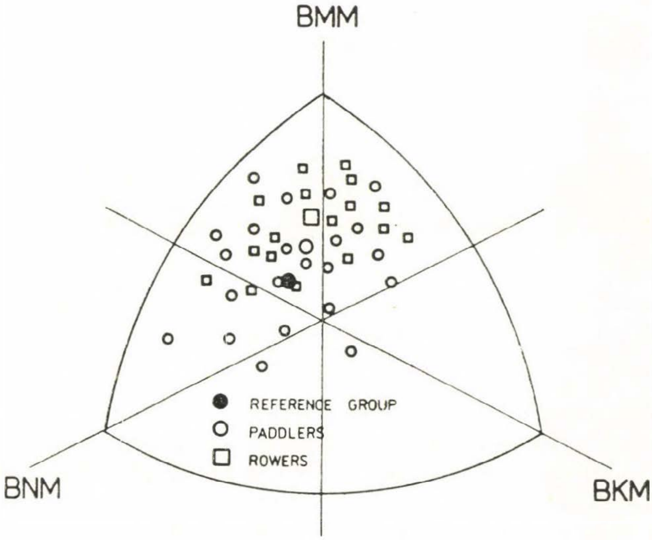

Fig. 2. Somatotypes of the females

similar, but the relative fatness of the freshmen is higher. Variability is largest in the second component, freshmen having an average score while paddlers scored four and a half. Relative robustness was greatest in the rowers and exceeded that of the paddlers by more than three quarters of a unit. The third component was lower than average and similar in all the three groups. The dominant character is robustness in the competitive groups while the share of the other two components in the somatotype is equally below average. The reference group may be called endomorphic mesomorphs.

Figure 3 demonstrates the somatotypes of the males. The groups are denoted by the symbols used before. The share of the first component is the smallest in all the three groups of the males, and the groups do not deviate from each other by more than half a unit. Relative robustness is above average here, too, without any remarkable intergroup difference. Linearity contributes to the somatotype to nearly the same extent as the first component. Since the groups do not differ in this characteristic either, all of them may be designated as balanced mesomorphs.

Our results harmonize with the dominant tendency of our days, namely that in the majority of sports competitors of above average stature and athletic build are the best performers. The height of the paddlers is very similar to the average Hungarian stature, and we may reason that vessels having a standard

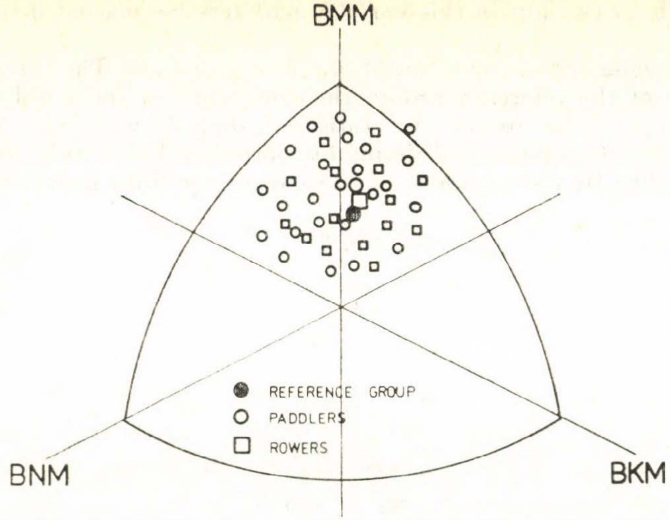

Fig. 3. Somatotypes of the males

size do not offer enough room for giants the balance of whom is also critical. The larger weight of these athletes is likely to be related to strength training. In view of the comparable stature of the female groups the significantly greater weight of the paddlers and rowers is due to differences in body density. This conclusion is, however, indirect and is based on the lower score in relative fatness. In this way, greater weight means greater active mass as well and is directly related to the well-known effects of physical training.

Among the males the rowers are distinctly the tallest, though by their mean stature of 181 cm they look almost like dwarfs beside the national team of the German Democratic Republic who now belong to the best of the world and are about 190 cm tall. Body composition being similar in the three groups, the athletes' greater weight is largely explained by the taller stature. As we saw, the height of the paddlers was comparable to the reference group, their greater body weight has to be explained therefore by the same training affect the analogy of which we have seen in the females.

FARMOSI (1980) found that the height of another sample of Hungarian female rowing competitors was above national average, with an average score in Ist and IInd components.

The mean height of both female and male Polish rower was also above the average Polish stature (DROZDOWSKI 1979).

The male Czechoslovakian paddlers were slightly taller and more robust than the population mean (ŠTĚPNIČKA 1977), and then the Hungarian paddlers of this study. In this Czechoslovakian sample endomorphy was about 1.5, this is rather low though YUHASZ (1977) too reported a fat content of 7–8% only in Canadian rowers. This is as low as that of sport gymnasts who are known to have the lowest content in fat.

Somatometric somatotyping has its natural limits, of course, and in the absence of such important factors as the distribution of body proportions it may be sometimes misleading. In particular for paddlers, the analysis of the proportions between stature and lower limb length, stature and torso as well as those of relative arm length and shoulder width would be a valuable contribution to disclose essential features.

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THE KÖRMEND GROWTH STUDY: BODY MEASUREMENTS

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Abstract: Based on his 25 years' human biological research activity at Körmend (Western Hungary), the author is giving a review on the "Körmend Growth Study". He investigated every healthy child between 3 and 18 years of age in 1958 (K-58), in 1968 (K-68), and in 1978 (K-78). During this period Körmend developed from an agricultural village into a relatively strong industrialized town. Its population increased, the town obtained an urbanized character. Medical attention developed, the interpersonal relations influencing education process of the children improved considerably. Physical activity of the children changed both in quality and quantity.

During the afore-mentioned quarter of a century the growth process of children changed remarkably, however, there are findings which augment our concerns. In 1968 the means of body weight both in boys and girls were found to be heavier than in 1958, and in 1978 weights showed an increase again. In 1968 the means of height were taller in both sexes than in 1958, and in 1978 height also increased, however, on the whole not so intensively than earlier. Biacromial width in every age group and in both sexes was narrower in 1968 than in 1958; in 1978 it was wider than in 1968, but narrower than in 1958. Bicristal width shows a similar trend, however, the decrease of means in 1968, related to those in 1958, were greater. Chest circumference does not show any one tendency. Girth measurements of the extremities did not change remarkably between 1968 and 1978, except calf circumference. Bicondylar widths were wider in 1978 than in 1968, especially in femur. Skinfolds were thicker in 1978 than in 1968. — The age at menarche of Körmend girls changed to earlier ages; in 1958 m = 13.6 ± 0.06 year, in 1968 m = 12.75 ± 0.04 year, and in 1978 m = 12.80 ± 0.04 year.

The physique of Körmend children became more linear, but a little bit fatter. The reasons of these changes are mostly due to environmental factors, belonging to the concept of secular changes.

Key words: Körmend Growth Study, Western-Hungarian youth, body measurements, age at menarche.

Introduction

A special kind of growth studies, a series of recalled cross-sectional growth studies were carried out at Körmend, a small town in Western Hungary. The first investigations of this series were made in 1958, then 10 years later, in 1968 the second series, and again 10 years later, in 1978 the third series.

The present contribution is aimed at

1. presenting an example for secular changes in body measurements of the youth in Hungary,

2. demonstrating the effect of urbanization and differentiation of social strata influencing growth and development of children at Körmend, as well as

3. laying down a documentation of the results of the Körmend Growth Study in body measurements, before a monographic publication.

Besides of the Körmend Growth Study (hereafter KGS) follow-up investigations, also some other, mostly partial human biological investigations were carried out at Körmend by the same author. As an "*inventory*" of these investigations it is worth mentioning that the first informing growth investigation on grammar school pupils was carried out in the mid-1950s, and a nation-wide systematic growth study of the Hungarian youth was proposed (EIBEN 1958a, 1958b). The survey of growth was combined with a study of physical fitness (EIBEN 1959a, 1959b, 1966). The first series of KGS started in 1958. Based on these investigations it was possible to describe a certain periodicity of growth process (EIBEN 1960a, 1961a, 1961b, 1962a, 1963a). On some aspects of these growth studies — such as nutrition of the children (EIBEN 1961c), the head and face measurements (EIBEN 1967a), body surface (EIBEN 1967—68), some methodological problems of growth studies (EIBEN 1961d), some pedagogical consequences (EIBEN 1961d, 1962b, 1963c, 1964, 1976) — the author published several papers. He also analysed the secular changes, and in the late 1960s he elaborated the first Hungarian reference-zones (EIBEN 1967b, 1969a, 1969b, 1972b, 1972c).

As additional data to all these, he published the body measurements of Körmend newborns (EIBEN 1960b, 1963b), as well as the age at menarche of Körmend girls (BOTTYÁN et al. 1963, EIBEN 1961a, 1968, 1970, 1971, 1972a, EIBEN—BODZSÁR 1970). He published the first data on bicondylar widths in Hungary in the mid-1970s which were based on the 1968 investigation of the KGS (EIBEN 1975). Based on the KGS in 1958 and 1968, he investigated the changes in motor activity and the mode of Körmend children's life (EIBEN 1977a), and analyzed the changes in body measurements and proportions of children (EIBEN 1977a, 1977c, 1978, 1979a, 1979b). Some information on KGS can also be found in IBP-volume of COLLINS and WEINER (EIBEN 1977b).

Recently, the author has presented these investigations and their results at several congresses (EIBEN 1981a, 1982a, 1982b, 1982c), in a report (EIBEN 1981b), and in a supplementum-volume (EIBEN—PANTÓ 1981).

The place of the investigations: Körmend

Körmend, often referred to as the "Gate of the Őrség region" is located in the valley of the river Rába in the western part of county Vas. The left bank of this river was already inhabited in ancient times. The history of the settlement, mentioned in early documents written in Latin by the name of *Curmend*, dates back to the Roman times. In the neighbourhood of the town the remains of the "Amber Road" or, as mentioned in a document dating from the year of 1274, the Via Latinorum can be found even in our days.

Körmend was granted the franchises of a town, a right of local government in 1244 by King Béla IV; it ceased to be a royal domain in 1394 and became the property of the *Peleskei* and later that of the *Széchy* family. Up to 1606 it changed hands several times, and then it became the property of the *Batthyány* family for more than three centuries.

Owing to its favourable geographic situation, the settlement is an important communication centre; therefore both the municipality and the population of the town have always made every effort to develop commerce. The merchants of Körmend asserted their exemption from tolls all over the country, moreover, even in the territories beyond its borders.

The development of industry does not present so favourable a picture. Even as late as in the 19th century and in the first half of the 20th, its advance was rather slow. In consequence also the number of the inhabitants grew at a slow pace: in 1909 the population was only 6757. Although in the period of economic prosperity after the Compromise of 1867 (between Hungary and Imperial Austria) the progress accelerated also in Körmend, its town status, however, was withdrawn in 1871. In subsequent years its status alternated between that of a small and large village, respectively. Since 1979 Körmend has had its town status again.

At the close of the 19th and early in the 20th century several attempts were made at establishing factories at Körmend. However, these endeavours were short-lived. The number of persons employed in the industry was all in all 1113 even in 1930.

Following World WarII, the years of reconstruction, the reorganization of agriculture, and, in particular, industrialization determined its development fairly favourably. Parallel with the large-scale industrial development beginning in the early 1960s, the number of Körmend's inhabitants grew rapidly. Important industrial branches were formed: pharmaceutical and food industrial, shoe manufacturing, timber conversion, brick-making. As a result of industrialization, the settlement has displayed and accelerated development in all fields of life in the past two decades. Besides the factories and vast modern housing estates also the new hospital, the public infants' nurseries, nursery school, the secondary school, the building of the primary-school students' boarding house, and of the new gymnasium, as well as the extended services of the Town and District Library, the prosperous and successfully working amateur ensambles of art, hallmark the effort was covered by the people of Körmend towards obtaining the status of a town.

One of the sights which attracts perhaps most foreign tourists is the Batthyány Castle, an artistic monument built upon the foundation of a water-fortress of the Árpád dynasty. Out of the medieval castle the two-storey, mansard-roofed baroque-like baronial mansion was formed in the 18th century. The order of columns of the entrance, the balcony resting on them, and the reversed adornment of the annexes already remind one of classicism. The ancient monuments of the castle yard: the buildings having more than one storey to be seen on the right and left sides of the main wing, the former marble hall and archive, as well as the riding-hall have at present cultural and industrial functions.

A further outstanding monument of art at Körmend is an example of classicist statues, infrequent even in all-Hungarian respect: the statue of St. John Nepomucenus to be found on the left bank of the river Rába. — The one-steepled Roman Catholic church of Petőfi square has a sanctuary of medieval origin. — The Immaculata (Immaculate Virgin Mary) statue in Szabadság square, the Calvinist and Lutheranian churches, as well as several dwelling houses and public buildings are art monuments, and of great importance in the townscape. The town is surrounded by pleasant places of excursion and fine forests.

Material and Methods

Three investigations were carried out at Körmend: in 1958 (K-58), in 1968 (K-68), and in 1978 (K-78). The number of the samples and the number of the inhabitants of Körmend developed as follows:

K-58	N = 1656,	7,500 inhabitants,
K-68	N = 1736,	10,000 inhabitants, and
K-78	N = 2420,	12,500 inhabitants.

Practically every healthy child at Körmend between 3 and 18 years of age of both sexes was investigated. Those suffering from serious anomalies or congenital defects were excluded. The number of the age groups of every investigation is given in Table 1. These figures are constant for all body measurements taken in each cohort.

Besides of the individual identification's data (subject's name, place and date of birth) some socio-demographic data were also registered (e.g. birth rank; number of siblings, living, dead; name, place of birth and occupation of the father and of the mother; distance from home to school, etc.).

The anthropometric programme was quite detailed. In K-58 15 body measurements and also 10 face and head measurements were taken, however, at this time the author was not able to measure the skinfolds and the bicondylar widths. In K-58 programme there were some other anthropologic characters such as grasp of the hands, colour of eyes, colour of hair, in girls also the age at menarche, etc. In K-68 21, and in K-78 23 body measurements were taken. From these data seven further measurements and indices were calculated (e.g. length of the upper and lower extremities, Kaup index, etc.). All these are identifiable in the tables.

The K-68 investigation was performed within the International Biological Programme (IBP/HA).

Table 1

The number of Körmend children investigated in frame of the Körmend Growth Study

Age (year)	K-58		K-68		K-78	
	Boys	Girls	Boys	Girls	Boys	Girls
3	13	18	12	17	23	21
4	24	33	22	33	71	68
5	38	22	35	20	59	75
6	49	41	41	29	75	72
7	79	103	53	43	78	75
8	71	62	53	39	80	80
9	61	60	67	52	94	87
10	65	68	51	46	60	69
11	67	65	60	48	93	61
12	41	76	67	43	121	76
13	59	64	87	72	103	88
14	66	65	85	81	81	108
15	50	56	140	73	109	59
16	66	31	109	45	92	62
17	53	22	89	65	86	77
18	44	24	25	34	77	40
Together:	846	810	996	740	1302	1118
Sum total:	1656		1736		2420	

The measuring methods used correspond to MARTIN's measure-techniques (MARTIN—SALLER 1957), taking into consideration also the recommendations of the IBP (see TANNER et al. 1969).

In the course of mathematical-statistical elaboration, the usual parameters were calculated ($\bar{x}$ = means, s = standard deviation, W = range), by which the results of the three investigations (K-58, K-68 and K-78) were comparable. These results are shown in Tables 2—41 with an intention to give a wide documentation of anthropometric data of the KGS. Further elaboration of these data is still in process.

Collecting data of age at menarche also belongs to KGS. Data collection was carried out with "status quo" method, calculation with probit analysis.

Results

In K-68 the mean *weights* of Körmend children, 0.3—3.2 kg in boys and 0.4—5.5 kg in girls, were heavier than in K-58. In K-78 weight increased again; it was found to be 0.5—6.2 kg and 0.9—4.6 kg in different age-groups of boys and girls, respectively (Tables 2 and 3).

In K-68 the mean of *height* was 1.2—5.5 cm in boys and 0.8—5.4 cm in girls taller than in K-58. In K-78 height also increased, however, on the whole not so intensively as earlier: 0.9—6.1 cm in boys and 0.1—6.4 cm in girls (Tables 4 and 5).

Sitting height, the length of the upper extremities, and the length of the lower extremities measured as height of anterior superior iliac spine correlate correctly with height of the children, thus these measurements show more or less a similar tendency as height. Mean values of *sitting height* do not change between K-68 and K-78 as intensively as height, especially in older age-groups (Tables 6 and 7). The *length of the upper extremities* show small changes between K-58 and K-68, and also between K-68 and K-78 (Tables 8 and 9). The *length of the lower extremities*, as a part of the stature, follows duly its changes (Tables 10 and 11).

Biacromial width in every age-group and in both sexes was narrower in K-68 than in K-58: the differences were 0.2—0.9 cm in boys and 0.2—1.9 cm in girls. In K-78 it was wider than in K-68, but narrower than in K-58 (Tables 12 and 13). *Bicristal width* shows a similar trend, however, the decrease of the means in K-68, related to those in K-58, were greater. In K-78 the mean values were greater than in K-68, but not as great as in K-58 (Tables 14 and 15). Mean values of *transverse chest diameter* increased modestly from K-58 to K-68, and again from K-68 to K-78. Except for two cases, differences are less than 1 cm (Tables 16 and 17). One can find the same in the *antero-posterior chest diameter:* the differences are small (Tables 18 and 19).

Chest circumference does not show any one tendency but one cannot speak of an increase in means either (Tables 20 and 21). The circumferences of the extremities were measured by the K-68 investigation. Mean values of *upper arm circumference* are not greater (if not smaller) in K-78 than in K-68 (Tables 22 and 23). *Thigh circumference* starts in the early childhood with smaller mean values in K-78 than in K-68, in boys till 7 years of age, in girls only till 5 years of age. By these ages means are generally higher in K-78, in boys more expressed than in girls (Tables 24 and 25). *Calf circumference* shows relatively greater increases in K-78 as compared to K-68 in both sexes, but this change is more remarkable in boys (Tables 26 and 27).

Bicondylar widths were measured only in K-68 and K-78, there are no data from K-58. *Bicondylar width of humerus* does not show any unambiguous tendency, however, mean values in K-78 are higher in more age groups than in K-68, especially in boys (Tables 28 and 29). *Bicondylar width of femur* produces the same phenomenon, more remarkably in boys (Tables 30 and 31).

Subcutan fat were measured in K-68 at five, in K-78 at six places of the body, no data in K-58. Means of *skinfolds* in K-78 are practically in all cases higher than in K-68 (Tables 32—41).

Analyzing the *age at menarche* of Körmend girls constitutes the basis of another paper, however, it seemed to be necessary to give its median values in the Abstract of this paper.

Discussion

The KGS — as the cross-sectional growth studies in general — is not meant to explain the growth and development *process* of the Körmend children, however, it presents *information with human biological contents and value* about differences between age groups. On the other hand, means of body measurements in different age groups following each other in a certain series do not show in all cases any increase. But this is characteristic of cross-sectional growth studies.

Instead of studying the rate of growth we can analyze the *age differences*. Supposing that the age groups following each other have very similar population genetical and environmental (socio-economic, etc.) factors influencing their growth and development, age differences may serve as "quasi growth rates".

In this paper special emphasis is laid on the *age differences in height.* In K-58 *boys* show the greatest age differences, 8.16 cm, between the 11 and 12 year age groups, then between the 14 and 15 year age groups (8.62 cm). These "quasi peak height velocities" may be explained as prepuberal and puberal growth spurts. In K-68 prepuberal gain is not so expressed, it seems to be distributed in the 10—12 year age groups. Between the 14 and 15 year age groups there is a gain of 7.19 cm, as a "quasi puberal growth spurt". In K-78 prepuberal growth gain seems to merge in the 10—11—12 year age groups, but between the 12 and 13 year age groups there is a gain of 6.95 cm, and between the 13 and 14 year age groups there is a gain of 7.70 cm. Thus it may be concluded — corresponding to the concept of secular changes — that puberal growth spurt also occurred earlier in Körmend boys.

The age groups of *girls* show a different character. In K-58 between 9 and 10 year age groups there is a difference of 6.94 cm, and then every age group is taller by 5—6 cm than the previous one. In K-68 the great age differences are distributed between 9 and 13 years, but there is a striking age difference (7.91 cm) between 11 and 12 year age groups. In K-78 this phenomenon is more or less similar: the great age differences are also between 9 and 13 years. The greatest one, however, appears between 10 and 11, then between 12 and 13 year age groups. It seems to be a tendency that a puberal growth spurt also in Körmend girls occurs earlier.

The well-known difference between boys and girls in this relation is recognizable also in Körmend children: the above described "quasi peak height velocity" appears earlier in girls.

The KGS showed that the Körmend children, in general, had became larger. During a quarter of a century their stature and weight had increased, but their trunk had became slender. Building-up of their extremities had not changed too much. Circumference of the upper arm practically had not changed at all. The only remarkable changes in a positive direction were found in calf circumference; these really demonstrate some increase in muscle-mass. The modest increase in thigh circumference seemed to be in connection with increase of fat and not of the muscles.

The fact, that girth measurements, in general, did not show an increasing tendency during the investigated period, but at the same time subcutan fat became greater, calls our attention to an undesirable phenomenon: a weak development of children's musculature. Physical education, and thereby muscle power of the children should be improved more intentionally. These findings indicate necessity of further investigations connected with physical fitness of Körmend children.

The above-described insufficiency seems to be interrelated to changes in mode of life at Körmend. The development of the settlement from an agricultural village into a relatively strong industrialized town, increasing of its population, in general: its urbanization consists of several parts.

Medical attention, compared to K-58, has developed about 150—200 per cent, first of all in the school doctors' service, the number of doctors, number of beds in the hospital, capacity of the polyclinic, and in like areas.

Nutrition of the children has also changed. Instead of a fat- and carbohydrate nutrition (cereals) which was characteristic for the Hungarian diet of K-58's period, today (K-78) it is more mixed, richer in proteins. On the other hand, however, it is rich in calories, too. In the last decade the increase of sugar consumption is considerable.

Nursery schools and schools became more modern. Interpersonal relations influencing the educational process of children improved remarkably. In K-58's period many teachers had only college certificates, now (K-78) the majority of them has his/her university-level diploma.

Physical activity of children changed both in quality and quantity. Instead of taking part in hard peasant work beside their parents (in K-58 period), children can now (K-78) participate in different sports in a very large, modern gymnasium. The grammar school pupils do not need to bicycle every day 10—20 km from home to school and back, as several of them living in the surrounding villages did in K-58's period. This could cause their wide hip (c.f. values of bicristal width in K-58 and K-68 !). Today, they live in a well-equipped student home. There is a tendency to have every modern comfort. On the other hand, however, spontaneous physical activity of children became to be limited, a mode of "sitting life" spread. The less physical activity combined with high calory intake led to overweight in many children, also at Körmend.

All these phenomena: biological, socio-economical, and demographic changes together led also to a differentiation of social strata, as well as to the fact, that the population's genetic balance of Körmend also changed slightly, first of all because of migration.

Accordingly, there are some problems. With full knowledge of the results of K-68 investigation, we put the questions:

— Do we consider the more linear physique of the children an "improvement" or is it a phenomenon showing a tendency for regression?

— How can these children resist "the benefits" or injuries of civilization, and how will they achieve the balance of their somatic and mental development?

— How will these children, having a more linear physique, be able to adapt to the burdens of a modern life?

Are these questions timely also today?

In the meantime the "more linear" physique of Körmend children became a little bit fatter. Their growth and development on the whole seems to be satisfactory. Taking into consideration the remarkable improvement of the environmental factors influencing their growth, they seem to come close to their *genetically given* possibilities in growth and development. The earlier regression in growth (c.f. Eiben 1967b, 1972b) seems to be eliminated also in Körmend children. Hence, some good tendencies are recognizable. The mentioned environmental factors have further, up to the present not yet well-utilized aspects. With a more intentional improvement of these, the desirable tendencies could be more considerable. To sum it up, based on a quarter of a century's growth study, secular changes seem to be manifested in Körmend children.

Table 2

Weight of Körmend boys (kg)

Age (years)	K-58			K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W	$\bar{x}$	s	W
3	14.54	1.56	12.5—16.7	14.83	1.91	12.0—19.5	14.87	1.42	12.5—18.0
4	26.75	2.28	13.5—21.0	15.64	1.85	13.0—19.5	16.05	2.01	11.5—23.0
5	18.23	2.22	14.0—24.0	18.03	2.49	13.5—23.5	17.58	1.97	12.5—21.5
6	19.28	2.28	15.0—23.5	20.36	3.16	16.0—29.0	19.89	2.72	15.0—28.0
7	19.67	2.55	15.0—25.0	21.74	2.35	17.5—27.5	22.96	3.74	16.5—35.0
8	23.54	3.75	16.0—35.0	24.34	3.57	17.5—37.0	27.10	4.26	17.0—41.0
9	25.13	3.48	19.0—34.5	27.07	5.59	16.0—50.5	28.91	5.27	19.0—47.7
10	29.12	4.65	19.5—42.0	30.35	4.78	20.0—65.0	32.33	6.44	22.0—56.0
11	29.96	4.11	20.0—39.0	32.65	5.79	26.0—54.0	34.40	6.45	22.5—59.0
12	33.74	5.88	27.0—55.0	35.42	5.65	27.0—50.0	38.78	7.69	26.0—75.0
13	37.98	5.43	25.0—53.0	39.57	7.27	29.0—65.5	43.79	9.24	29.0—81.0
14	41.30	8.97	26.0—77.0	44.47	8.06	29.5—73.0	50.91	10.31	29.0—92.0
15	50.16	8.88	31.5—75.0	51.59	9.45	33.5—91.0	54.33	8.58	36.0—79.0
16	54.41	6.60	35.0—70.0	56.60	9.86	34.0—95.0	59.34	8.49	42.5—90.0
17	57.17	8.52	45.0—80.0	60.21	6.63	45.0—79.0	59.42	7.75	38.5—81.0
18	61.77	8.22	45.5—80.0	59.48	4.72	52.0—68.5	64.40	7.96	48.5—80.0

Table 3

Weight of Körmend girls (kg)

Age (years)	K-58			K-68			K-78		
	$\bar{x}$	s	W	–	s	W	$\bar{x}$	s	W
3	14.33	2.13	12.6—19.0	13.35	1.75	10.5—17.5	14.67	1.77	11.0—19.0
4	16.09	1.77	13.0—20.5	16.09	2.31	12.5—22.0	15.75	2.10	11.0—21.0
5	17.59	2.28	12.5—21.0	17.32	2.37	14.0—20.5	17.87	2.29	12.0—24.0
6	20.49	3.39	13.5—26.5	21.11	3.93	15.5—35.0	19.47	2.89	14.5—29.8
7	20.42	3.30	17.5—38.0	21.84	2.58	17.5—28.0	22.73	3.73	15.5—40.0
8	21.82	3.96	17.0—41.0	24.21	3.57	29.0—33.0	24.69	4.16	17.0—35.5
9	25.40	4.65	16.0—40.0	26.31	4.07	19.0—40.0	28.81	4.16	19.5—46.0
10	29.08	4.35	22.0—43.0	31.46	5.83	22.0—52.0	31.06	5.66	21.0—51.5
11	39.92	5.52	21.5—48.0	34.19	7.13	25.0—59.5	35.30	7.00	25.0—56.0
12	35.21	7.23	23.0—58.0	39.72	7.63	27.0—63.0	40.28	8.26	24.5—68.5
13	38.06	5.82	28.0—54.5	43.54	7.75	28.0—63.0	45.36	8.53	27.5—71.0
14	44.91	7.14	33.0—70.0	47.81	7.22	35.5—75.0	48.77	8.31	26.0—86.0
15	48.96	6.30	33.0—62.0	51.69	7.09	40.0—75.0	51.17	8.16	35.5—75.0
16	48.97	6.09	34.5—60.0	52.20	7.36	40.5—68.5	51.92	6.96	38.0—77.0
17	51.41	6.36	41.0—64.0	52.74	6.86	41.0—70.0	54.92	9.10	34.0—88.0
18	54.00	2.90	42.0—78.0	55.56	6.49	43.0—68.0	52.38	6.21	42.0—65.0

Table 4

Height of Körmend boys (cm)

Age (years)	K-58			K-68			K-78		
	x̄	s	W	x̄	s	W	x̄	s	W
3	94.46	4.38	96.4— 99.0	97.99	3.74	94.3—104.5	97.57	3.46	91.8—106.3
4	100.12	4.44	93.3—110.3	101.73	4.13	95.3—111.5	102.23	4.04	91.7—110.5
5	107.66	5.13	98.2—112.0	109.40	5.34	100.5—125.3	108.70	4.24	98.3—115.8
6	112.43	4.77	99.9—121.4	114.88	5.38	106.1—132.6	115.72	5.10	100.4—138.8
7	116.86	4.83	106.8—128.6	120.60	4.92	108.9—130.1	121.22	5.37	111.5—138.8
8	123.43	5.43	109.3—133.8	126.07	5.30	117.0—137.3	126.93	6.10	111.5—141.3
9	128.62	5.76	115.6—144.2	131.18	6.26	112.7—143.0	132.87	6.36	111.7—148.5
10	134.20	6.60	121.3—149.8	137.29	7.08	115.8—160.3	139.10	6.28	126.0—152.7
11	135.60	6.60	115.8—151.5	141.20	7.54	122.8—158.0	142.46	6.22	128.1—155.7
12	143.76	7.53	132.6—165.0	145.26	6.71	133.3—162.5	148.26	6.86	134.0—164.8
13	148.81	6.78	133.8—164.7	152.07	7.34	135.7—170.8	155.21	8.39	137.4—173.0
14	153.00	8.85	134.1—169.5	156.85	8.36	135.1—177.5	162.91	7.71	146.0—180.8
15	161.62	8.31	143.7—179.8	164.04	8.46	130.0—191.0	166.76	8.05	148.2—189.8
16	164.82	5.79	147.5—176.4	167.74	7.07	152.0—187.7	170.59	6.73	146.4—188.4
17	166.45	7.08	149.9—181.4	171.07	6.54	158.0—190.3	172.21	7.74	157.8—186.1
18	171.18	7.44	153.7—182.4	171.12	7.37	157.7—186.5	172.83	6.38	159.6—187.1

Table 5

Height of Körmend girls (cm)

Age (years)	K-58			K-68			K-78		
	x̄	s	W	x̄	s	W	x̄	s	W
3	95.00	4.41	86.4—110.4	94.23	3.69	86.5—102.5	96.67	3.48	87.4—103.4
4	101.00	3.39	93.5—109.6	103.09	4.29	96.0—113.3	102.03	5.52	85.0—115.3
5	105.27	4.53	98.9—110.0	109.25	5.26	99.0—119.3	109.11	4.89	94.6—120.8
6	113.56	5.37	110.9—123.3	115.65	4.31	107.5—124.8	114.94	4.67	106.0—127.2
7	117.40	4.92	105.2—130.5	121.43	5.98	108.5—131.3	121.03	5.08	109.3—130.8
8	120.77	6.18	109.3—132.5	126.15	5.69	115.8—137.3	126.25	5.92	114.4—139.3
9	125.45	6.51	111.8—141.2	130.09	4.64	119.7—142.2	132.60	6.75	115.6—154.4
10	132.39	7.68	119.1—148.7	137.06	6.37	125.8—153.0	137.97	7.24	119.5—160.8
11	137.72	7.41	118.1—156.3	141.44	6.22	128.0—153.8	144.07	5.41	132.0—155.5
12	144.35	7.11	126.6—159.1	149.35	6.55	138.3—164.2	148.09	6.19	133.4—164.5
13	149.81	6.06	133.4—168.8	154.75	7.13	139.8—172.0	155.80	6.48	134.4—170.8
14	155.31	4.89	138.8—167.7	156.33	4.73	143.8—165.4	158.26	5.83	140.9—172.5
15	157.76	5.73	147.3—168.4	158.62	4.87	148.0—170.3	160.54	6.29	146.3—181.3
16	157.55	5.07	147.3—172.4	159.59	5.89	148.5—170.3	159.95	5.30	148.0—176.6
17	161.45	5.79	153.8—176.0	159.17	5.48	146.8—171.5	161.21	4.93	145.0—171.7
18	168.25	4.44	148.0—172.2	158.85	5.29	149.5—159.0	160.22	5.19	146.7—170.7

Table 6

Sitting height of Körmend boys (cm)

Age (years)	K-58			K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W	$\bar{x}$	s	W
3	54.92	2.73	52.8—58.8	56.75	2.38	54.0—59.8	55.74	2.42	51.8— 60.0
4	57.00	3.45	52.4—65.3	58.41	2.82	54.8—65.0	58.56	2.63	53.3— 64.0
5	58.34	3.57	49.7—66.7	61.14	2.65	56.8—66.1	60.83	2.44	55.7— 68.0
6	61.53	2.85	54.2—66.4	63.95	3.18	59.5—73.3	63.97	2.69	55.3— 69.7
7	64.18	2.58	60.1—69.1	65.64	2.61	59.8—70.0	66.32	3.22	59.8— 75.0
8	66.34	2.73	59.2—72.8	67.72	3.15	61.5—74.7	68.98	2.97	62.0— 76.4
9	68.81	2.76	63.2—74.0	70.12	3.34	60.8—77.5	71.33	3.34	61.8— 80.1
10	71.59	3.33	64.2—78.5	73.06	3.38	65.8—83.1	73.85	3.07	66.0— 80.0
11	72.07	3.12	63.0—77.9	74.50	3.59	67.3—83.0	75.04	3.22	67.1— 82.5
12	75.95	3.24	68.7—87.9	75.89	3.31	69.8—84.0	77.33	3.99	64.7— 88.0
13	77.80	3.51	69.9—86.5	78.57	3.74	71.0—90.1	80.44	4.41	71.4— 91.3
14	79.32	4.80	69.4—89.3	81.51	4.56	72.0—94.0	84.64	4.86	75.4— 93.8
15	83.28	4.68	73.3—94.7	84.85	4.89	67.5—97.0	85.56	4.45	73.4— 98.9
16	85.64	3.39	77.2—93.2	87.00	4.85	79.5—96.4	88.48	3.87	77.4—100.1
17	86.21	3.60	77.1—94.1	88.90	3.86	80.5—98.9	89.27	3.48	78.7— 96.3
18	88.64	3.81	80.5—95.1	89.76	3.49	80.6—94.5	89.80	3.85	80.3—100.3

Table 7

Sitting height of Körmend girls (cm)

Age (years)	K-58			K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W	$\bar{x}$	s	W
3	54.48	3.03	50.7—60.4	54.65	2.35	57.3—50.9	54.86	2.08	51.3—59.1
4	55.53	2.22	51.4—61.3	58.27	0.87	55.0—63.2	57.63	3.16	46.5—65.5
5	57.66	2.04	53.4—61.4	61.00	4.13	55.5—76.0	59.76	2.97	50.9—68.3
6	62.10	2.64	56.2—67.0	63.42	3.33	67.2—70.2	62.94	2.82	56.4—69.1
7	63.81	2.91	58.5—70.9	66.16	3.04	59.0—72.5	66.13	3.19	57.7—72.6
8	65.16	2.88	57.7—71.8	67.69	3.26	60.4—75.5	68.25	3.15	62.8—74.7
9	67.53	3.42	59.3—77.0	69.02	3.02	63.2—76.1	70.86	3.55	63.8—72.6
10	70.14	3.00	63.4—77.4	72.41	3.52	67.0—82.8	72.38	3.59	64.8—85.7
11	72.09	3.78	62.7—80.5	74.19	3.44	69.3—81.8	75.56	3.46	69.1—85.5
12	75.69	4.02	66.8—86.3	78.77	3.94	71.0—84.4	77.92	3.71	69.3—88.0
13	78.09	3.99	67.3—86.8	81.21	3.88	74.3—88.7	82.90	3.75	69.5—90.4
14	81.09	3.78	71.8—88.9	82.26	2.92	75.5—89.6	33.58	2.92	71.7—88.7
15	81.17	2.94	75.5—88.7	83.31	2.96	74.8—91.8	83.95	3.61	73.1—91.6
16	82.74	3.30	78.4—88.7	84.13	3.16	78.6—89.5	84.11	2.74	75.4—93.4
17	84.93	2.31	79.6—90.5	84.12	3.03	78.4—89.5	84.83	3.25	76.0—90.8
18	84.24	3.84	78.3—90.2	84.47	2.75	79.6—91.7	84.80	2.98	70.8—91.4

Table 8

Length of the upper extremities in Körmend boys (cm)

Age (years)	K-58			K-68			K-78		
	x̄	s	W	x̄	s	W	x̄	s	W
3	38.06	1.80	34.9—40.9	39.00	1.81	36.6—41.0	39.26	2.09	35.1—44.8
4	40.62	3.45	32.7—47.3	41.18	3.61	30.3—47.3	41.48	2.34	35.2—46.5
5	44.45	4.88	39.2—50.8	45.89	3.04	40.9—53.8	44.71	2.25	37.8—48.8
6	47.92	3.93	41.2—54.0	48.05	3.20	40.8—55.7	48.27	3.72	42.2—53.8
7	50.21	3.06	44.4—56.6	51.13	3.29	45.0—60.5	51.22	2.89	45.4—57.5
8	52.98	3.12	46.0—61.1	54.07	3.29	43.3—60.5	54.08	3.52	42.8—64.0
9	56.12	2.88	49.0—64.4	56.60	3.38	47.3—63.8	57.01	3.73	47.5—66.8
10	59.31	3.54	51.5—68.7	59.47	4.09	49.7—70.0	60.70	3.63	63.2—67.1
11	59.87	3.30	48.0—67.3	61.69	4.61	52.0—72.0	61.85	3.58	49.3—73.4
12	63.29	3.72	56.9—71.6	63.42	4.40	56.0—77.7	64.61	3.43	56.1—74.0
13	66.03	3.45	58.6—75.1	67.28	4.70	52.9—77.7	67.50	4.53	52.6—77.9
14	57.39	4.65	58.8—75.5	69.83	4.88	57.1—80.5	71.17	4.57	61.7—82.6
15	72.00	3.54	61.2—80.6	73.31	4.70	61.5—84.3	73.43	5.55	63.3—95.9
16	73.68	3.60	63.3—80.8	75.25	4.02	63.8—90.3	74.78	3.95	62.9—85.9
17	73.75	3.84	64.3—80.8	77.28	3.50	69.3—86.0	75.66	3.14	68.9—87.5
18	76.16	3.78	70.0—83.8	76.44	4.17	68.3—85.5	75.97	3.39	68.0—83.5

Table 9

Length of the upper extremities in Körmend girls (cm)

Age (years)	K-58			K-68			K-78		
	x̄	s	W	x̄	s	W	x̄	s	W
3	32.19	3.57	32.8—46.5	38.12	2.60	33.0—42.8	38.95	1.50	36.2—42.9
4	40.62	2.97	35.8—46.8	42.36	3.07	36.5—49.5	41.10	2.79	34.3—49.1
5	43.77	2.16	39.7—48.3	44.90	3.10	40.8—50.3	44.53	2.54	36.1—50.8
6	47.94	2.49	42.8—54.2	49.50	2.60	44.5—53.7	47.39	2.79	41.3—54.4
7	50.01	2.94	42.8—56.3	51.91	3.11	43.3—58.8	51.63	3.08	44.9—54.0
8	51.18	2.58	45.7—57.2	53.46	3.32	45.7—63.3	53.59	3.67	43.4—61.3
9	53.65	3.39	47.0—61.9	54.98	2.84	44.1—60.5	56.78	4.60	33.3—67.3
10	57.21	3.60	46.8—66.1	58.70	3.96	50.7—68.2	59.64	3.98	44.6—68.7
11	59.91	4.14	50.4—71.3	61.00	4.39	51.0—75.0	62.34	3.15	54.3—68.5
12	62.88	4.23	49.5—72.0	64.95	3.99	58.1—75.8	64.45	3.43	58.1—77.7
13	65.55	3.60	53.2—73.9	67.29	3.98	59.0—77.5	67.33	3.64	56.4—75.5
14	67.89	3.21	56.8—76.5	68.15	3.18	61.0—76.5	68.66	3.40	57.3—75.5
15	68.31	3.54	59.1—78.4	69.72	3.01	63.3—79.7	69.75	4.62	60.5—89.7
16	69.18	3.42	62.9—76.9	70.27	3.42	57.2—77.8	69.18	3.46	59.9—79.0
17	71.04	2.91	65.9—78.4	70.17	3.67	60.2—81.1	69.32	3.03	61.7—76.0
18	69.48	3.84	63.0—78.8	69.41	3.64	63.1—77.5	68.52	3.25	61.4—75.9

Table 10

Length of the lower extremities (height of anterior superior iliac spine) in Körmend boys (cm)

Age (years)	K-58			K-68			K-78		
	x̄	s	W	x̄	s	W	x̄	s	W
3	46.92	3.12	39.4— 49.7	48.00	1.81	45.8— 51.0	48.57	2.91	44.0— 55.0
4	51.71	3.80	45.8— 59.1	51.00	2.93	45.3— 58.5	51.79	2.67	44.3— 56.8
5	56.05	3.66	49.7— 65.1	56.41	4.05	50.5— 64.0	56.46	3.03	49.8— 61.6
6	59.47	3.17	51.3— 63.7	60.56	3.89	54.8— 76.4	60.92	3.30	53.8— 69.8
7	62.37	3.54	52.7— 73.4	64.13	3.85	53.8— 72.3	65.00	3.57	58.7— 76.5
8	66.47	3.73	58.5— 74.0	68.05	3.65	61.5— 75.5	68.58	4.13	58.3— 77.5
9	70.49	4.49	62.8— 84.8	71.52	4.23	60.8— 79.1	72.68	4.55	62.3— 83.3
10	74.59	4.79	63.8— 87.0	74.59	4.59	60.0— 90.8	77.33	4.20	68.4— 86.5
11	75.58	4.49	62.2— 85.2	78.40	5.33	67.9— 97.8	79.81	4.24	70.7— 89.9
12	80.56	4.95	71.2— 93.2	80.26	4.63	69.2— 90.1	83.67	4.70	73.3— 93.3
13	84.64	5.01	71.0— 96.9	84.36	4.78	74.0— 94.4	88.13	5.33	75.1— 98.5
14	86.36	5.77	72.8— 98.0	86.27	5.23	73.3— 97.0	91.69	5.07	78.8—108.5
15	91.72	4.90	81.0—102.4	90.09	4.96	78.0—113.0	94.72	4.93	83.0—112.5
16	93.11	4.23	79.9—101.0	91.37	4.43	81.2—102.8	95.57	4.22	81.0—105.6
17	93.59	5.31	80.1—115.1	92.72	3.92	84.2—106.1	96.65	3.99	87.8—108.8
18	95.52	4.76	86.4—103.1	91.84	4.26	84.3—103.4	96.81	4.44	87.0—104.8

Table 11

Length of the lower extremities (height of anterior superior iliac spine)
in Körmend girls (cm)

Age (years)	K-58			K-68			K-78		
	x̄	s	W	x̄	s	W	x̄	s	W
3	47.56	4.42	41.7— 56.8	46.59	2.59	42.0—52.8	49.52	3.48	42.2— 61.0
4	52.33	3.04	45.3— 59.0	53.27	3.54	45.4—60.7	52.21	3.81	41.5— 63.1
5	54.91	2.39	50.8— 58.0	56.90	4.47	50.0—65.3	57.32	3.48	49.4— 66.1
6	61.17	3.14	56.1— 68.1	61.38	2.98	53.4—65.0	61.54	3.31	54.9— 70.4
7	63.80	3.57	56.2— 73.0	65.37	3.86	56.2—72.6	65.01	3.70	56.3— 72.8
8	65.95	3.54	58.8— 74.0	67.99	3.34	58.8—73.0	69.11	4.33	59.5— 80.3
9	69.58	4.75	60.2— 79.8	71.02	3.14	63.3—76.4	73.08	5.35	56.2— 88.5
10	74.18	4.54	64.8— 85.1	75.28	4.54	68.3—83.3	76.61	6.03	52.0— 90.5
11	77.84	5.55	64.9— 90.6	78.50	3.97	68.9—86.4	81.00	4.05	72.2— 89.0
12	81.33	5.52	65.7— 92.9	82.60	4.12	73.5—91.3	83.64	4.02	75.1— 93.4
13	84.77	4.44	75.2— 94.8	84.33	4.70	74.0—94.1	87.43	4.24	74.8— 97.5
14	86.71	5.77	75.2— 98.5	85.33	3.65	76.0—94.3	88.14	5.96	54.8— 98.7
15	88.38	4.21	79.8— 98.7	86.95	3.39	80.5—92.5	89.81	4.62	80.6—104.8
16	87.71	4.23	80.8—100.9	87.07	3.74	79.0—95.1	88.97	3.98	78.5— 98.0
17	90.55	3.49	85.1— 99.4	86.26	3.83	77.0—96.8	89.58	3.85	78.4— 99.3
18	89.21	4.92	77.0—100.2	86.17	4.11	80.5—92.5	89.00	3.98	78.8— 97.5

Table 12

Biacromial diameter of Körmend boys (cm)

Age (years)	K-58			K-68			K-78		
	x̄	s	W	x̄	s	W	x̄	s	W
3	22.46	1.08	21.3—24.0	22.25	0.61	20.0—23.2	23.04	0.93	21.0—24.7
4	23.67	1.84	20.4—28.4	23.00	1.25	20.5—24.7	23.52	1.07	21.3—26.0
5	24.82	1.21	22.2—29.0	24.49	1.34	21.8—26.7	24.75	1.32	21.0—27.0
6	25.43	1.27	22.0—27.9	24.93	1.59	18.8—28.4	25.80	1.50	17.5—28.2
7	26.47	1.28	23.0—29.3	26.11	1.31	22.6—29.2	27.55	1.70	25.1—31.5
8	27.62	1.41	25.1—31.0	27.11	1.86	19.2—30.3	28.26	1.41	22.0—32.3
9	29.13	1.39	26.1—31.5	28.28	2.03	23.0—32.2	29.68	1.63	26.4—35.7
10	30.05	1.63	26.8—33.8	29.45	1.75	26.0—34.8	31.08	1.97	27.4—36.1
11	30.43	1.73	23.7—34.4	30.25	2.04	26.4—34.7	31.55	1.55	27.6—37.9
12	31.72	2.06	26.2—36.4	31.21	1.88	27.8—36.3	32.98	1.77	28.4—37.8
13	33.10	1.65	30.1—39.2	32.71	2.12	23.4—38.5	34.10	2.42	23.5—39.3
14	34.09	2.49	28.9—39.6	34.23	2.37	29.6—39.4	36.41	2.46	30.8—41.7
15	36.34	2.80	31.9—41.7	36.05	2.61	30.7—47.5	37.30	2.19	32.6—41.6
16	37.74	1.91	33.2—42.2	36.85	2.23	32.2—42.3	38.02	2.20	32.9—45.2
17	37.91	2.06	33.5—43.4	38.08	2.07	30.0—42.1	39.24	2.24	32.0—47.1
18	38.86	1.89	33.1—42.8	38.64	2.01	34.4—42.0	39.96	1.77	36.1—43.6

Table 13

Biacromial diameter of Körmend girls (cm)

Age (years)	K-58			K-68			K-78		
	x̄	s	W	x̄	s	W	x̄	s	W
3	23.27	1.80	19.5—25.8	21.82	1.24	19.5—24.5	23.05	1.83	20.3—29.0
4	23.76	1.26	20.9—26.4	23.27	2.23	21.1—26.2	23.41	1.33	19.9—26.7
5	24.04	1.18	22.7—26.1	23.75	1.18	21.2—25.4	24.01	1.31	21.4—26.5
6	25.93	1.18	23.1—28.3	25.42	0.99	24.1—28.2	25.68	1.56	21.0—29.5
7	26.48	1.51	21.1—29.9	26.30	1.04	23.8—28.5	27.17	1.16	24.1—29.8
8	27.20	1.44	24.7—33.6	26.80	1.35	24.0—29.2	27.99	1.92	19.1—31.9
9	28.28	1.73	24.5—34.7	27.90	1.31	24.5—30.3	29.29	1.74	24.7—33.1
10	29.70	1.46	27.1—34.5	29.48	1.53	26.8—32.9	30.26	1.52	27.6—36.3
11	30.38	1.75	26.5—36.6	30.10	1.70	26.5—32.9	31.68	1.89	23.3—34.8
12	31.92	2.18	24.6—37.3	31.67	2.31	23.1—36.3	32.96	1.70	29.5—37.4
13	33.09	1.91	28.4—39.0	33.28	1.89	29.0—38.0	34.39	1.96	28.8—39.1
14	34.70	1.65	30.9—39.2	34.00	1.54	29.4—39.5	35.26	1.66	31.0—39.4
15	35.48	1.64	31.9—39.3	34.88	1.66	31.6—38.4	35.12	1.69	30.1—38.8
16	35.70	1.52	31.9—38.0	34.60	1.38	31.4—37.5	35.58	1.84	31.5—40.2
17	36.45	1.72	33.8—40.8	35.11	1.84	31.8—40.5	36.13	1.81	31.3—30.9
18	36.84	1.72	34.5—40.4	34.94	1.65	31.3—38.8	35.83	1.36	32.0—38.4

Table 14

Bi-iliocristal diameter of Körmend boys (cm)

Age (years)	K-58			K-68			K-78		
	x̄	s	W	x̄	s	W	x̄	s	W
3	17.54	0.84	16.0—19.0	16.17	0.94	15.3—18.3	16.65	0.89	14.5—18.4
4	18.67	1.31	16.8—20.4	17.14	1.08	15.5—18.8	17.42	1.18	15.9—24.1
5	19.45	1.04	17.2—21.8	18.03	1.01	16.3—20.5	18.15	0.93	15.5—19.9
6	19.80	0.92	17.9—21.7	18.68	1.01	17.2—21.2	18.80	1.09	15.9—22.3
7	20.48	1.15	18.2—24.7	19.15	1.15	16.5—21.5	19.74	1.23	17.4—22.8
8	21.51	1.51	19.9—26.4	20.08	1.17	18.1—22.8	20.48	1.54	18.0—24.9
9	22.20	1.51	19.3—26.1	20.93	1.32	17.6—24.8	21.45	1.81	19.2—30.0
10	23.66	1.86	20.2—28.8	21.76	2.02	18.5—29.0	22.43	1.79	18.7—27.5
11	23.72	1.62	18.7—27.0	22.60	1.96	19.5—27.5	22.84	1.73	19.6—28.6
12	24.76	1.70	21.8—30.6	23.11	1.61	19.7—27.8	23.91	1.84	21.2—30.5
13	26.29	1.86	21.9—30.4	24.07	1.62	21.1—30.3	24.98	2.24	21.4—33.0
14	27.23	2.53	22.6—29.9	24.93	1.83	20.1—29.8	26.22	2.31	21.0—33.7
15	29.26	2.00	24.6—35.1	26.26	2.10	21.0—34.0	26.84	1.79	21.3—31.7
16	29.62	1.72	25.8—33.3	27.24	2.04	22.1—31.7	27.85	1.95	23.9—34.8
17	30.72	2.03	25.7—35.8	27.77	1.55	23.7—31.9	28.21	2.20	24.1—39.5
18	31.64	2.15	27.3—36.4	28.24	1.74	25.4—32.2	28.60	1.57	24.8—32.3

Table 15

Bi-iliocristal diameter of Körmend girls (cm)

Age (years)	K-58			K-68			K-78		
	x̄	s	W	x̄	s	W	x̄	s	W
3	18.27	1.24	16.0—20.2	16.06	0.97	14.5—17.7	16.67	1.11	13.5—18.7
4	18.91	1.11	18.8—21.3	17.48	0.76	15.6—19.7	16.99	1.06	14.6—20.4
5	19.75	1.31	18.2—22.8	17.70	0.85	16.4—19.3	17.93	1.41	15.5—26.0
6	20.51	1.25	18.4—23.6	18.73	1.35	15.4—21.6	18.56	1.37	15.3—21.5
7	20.55	1.26	18.1—26.1	19.47	1.22	17.1—21.9	19.99	1.35	17.2—24.1
8	21.09	1.47	19.0—27.3	20.08	1.33	18.2—25.3	20.13	1.67	13.8—28.2
9	21.80	1.30	19.4—24.8	20.81	1.67	18.4—26.6	21.31	1.68	18.2—27.9
10	23.32	1.67	20.0—28.8	21.85	1.54	18.8—25.5	22.06	1.52	18.5—27.4
11	24.47	1.97	20.8—28.9	22.54	1.55	19.7—27.5	23.26	1.88	19.0—29.5
12	25.84	2.72	19.3—27.0	24.21	1.71	21.5—28.1	24.34	2.00	20.9—31.7
13	27.35	1.81	22.7—31.0	25.44	1.67	21.5—28.8	25.75	1.93	21.2—30.7
14	29.64	1.92	25.0—34.8	26.33	1.68	22.9—31.9	26.51	2.06	21.3—33.4
15	30.48	1.82	26.1—32.3	27.42	1.61	23.0—31.5	27.25	1.69	23.8—33.3
16	30.48	1.74	26.2—33.5	27.33	1.55	24.2—30.3	27.26	2.12	21.6—34.5
17	31.13	1.96	27.4—35.0	27.75	1.41	24.5—30.4	28.13	1.89	23.0—33.7
18	31.45	1.91	27.3—36.3	28.06	1.57	24.9—32.1	27.48	2.27	23.5—38.3

Table 16

Transverse chest diameter of Körmend boys (cm)

Age (years)	K-58			K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W	$\bar{x}$	s	W
3	16.67	0.66	15.9—17.4	17.25	0.87	16.0—18.7	16.91	0.90	15.4—18.5
4	17.21	1.03	15.3—19.8	17.68	0.57	16.6—18.6	17.30	0.96	14.1—19.7
5	17.92	0.27	15.6—20.1	18.03	0.82	16.7—20.2	17.63	0.80	16.1—19.7
6	18.10	0.99	16.7—20.4	18.37	0.89	16.9—20.1	18.20	0.89	16.1—21.3
7	18.49	1.11	17.0—20.2	18.58	0.99	17.4—20.5	19.15	1.08	17.0—21.3
8	19.80	1.41	17.4—22.3	19.19	1.11	16.9—22.8	19.70	1.37	15.2—24.3
9	20.21	1.32	17.5—22.3	19.98	2.05	16.8—28.3	20.50	1.43	17.5—27.7
10	20.86	1.59	18.7—28.0	20.47	1.79	18.2—29.6	21.40	1.68	17.8—26.7
11	21.18	1.71	18.1—29.4	21.05	1.41	19.2—25.2	21.83	1.91	15.8—27.5
12	22.03	1.62	19.8—28.1	21.68	1.80	18.6—24.6	22.77	1.62	18.7—29.1
13	22.88	2.74	20.3—26.3	23.25	1.97	19.6—28.2	23.54	1.90	20.5—31.7
14	23.68	2.49	20.3—31.8	23.89	1.67	20.0—27.6	25.16	2.14	21.3—31.3
15	25.14	2.25	21.2—29.6	25.21	2.02	20.8—32.8	25.69	1.79	21.3—30.3
16	25.91	1.71	22.2—30.2	26.42	2.37	21.9—33.5	28.86	1.88	22.8—34.1
17	26.78	2.16	21.4—32.5	27.40	1.59	23.9—31.0	27.02	1.74	22.9—33.5
18	27.41	2.19	23.3—32.9	27.36	1.32	24.5—31.5	28.00	1.83	24.4—31.7

Table 17

Transverse chest diameter of Körmend girls (cm)

Age (years)	K-58			K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W	$\bar{x}$	s	W
3	17.21	0.77	15.8—18.7	16.65	1.23	15.0—18.8	16.48	0.99	12.2—28.6
4	17.12	0.85	15.5—28.9	17.06	0.99	15.5—19.4	16.84	0.83	15.4—19.3
5	17.84	0.84	16.5—19.0	17.15	0.93	15.5—18.8	17.43	0.96	15.5—19.9
6	18.31	0.89	16.4—20.5	18.08	1.23	15.9—22.4	17.92	0.99	15.4—20.2
7	18.49	0.97	16.3—21.0	18.23	0.72	16.8—20.4	18.76	1.29	14.3—24.2
8	18.74	1.27	16.5—24.6	18.44	0.94	16.8—20.8	19.29	1.26	16.9—28.4
9	19.51	1.15	14.4—22.6	19.25	1.36	16.7—23.5	20.07	1.45	17.3—26.9
10	20.22	1.32	18.3—24.1	20.39	1.89	16.8—28.3	20.55	1.36	18.3—24.0
11	30.93	1.26	18.6—25.1	20.75	1.78	18.3—26.5	24.43	1.60	18.8—26.6
12	22.13	1.59	18.9—27.9	22.19	2.29	18.9—27.7	22.67	2.13	18.4—29.0
13	22.68	1.41	19.9—26.4	23.39	2.08	19.0—29.1	23.55	1.76	19.1—27.7
14	24.12	1.58	21.6—28.0	24.21	2.02	21.0—30.6	24.52	1.73	19.5—30.9
15	24.64	1.51	21.7—27.6	25.19	1.83	22.6—32.4	24.58	1.61	22.1—28.7
16	24.48	1.48	21.7—27.7	25.02	1.95	20.9—28.8	25.02	1.54	21.5—31.3
17	25.69	1.61	22.8—29.7	25.35	1.57	22.4—28.3	25.55	1.95	20.7—32.2
18	25.58	1.41	23.5—28.5	29.94	1.61	23.0—30.2	25.05	1.36	22.6—28.7

Table 18

Antero-posterior chest diameter of Körmend boys (cm)

Age (years)	K-58			K-68			K-78		
	x̄	s	W	x̄	s	W	x̄	s	W
3	12.00	0.57	11.4—12.8	12.00	0.85	10.8—13.5	12.30	1.58	10.0—17.4
4	12.67	1.07	10.3—14.7	12.32	0.72	10.9—13.5	12.34	0.88	10.4—14.1
5	13.18	0.69	12.0—15.2	12.77	0.74	11.3—14.2	12.71	0.91	10.2—14.5
6	13.41	0.81	12.0—15.3	13.02	0.72	11.6—15.4	13.24	0.87	11.5—15.1
7	13.56	0.73	11.8—15.3	13.36	0.79	12.0—14.9	13.45	0.99	11.8—16.5
8	13.61	0.85	10.3—16.0	13.81	0.99	11.9—15.8	13.98	1.25	11.2—17.8
9	13.94	0.85	12.4—15.8	14.42	1.37	12.4—21.5	14.37	1.16	11.7—18.3
10	14.17	1.01	12.2—16.6	14.71	1.55	12.2—29.6	14.78	1.43	11.4—18.3
11	14.27	0.49	12.3—16.6	15.13	1.51	12.7—18.8	15.05	1.25	12.7—20.1
12	14.64	1.14	13.1—17.9	15.49	1.10	13.5—18.0	15.63	1.47	13.1—21.2
13	15.54	1.29	12.4—18.6	16.01	1.53	13.3—21.3	16.40	1.65	13.0—22.6
14	15.96	1.60	13.3—20.1	16.88	1.49	13.9—20.0	17.19	1.57	13.7—22.8
15	17.22	1.52	14.2—20.5	17.62	1.57	14.2—24.2	17.74	1.42	14.0—21.9
16	17.71	1.22	15.1—21.2	18.10	1.41	15.6—21.5	18.12	1.71	14.9—22.2
17	17.91	1.36	15.9—21.4	18.76	1.39	14.7—21.8	18.46	1.66	14.8—22.2
18	17.61	1.17	15.7—21.3	18.72	1.15	16.1—21.2	19.00	1.42	16.1—23.1

Table 19

Antero-posterior chest diameter of Körmend girls (cm)

Age (years)	K-58			K-68			K-78		
	x̄	s	W	x̄	s	W	x̄	s	W
3	13.14	0.58	12.6—14.6	11.82	0.88	10.9—14.1	11.95	0.92	10.0—13.9
4	13.00	0.95	10.7—14.3	11.70	0.83	10.1—13.1	12.19	0.82	10.0—14.1
5	13.27	1.01	12.2—15.8	12.05	0.69	11.2—13.3	12.52	0.83	10.5—14.3
6	13.39	0.94	11.8—16.4	12.85	1.16	11.5—16.7	12.91	0.82	11.2—15.4
7	13.34	0.34	11.5—15.4	12.98	0.84	11.2—14.2	13.32	1.18	11.2—18.0
8	13.58	1.02	12.2—16.2	13.41	1.07	11.8—15.6	13.44	1.08	11.3—16.9
9	13.72	1.00	12.2—16.2	13.90	1.17	10.8—16.7	14.05	1.32	11.0—19.4
10	14.25	1.30	11.8—18.7	14.41	1.53	12.6—19.8	14.46	1.15	12.0—18.3
11	14.13	1.08	11.4—17.2	14.96	1.71	11.7—19.6	14.75	1.43	11.0—19.5
12	14.96	1.26	12.8—18.7	15.74	1.45	12.7—18.9	15.58	1.45	13.0—18.5
13	15.33	1.14	12.6—18.1	16.32	1.43	13.4—20.7	16.24	1.74	13.3—23.3
14	16.53	1.11	13.8—19.4	16.78	1.38	14.2—21.1	16.80	1.41	13.0—20.6
15	16.60	1.26	13.8—19.4	17.32	1.45	15.1—21.7	17.08	1.64	14.5—23.8
16	16.32	0.82	14.8—18.2	17.33	1.11	14.7—19.9	17.05	1.55	13.4—21.2
17	16.82	1.19	14.6—19.5	17.28	1.43	13.1—19.8	17.51	1.82	14.0—27.2
18	19.96	1.37	14.2—20.0	17.53	1.38	13.8—21.3	16.83	1.53	13.4—21.3

Table 20

Chest circumference of Körmend boys (cm)

Age (years)	K-58			K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W	$\bar{x}$	s	W
3	52.08	2.43	48.0— 54.8	52.50	2.07	48.5— 56.5	51.17	2.08	46.3— 54.6
4	54.62	2.85	49.0— 61.0	53.55	2.14	50.0— 58.1	52.44	2.47	45.0— 60.3
5	56.00	2.37	50.8— 60.1	55.86	2.88	50.3— 61.2	53.74	2.36	48.5— 61.0
6	56.61	2.88	50.0— 62.0	56.68	2.78	51.3— 64.7	56.20	3.37	50.5— 74.2
7	57.86	2.58	51.0— 63.2	57.68	3.61	53.5— 65.5	58.18	3.47	51.5— 68.0
8	60.06	3.34	54.3— 74.6	59.92	3.50	55.0— 70.2	61.01	4.13	50.2— 77.4
9	62.15	3.00	55.8— 70.0	62.52	6.12	53.8— 92.0	62.57	4.23	54.8— 90.0
10	64.68	3.90	57.2— 76.0	63.99	5.81	56.2— 93.0	65.58	5.49	53.5— 85.7
11	65.71	3.69	57.8— 73.5	66.00	4.52	59.6— 85.0	67.04	5.46	58.3— 88.3
12	69.02	4.35	61.8— 80.5	67.79	5.06	52.8— 80.8	69.79	5.86	60.7— 90.5
13	72.27	4.17	61.8— 83.1	71.43	5.87	57.3— 94.0	72.22	6.27	63.3—100.0
14	74.64	6.06	63.5— 96.5	75.05	5.86	61.8— 92.2	77.88	7.75	56.0—102.5
15	80.32	5.82	67.4— 95.3	78.92	7.07	53.8—100.1	79.56	5.85	66.8— 95.0
16	83.03	4.53	71.3— 93.3	82.93	7.45	56.7— 98.1	83.39	6.28	64.0—105.0
17	84.76	5.73	75.3—102.8	85.43	5.39	59.0— 95.3	84.16	5.43	68.0—103.8
18	88.32	4.38	78.8—101.0	86.00	3.35	78.1— 93.0	87.83	6.45	76.2—102.8

Table 21

Chest circumference of Körmend girls (cm)

Age (years)	K-58			K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W	$\bar{x}$	s	W
3	53.17	2.79	47.0—56.3	51.47	2.86	48.2— 58.2	50.67	3.28	43.8— 60.5
4	53.82	2.55	49.0—59.0	53.18	2.94	48.2— 59.6	51.43	2.40	47.0— 57.3
5	55.64	2.16	52.8—61.8	53.50	2.86	49.5— 58.2	53.68	2.70	46.8— 61.3
6	57.59	3.06	52.4—63.4	56.54	2.63	50.7— 76.2	55.19	3.46	48.4— 69.0
7	58.08	2.79	51.5—66.6	56.84	2.22	51.8— 62.0	57.59	3.70	51.0— 77.3
8	59.51	4.11	51.5—79.0	57.92	2.87	53.8— 64.5	59.19	3.88	51.5— 73.5
9	60.60	3.27	55.0—72.7	59.73	3.74	53.0— 69.2	62.17	5.14	52.5— 85.0
10	63.00	4.02	56.3—76.7	64.72	6.36	55.0— 91.2	63.80	4.56	55.3— 77.3
11	64.89	4.77	57.3—79.0	66.94	7.51	57.1— 90.6	67.23	6.05	58.5— 89.0
12	69.71	5.46	60.0—88.0	72.35	7.61	59.0— 87.5	70.96	6.79	59.5— 91.0
13	72.05	4.47	61.5—82.5	76.96	7.30	57.3— 92.8	74.68	6.43	62.2— 96.5
14	76.66	5.22	69.0—92.5	80.55	7.17	66.6—102.2	77.90	6.50	59.5—100.5
15	77.95	5.01	64.0—92.7	83.88	6.92	75.0—115.5	78.73	5.42	69.0— 94.0
16	78.87	3.33	73.0—86.6	83.33	6.49	73.1—101.8	80.19	5.77	68.1—102.8
17	81.54	4.65	72.0—96.0	85.06	5.21	73.8— 98.0	81.83	6.64	68.3—108.5
18	81.50	4.86	72.3—93.8	87.00	5.48	76.8—102.8	79.35	4.59	73.0— 91.8

Table 22

Upper arm circumference of Körmend boys (cm)

Age (years)	K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W
3	15.58	1.09	14.2–17.0	15.09	1.60	13.3–18.0
4	15.86	0.94	14.4–18.0	15.30	1.38	11.0–21.5
5	16.14	1.40	13.0–20.3	15.46	0.99	13.4–18.8
6	16.56	1.85	12.0–20.0	15.81	1.23	12.7–19.3
7	16.49	1.17	14.6–19.0	16.35	1.46	13.8–21.0
8	17.10	2.09	14.0–22.2	16.84	1.60	14.3–23.4
9	17.78	2.18	14.2–26.8	17.79	2.03	14.8–25.5
10	18.53	2.45	15.5–30.2	18.63	2.34	15.3–26.9
11	19.40	2.06	16.3–25.4	19.15	2.16	15.3–26.6
12	19.99	2.15	16.8–25.3	19.88	2.35	15.8–27.8
13	21.07	2.54	17.8–31.0	20.74	2.89	16.9–32.8
14	22.40	2.44	17.3–28.5	22.40	3.01	16.3–31.3
15	23.55	2.59	18.1–33.4	22.93	2.03	17.5–29.0
16	24.93	2.70	18.5–32.1	24.02	2.06	19.7–29.8
17	25.71	2.15	20.8–32.3	23.97	2.23	17.8–33.0
18	25.64	1.80	23.0–29.3	25.36	2.13	19.9–31.0

Table 23

Upper arm circumference of Körmend girls (cm)

Age (years)	K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W
3	15.53	0.88	14.0–17.2	15.29	1.09	12.2–18.0
4	16.03	1.13	14.2–17.2	15.29	0.33	13.0–17.6
5	15.65	1.23	14.0–17.8	15.56	1.18	13.0–18.5
6	16.62	1.86	14.2–22.6	15.99	1.39	13.4–18.8
7	16.63	1.28	14.0–19.5	16.57	1.62	13.7–23.3
8	17.41	1.31	15.6–20.5	17.34	1.71	14.0–21.4
9	18.06	1.90	15.3–23.5	18.10	2.01	14.1–24.8
10	19.41	2.22	15.4–26.8	18.55	1.88	15.3–24.8
11	20.19	3.05	16.6–28.5	19.38	2.72	15.3–29.4
12	21.21	2.48	17.6–27.2	20.16	2.63	16.3–29.5
13	22.17	2.22	17.9–26.8	21.08	2.36	15.8–28.0
14	23.08	2.45	19.3–30.1	22.00	2.65	17.2–31.8
15	24.14	2.37	20.7–30.6	22.54	2.40	17.3–27.0
16	24.18	2.43	20.4–29.0	23.11	1.92	18.4–30.3
17	24.62	2.35	29.2–29.6	23.69	2.44	17.0–31.7
18	25.47	2.19	22.5–32.0	23.00	2.13	19.4–27.9

Table 24

Thigh circumference of Körmend boys (cm)

Age (years)	K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W
3	29.32	2.21	25.5—33.6	29.33	1.43	24.8—31.9
4	31.05	2.64	27.7—38.8	29.46	2.40	20.3—37.0
5	31.32	3.26	22.5—37.7	30.93	2.28	26.0—36.4
6	32.97	2.75	28.5—39.2	32.55	2.72	24.8—39.4
7	33.38	2.38	29.3—40.2	32.09	3.46	28.0—46.6
8	35.30	3.36	30.9—43.5	36.69	4.10	28.8—48.3
9	36.88	4.37	30.4—53.2	38.57	4.38	31.8—55.8
10	38.71	4.66	31.5—60.0	40.33	5.01	32.5—56.5
11	40.85	4.88	34.0—60.0	41.42	4.59	31.5—54.9
12	41.00	3.80	35.0—63.3	43.16	5.02	34.0—62.0
13	43.36	3.97	36.8—60.0	44.83	4.97	36.3—65.3
14	44.76	4.31	34.9—59.0	47.41	5.05	35.0—62.0
15	47.00	4.84	32.5—65.5	48.14	3.77	39.4—60.3
16	48.81	4.49	35.6—63.0	50.22	4.29	40.4—65.5
17	50.83	3.90	45.0—60.4	49.50	4.71	40.0—59.7
18	49.88	2.80	45.2—54.0	51.23	3.63	43.3—59.2

Table 25

Thigh circumference of Körmend girls (cm)

Age (years)	K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W
3	30.82	2.11	26.8—34.7	30.19	3.39	24.8—38.5
4	32.36	2.51	28.0—38.5	30.69	2.53	24.9—38.3
5	31.95	3.00	26.8—37.2	32.29	2.70	25.8—41.2
6	31.85	2.93	29.0—41.3	34.08	3.04	28.3—44.0
7	35.12	2.38	30.0—40.9	35.96	3.56	29.5—48.8
8	37.15	3.01	32.0—44.5	37.03	3.89	29.0—46.4
9	38.42	3.73	33.0—49.0	39.49	4.15	31.7—51.8
10	41.50	4.37	33.1—55.8	40.46	3.90	32.4—50.3
11	42.94	5.63	35.2—60.5	43.30	4.88	34.2—57.3
12	45.77	4.77	37.3—56.0	45.39	5.47	29.4—60.4
13	47.66	4.88	37.4—57.8	48.27	5.03	35.5—58.5
14	50.04	4.60	41.0—64.3	50.10	5.27	37.9—73.3
15	51.70	4.65	44.5—69.5	51.34	4.73	41.7—62.1
16	51.80	4.40	45.0—63.0	51.53	4.10	36.8—63.0
17	52.60	3.76	45.3—61.5	53.40	4.82	39.4—68.8
18	54.65	4.16	46.5—66.0	53.45	3.98	43.4—62.0

Table 26

Calf circumference of Körmend boys (cm)

Age (years)	K-68			K-78		
	x̄	s	W	x̄	s	W
3	20.25	1.44	18.8—22.6	20.39	0.99	18.8—21.6
4	20.83	1.03	18.6—23.5	20.65	1.41	18.4—34.8
5	21.40	1.70	16.3—24.4	21.47	1.25	28.1—24.0
6	22.46	1.66	19.7—26.6	22.53	1.62	19.3—26.2
7	22.72	1.46	20.0—26.3	23.69	2.00	20.1—29.3
8	24.06	2.32	20.8—29.7	25.00	1.92	21.3—29.0
9	25.15	2.66	19.5—35.3	26.22	2.54	19.5—36.8
10	25.88	2.48	21.6—36.2	27.15	2.67	22.0—35.2
11	26.75	2.57	20.1—35.3	27.92	2.47	23.0—35.9
12	28.00	2.54	24.0—32.1	29.11	2.69	21.7—40.0
13	28.68	3.00	18.6—36.8	30.72	3.26	22.8—41.3
14	30.61	2.77	25.2—40.0	32.68	3.15	24.5—40.8
15	32.02	2.78	26.8—41.0	33.36	2.41	28.0—40.5
16	33.39	3.03	26.6—43.3	34.48	2.49	29.7—41.8
17	33.88	2.27	27.9—39.4	33.90	2.32	29.1—39.6
18	33.28	1.33	30.9—37.2	34.80	2.24	30.2—40.7

Table 27

Calf circumference of Körmend girls (cm)

Age (years)	K-68			K-78		
	x̄	s	W	x̄	s	W
3	20.06	1.20	18.0—22.2	20.62	1.80	14.5—23.8
4	21.82	1.97	18.8—28.0	21.10	1.39	18.0—25.2
5	21.10	1.25	18.0—23.2	22.00	1.61	18.1—28.3
6	22.96	1.66	19.8—28.3	22.74	1.51	18.3—27.4
7	23.53	1.30	21.2—27.4	24.12	1.85	20.0—31.0
8	24.21	1.63	20.8—27.8	24.96	2.13	20.8—29.3
9	25.13	2.07	21.4—31.0	26.34	2.51	21.1—38.2
10	26.43	2.36	21.1—34.8	27.07	2.68	22.3—35.2
11	27.13	2.60	20.7—33.2	28.52	2.89	23.3—37.5
12	29.24	2.79	23.6—36.2	29.63	3.16	19.8—38.5
13	30.50	2.62	25.2—27.2	30.86	2.82	23.3—37.5
14	31.56	2.52	36.6—38.0	32.16	2.98	26.0—40.8
15	32.56	2.51	28.3—37.7	32.66	2.52	26.8—37.0
16	32.27	2.76	27.3—40.7	33.15	2.13	27.6—37.7
17	32.94	2.47	28.3—39.0	33.44	2.60	26.0—41.3
18	33.79	1.99	29.2—37.8	32.95	1.91	27.9—36.9

Table 28

Bicondylar humerus of Körmend boys (mm)

Age (years)	K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W
3	44.75	2.00	42—49	43.91	2.92	39—49
4	44.73	1.83	42—49	45.00	2.77	39—54
5	47.08	2.95	42—53	46.47	2.35	41—52
6	48.07	3.18	43—54	48.00	2.82	42—57
7	49.47	4.47	42—72	50.06	3.32	43—59
8	50.28	3.39	38—56	52.63	3.98	46—73
9	53.25	3.74	43—65	54.91	4.00	49—78
10	56.00	4.19	49—69	56.35	3.90	48—69
11	57.50	4.18	52—79	57.96	3.58	50—75
12	58.84	4.13	50—68	60.00	3.78	52—74
13	61.78	4.47	52—74	62.34	4.29	53—74
14	65.23	4.91	54—85	65.58	4.32	54—73
15	67.04	4.07	53—77	67.48	4.24	58—80
16	68.75	4.34	60—84	68.89	3.60	60—77
17	69.79	3.53	62—78	69.48	3.40	51—78
18	70.04	2.73	65—74	69.29	3.53	60—77

Table 29

Bicondylar humerus of Körmend girls (mm)

Age (years)	K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W
3	41.41	2.17	37—44	42.29	2.40	35—45
4	43.91	2.65	39—50	43.24	2.43	36—49
5	43.50	2.86	35—48	44.97	2.92	38—56
6	45.92	3.38	42—53	46.29	2.89	41—53
7	47.79	2.96	43—54	48.24	3.23	39—57
8	50.00	2.63	44—55	49.30	3.06	44—57
9	51.06	3.17	45—58	52.15	3.70	44—65
10	54.50	4.55	47—74	54.17	3.26	46—64
11	55.75	3.36	49—64	55.80	3.22	48—63
12	57.84	3.95	50—69	57.20	3.61	51—67
13	58.41	3.43	52—68	58.64	3.70	50—76
14	59.89	3.13	53—70	59.65	3.60	52—73
15	61.12	3.59	54—69	58.24	3.25	54—67
16	60.79	3.59	53—68	60.81	3.66	54—76
17	61.00	3.48	54—68	61.29	3.63	52—70
18	62.00	3.30	54—68	60.00	3.18	52—68

Table 30

Bicondylar femur of Körmend boys (mm)

Age (years)	K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W
3	66.50	3.35	60— 72	66.17	3.61	55— 72
4	68.18	3.64	60— 75	69.18	3.58	61— 80
5	71.97	4.24	63— 82	70.95	3.54	61— 78
6	73.80	3.80	66— 82	73.08	3.55	66— 84
7	75.07	2.96	68— 81	77.35	4.77	65— 90
8	78.55	4.26	70— 88	80.13	4.24	71— 92
9	81.21	4.90	70— 96	83.30	4.97	72— 99
10	83.82	5.66	63—104	86.20	5.53	76—104
11	86.70	5.11	79—100	87.23	6.63	62—102
12	89.27	4.95	81— 99	90.64	5.59	74—110
13	91.29	5.23	80—103	94.04	6.55	78—118
14	94.91	5.21	84—108	97.27	5.93	85—122
15	96.62	5.56	83—118	96.90	4.64	85—109
16	97.87	5.57	84—123	98.65	5.01	85—110
17	99.11	5.11	88—110	97.80	4.65	88—108
18	97.24	3.96	90—106	98.64	4.41	89—110

Table 31

Bicondylar femur of Körmend girls (mm)

Age (years)	K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W
3	64.23	3.21	59— 72	65.14	3.27	58— 73
4	67.36	3.69	61— 74	66.99	3.49	56— 74
5	67.50	4.20	61— 72	68.73	3.47	58— 76
6	71.54	4.22	66— 84	70.64	3.92	61— 81
7	73.46	3.73	66— 82	73.88	4.16	66— 92
8	75.77	3.49	68— 83	75.55	3.96	68— 84
9	77.54	4.26	68— 87	79.21	5.09	66— 96
10	81.32	5.52	73— 93	81.96	5.01	72— 95
11	83.88	4.95	74— 95	84.51	4.45	75— 94
12	86.28	5.66	74—104	86.38	5.89	70—106
13	87.29	4.45	78— 97	88.77	4.71	78—101
14	89.11	4.83	78—103	89.94	5.81	77—114
15	90.63	4.37	81—100	90.20	4.87	80—102
16	90.93	6.28	81—108	90.73	5.21	81—103
17	89.89	4.65	78—101	91.34	5.26	80—104
18	91.56	3.84	82— 98	89.48	4.41	80— 96

Table 32

Skinfold thickness over biceps in Körmend boys (mm)

Age (years)	K-68			K-78		
	x̄	s	W	x̄	s	W
3	5.83	1.47	4— 9.5	7.48	2.26	3—14
4	5.66	1.35	3— 8.5	6.76	2.33	2—14
5	5.42	1.17	4— 8.0	6.86	2.33	2—12
6	5.36	1.53	3— 8.0	5.95	3.14	2—12
7	4.91	1.22	3— 8.0	5.10	2.71	2—17
8	5.41	1.36	3— 9.0	5.35	2.72	2—14
9	5.66	2.21	3—11.5	6.27	2.88	3—18
10	4.43	1.68	3—11.0	6.37	3.57	2—15
11	4.83	1.71	2— 9.5	7.01	4.34	2—24
12	4.42	1.75	2—10.0	7.04	4.23	2—30
13	4.76	2.00	2—11.0	7.17	4.08	2—22
14	4.39	1.48	2—10.0	6.26	3.26	2—18
15	3.04	0.96	3— 7.5	5.65	2.64	2—13
16	4.26	1.14	3— 9.5	5.22	2.60	2—18
17	4.18	2.68	2— 7.5	5.15	2.85	3—22
18	3.93	0.71	3— 6.0	5.21	2.69	2—14

Table 33

Skinfold thickness over biceps in Körmend girls (mm)

Age (years)	K-68			K-78		
	x̄	s	W	x̄	s	W
3	5.74	1.72	3—10	7.97	2.48	3—14
4	5.61	1.38	3— 9	7.41	2.09	3—13
5	5.42	1.17	4— 8	7.36	2.22	4—12
6	5.36	1.53	3— 8	7.33	2.46	3—12
7	4.91	1.22	3— 8	6.89	3.00	2—21
8	5.41	1.36	3— 9	5.44	2.66	3—18
9	5.66	2.21	3—11	7.78	2.90	3—17
10	6.45	2.07	3—11	7.70	3.37	2—17
11	6.24	2.48	4—12	8.21	3.66	2—17
12	6.20	1.86	4—10	8.12	3.98	3—27
13	6.86	2.29	4—13	8.61	3.78	2—22
14	7.08	2.17	3—12	8.88	3.66	2—25
15	8.22	2.98	4—16	17.40	4.17	2—25
16	7.99	3.10	5—15	10.58	3.92	4—26
17	7.56	2.37	3—13	10.48	4.04	3—24
18	8.04	1.91	5—11	8.85	3.86	2—22

Table 34

Skinfold thickness over triceps in Körmend boys (mm)

Age (years)	K-68			K-78		
	x̄	s	W	x̄	s	W
3	10.44	1.58	7—15	11.78	2.55	9—18
4	9.19	1.36	6—11	10.72	2.80	5—19
5	8.56	1.48	6—13	9.85	2.21	6—15
6	8.31	1.69	5—13	9.51	2.62	5—18
7	7.34	1.70	4—13	8.90	3.33	4—22
8	7.85	1.85	5—13	9.59	4.02	3—24
9	7.43	1.65	4—12	10.34	4.03	4—24
10	7.78	2.31	4—13	10.30	4.47	3—23
11	8.40	2.65	4—16	10.31	5.37	5—32
12	6.42	2.06	3—14	10.82	5.03	3—28
13	7.96	2.67	4—16	10.21	5.26	3—35
14	7.65	1.94	4—13	9.88	5.34	3—32
15	6.98	1.87	4—12	9.02	3.77	2—19
16	7.13	2.17	4—14	8.73	3.96	3—28
17	7.87	1.83	4—11	8.06	4.08	3—25
18						

Table 35

Skinfold thickness over triceps in Körmend girls (mm)

Age (years)	K-68			K-78		
	x̄	s	W	x̄	s	W
3	10.11	2.30	6—15	11.90	2.76	6—16
4	10.12	1.55	7—14	11.75	2.79	6—18
5	8.50	1.07	6—11	11.17	2.86	6—20
6	8.64	1.93	4—11	10.79	2.86	4—18
7	8.54	2.05	5—12	11.19	4.13	5—28
8	9.37	2.15	6—14	10.65	3.97	6—21
9	9.31	2.58	5—15	11.97	4.20	5—29
10	10.27	3.00	6—17	12.10	4.14	5—27
11	10.74	3.03	7—17	11.72	4.16	4—23
12	10.00	2.43	6—14	12.18	5.50	6—37
13	10.54	2.85	6—16	12.89	5.63	5—35
14	10.34	2.96	7—17	14.22	5.61	6—35
15	14.57	3.67	6—23	14.68	4.92	5—27
16	13.80	4.87	8—24	16.19	5.38	5—39
17	13.65	4.17	8—24	16.99	5.93	2—33
18	14.74	3.30	8—21	15.65	8.08	5—25

Table 36

Subscapular skinfold thickness in Körmend boys (mm)

Age (years)	K-68			K-78		
	x̄	s	W	x̄	s	W
3	6.15	1.21	5—9	6.00	1.62	3—8
4	5.36	1.13	4—8	6.13	2.77	3—17
5	5.03	0.94	3—7	6.03	2.12	3—11
6	5.14	1.21	3—9	5.87	2.40	3—16
7	5.01	1.18	4—8	5.24	2.82	2—18
8	4.44	1.29	3—10	6.79	5.07	2—34
9	5.27	1.28	3—9	6.93	4.33	2—30
10	5.77	1.54	3—10	5.13	5.60	3—31
11	6.47	2.27	4—15	8.38	6.05	3—35
12	6.08	1.96	4—15	8.96	5.89	2—32
13	6.49	2.29	4—15	9.15	6.81	3—48
14	6.53	2.44	3—14	9.21	5.80	3—38
15	6.95	1.52	4—12	8.85	3.71	3—23
16	7.49	1.86	5—15	9.67	4.24	5—31
17	7.97	2.02	5—14	9.48	4.34	4—30
18	8.18	1.56	5—12	11.26	5.39	5—36

Table 37

Subscapular skinfold thickness in Körmend girls (mm)

Age (years)	K-68			K-78		
	x̄	s	W	x̄	s	W
3	6.19	1.26	4—8	6.95	2.62	3—14
4	6.43	1.35	4—10	6.51	2.49	3—17
5	6.06	1.49	4—9	7.13	2.43	4—15
6	5.89	1.28	4—9	7.36	3.05	3—18
7	5.75	1.49	4—10	7.87	4.96	2—33
8	6.83	2.34	4—12	7.89	5.09	3—28
9	6.92	2.63	4—15	9.18	5.52	3—32
10	8.05	2.47	4—15	9.46	5.28	3—25
11	9.16	3.96	6—18	9.89	5.90	2—34
12	8.52	2.11	6—14	11.17	7.61	3—48
13	9.57	2.90	5—15	12.45	6.58	5—37
14	10.93	3.15	6—17	13.63	6.19	4—35
15	13.43	3.61	8—21	13.76	5.90	5—33
16	13.74	4.21	9—23	15.11	7.28	7—47
17	13.33	3.73	8—20	16.47	6.42	5—41
18	13.44	4.02	8—22	15.18	5.27	7—32

Table 38

Supra-iliac skinfold thickness in Körmend boys (mm)

Age (years)	K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W
3	6.31	2.57	4—12	6.70	1.64	4—11
4	5.49	2.02	3—10	6.69	2.82	2—22
5	4.79	2.10	3—13	6.81	2.52	2—13
6	4.76	1.35	3— 8	7.20	3.11	2—20
7	4.70	2.46	3—14	6.65	4.12	2—24
8	5.55	2.68	3—14	8.88	7.56	2—39
9	5.04	2.09	3—13	10.29	7.73	2—45
10	5.49	2.07	3—10	11.92	8.94	2—42
11	6.42	2.80	3—13	12.59	9.99	3—50
12	6.10	2.71	3—14	12.82	8.99	3—46
13	6.67	2.96	3—15	13.29	9.92	3—58
14	6.53	2.44	4—14	13.16	8.86	2—55
15	6.89	2.54	4—18	12.01	6.69	3—35
16	7.19	2.31	4—14	12.52	7.33	4—58
17	8.20	3.14	4—17	12.08	7.25	5—52
18	6.86	2.08	5—13	14.74	7.82	4—46

Table 39

Supra-iliac skinfold thickness in Körmend girls (mm)

Age (years)	K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W
3	7.33	2.68	4—13	7.61	2.74	3—14
4	7.54	2.21	5—13	8.10	2.98	3—18
5	7.03	2.71	4—13	8.99	3.27	4—19
6	6.65	2.14	4—12	9.40	3.77	3—21
7	6.39	3.11	4—12	10.48	6.18	3—38
8	7.24	2.49	4—14	9.88	4.99	2—31
9	7.67	2.86	4—13	13.11	7.68	3—38
10	9.48	3.15	4—15	13.19	6.59	5—33
11	9.05	3.27	4—14	14.07	7.63	3—35
12	8.84	2.53	5—13	15.29	9.63	3—41
13	10.46	3.61	6—18	16.49	8.43	5—40
14	10.93	3.15	6—17	17.50	7.95	3—47
15	16.10	3.99	9—23	17.81	7.52	6—37
16	17.73	4.80	12—28	19.18	7.33	10—52
17	15.13	4.44	8—23	21.66	8.80	7—50
18	20.60	4.93	14—31	18.18	6.92	7—42

Table 40

Abdomen skinfold thickness in Körmend boys (mm)

Age (years)	K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W
3	8.45	3.24	4—14	5.88	2.42	3—13
4	6.25	2.24	4—12	5.97	2.89	2—14
5	5.73	1.47	3— 9	5.42	2.29	2—13
6	6.11	1.81	3—10	6.33	3.64	1—20
7	5.32	1.79	3—12	5.69	4.10	2—24
8	6.72	3.37	3—16	7.70	6.84	2—38
9	6.10	2.47	3—13	8.81	7.11	2—38
10	6.65	2.78	3—14	10.68	8.58	3—36
11	8.36	4.28	4—21	10.43	8.55	3—45
12	7.88	2.75	4—14	11.20	9.25	2—47
13	9.24	3.88	4—20	11.57	8.80	3—50
14	10.11	3.84	6—19	11.47	8.34	3—50
15	9.19	3.11	4—17	11.57	8.80	3—50
16	10.16	3.14	5—19	12.37	7.10	4—48
17	10.89	4.31	5—21	11.92	8.00	4—54
18	11.00	3.08	6—20	13.89	8.44	5—48

Table 41

Abdomen skinfold thickness in Körmend girls (mm)

Age (years)	K-68			K-78		
	$\bar{x}$	s	W	$\bar{x}$	s	W
3	7.31	1.58	4— 9	8.38	3.52	5—21
4	7.53	3.39	5—16	7.31	2.52	2—15
5	6.42	2.38	4—12	7.20	3.39	2—18
6	8.05	3.40	4—15	8.01	4.06	2—20
7	6.70	2.11	4—13	8.65	5.77	3—34
8	8.25	3.20	4—15	8.31	5.34	2—27
9	8.77	3.01	4—15	11.21	7.57	2—48
10	10.63	3.61	5—17	11.49	6.21	3—31
11	10.20	3.37	5—15	13.41	7.71	3—36
12	13.34	4.60	7—20	15.41	9.15	3—44
13	15.41	4.52	9—24	16.56	8.01	6—42
14	18.93	6.01	10—30	18.94	8.14	4—53
15	22.08	4.18	16—30	19.93	7.85	8—42
16	22.80	4.99	17—33	21.63	8.84	9—55
17	17.79	4.60	11—27	22.73	8.89	8—44
18	24.28	4.71	14—31	20.00	9.15	8—35

Summary

Changes in body measurements investigated in KGS demonstrate secular changes in Körmend children. All these changes are the consequence of an urbanization process of the settlement, including migration. In this paper the author presented values of body measurements as a complete series of anthropometric data of the KGS.

Special Acknowledgements: It was difficult to speak without any emotion on 28th May, 1981. This day was a splendid landmark in the history of the Körmend Growth Study. After many conferences in Hungary and abroad I had an opportunity to give a presentation on my Körmend Growth Study there, just at Körmend. Many of the participants of our Symposium had known more or less about this study years before, however, very few of them know Körmend itself. We were there, and I was able to report some selected data of my investigations at Körmend. Our Körmend friends were happy to see the participants of our Symposium there. It is a fact that in the 700 years' history of Körmend there had never been organized such scientific conference with the attendance of such an international group of outstanding scientists. Therefore, my first words were those of thanks. I really was and I am extremely happy and grateful for the extensive and permanent help and exceptionally willing co-operation of my Körmend colleagues and friends during the course of this study. Without their help and collaboration I would never have been able to carry out this study. I am convinced that they knew for as certain as I did that with this Körmend Growth Study all of us served the better knowledge of our Körmend youth, and with it we wanted to create better circumstances for their growth and development process.

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FRÁTER ERZSÉBET: A Kaszásdűlői (Budapest, III. ker.) késő római kori temető csontleleteinek paleoszerológiai vizsgálata.
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NAGY MÁRIA–MARKEL ÉVA–KÓNYA GUSZTÁVNÉ: Az egészségügyi főiskolát végzettek szerepe a fogyatékosságok megelőzésében és gyógyításában.

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Kelemen András: Biológiai szempontok a skizofrénia nozológiájához.
Skripeczky Katalin: Az öröklődő hallászavarok néhány differenciál-diagnosztikai kérdése.
Molnár Miklós: A pajzsmirigy funkciói, jelentősége a szellemi retardációban.
Mandel Györgyi: Aminoacidopathia szűrés értelmi fogyatékos gyermekek körében.
Nemeskéri János: A budapesti agglomeráció népességének adaptációs kérdése — humánbiológiai vizsgálatok.
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Nyilas Károly—Gönczi András: Dermatoglypha vizsgálatok Szabolcs-Szatmár megyei értelmi fogyatékos gyermekeken.
Héra György—Béndekné Kurovszki Ildikó: Atipusos tenyéri redők előfordulása értelmi fogyatékos gyermekeknél.
Szilágyi Katalin: Értelmi fogyatékosok bőrlécrendszerének kvantitatív jellegei.
Szabó Terézia: Értelmi fogyatékos gyermekek metrikus jellegeinek variációi Szabolcs-Szatmár megyében.
Darvay Sarolta: Fogyatékos leánygyermekek testi fejlettsége és menarche kora.
Joubert Kálmán: A veleszületett fejlődési rendellenességgel születettek testfejlettségének alakulása.
Eiben Ottó—Buday József: Down-kóros felnőttek testalkata.
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223. szakülés, 1982. június 21.

Susa Éva—Segesdi Katalin: A talpi bőrlécrendszer vizsgálata egy budapesti mintában, 2. A talpi területek elemzése.
Fazekas András—Farkas Gyula—Szekeres Erzsébet—Kocsis Gábor: Különböző menynyiségű fluoridot tartalmazó ivóvízű települések 6,5—16,5 éves fiataljainak szomatikus fejlettsége.

224. szakülés, 1982. október 11.

Lipták Pál: Az Embertani Szakosztály 30 éve.
Pap Ildikó: Egy Árpádkori temető (Szabolcs, Petőfi u.) embertani anyagának vizsgálata.

225. szakülés, 1982. december 13.

Juhász Nagy Pál: Gondolatok az antropológiai és biológiai modellezés viszonyáról.
Izsák János: A haláloki koncentráció újszerű statisztikai vizsgálatának eredményei a humánbiológia tükrében.
Környei Vilmos—Gyódi Gyula—Gelencsér Erzsébet—Kercsó Klára—Szokola Ágnes: Kaposvári leányok menarche kora 1981-ben.

Gy. Gy.

KÖNYVISMERTETÉSEK

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FALKNER, F. & TANNER, J. M. (Eds): *Human Growth. 1. Principles and Prenatal Growth, 2. Postnatal Growth, 3. Neurobiology and Nutrition.* (Plenum Publ. Co. New York, 1978, 1979. — 634+634+606, összesen 1876 oldal, számos táblázattal, ábrával.)

Ez a háromkötetes munka összefoglalja mindazt, amit az 1970-es évek közepén a tudomány a gyermek növekedéséről, testi fejlődéséről tudott. A gyermek növekedésének kutatása az utóbbi évtizedekben egyre intenzívebbé és komplexebbé vált. A hagyományos tudományágak, mint az anatómia, az élettan, a biofizika, a biokémia, az endokrinológia, újabban az epidemiológia és különösen a gyermekgyógyászat eredményei óriási mértékben vitték előbbre a gyermek növekedésére vonatkozó ismereteinket. Egy részletes összefoglaló kézikönyv azonban eddig nem létezett. E három kötet olyan standard munka, amely a biológia és az orvostudomány eddigi ismereteit, kutatási eredményeit ötvözi egybe, az elmélet és a gyakorlat szoros egységében.

A szerkesztők a növekedéskutatás nemzetközileg elismert, vezető tudósai. A három kötetben nyolc nagyobb egységet, összesen 57 fejezetet találunk. Ezeket tíz országból származó 77 szakember írta; két szerző 2—2 fejezettel járult hozzá a munkához, számos fejezetet több szerző írt meg. Valamennyiük nevének felsorolása szinte lehetetlen, az ismertetés szubjektivitásából adódik, hogy néhány szerző nevét mégis megemlítjük. Mindenesetre a puszta számadatok alapján is fogalmat alkothatunk e vállalkozás óriási méreteiről.

Az *1. kötet* négy nagyobb egységet foglal magában. Az első rész, Fejlődésbiológia, négy fejezetben tárgyalja a növekedési folyamat mechanizmusát és a biokémiai alapokat, sőt bizonyos sejtéseket is felvázol az összehasonlító növekedéskutatás problémáiból. — A második rész a növekedéskutatásban alkalmazott biometriai módszereket foglalja össze. E három fejezetben igen alaposan tájékozódhatunk a növekedési standardek statisztikai kérdéseiről (HEALY), a mintaválasztás (GOLDSTEIN) és a longitudinális növekedési vizsgálatok sajátos matematikai—statisztikai problémáiról (MARUBINI). E fejezetek ismerete különösen fontos a vizsgálatok megtervezésének fázisában. — A harmadik rész öt fejezetben mutatja be a növekedés genetikai problémáit, alapvető módszereit. A magzati növekedés genetikája (ROBERTS), továbbá olyan speciális kérdések, mint a születési súly vagy a felnőttkori termet vagy az érési folyamat genetikai aspektusai kapnak itt helyet.

A kötet negyedik része kilenc fejezetben foglalja össze a prenatalis növekedés problémáit. A placenta anatómiája és fiziológiája, a magzati méretek éppúgy szerepelnek itt, mint az ikrek növekedésének kérdései (FALKNER), vagy olyan nagyon is gyakorlati kérdések, mint az anya táplálkozása és a magzat növekedése közötti összefüggések, az anyának és magzatának anyagcsere-problémái, vagy a prenatalis és perinatalis kor endokrinológiai kérdései, az immunrendszer kiépülése, avagy a magzati növekedés speciális szülészeti aspektusai.

A *2. kötet* a postnatalis növekedést tárgyalja — a hazai növekedésvizsgálatok mindennapi gyakorlata számára is igen hasznosan. Két fejezet foglalkozik a különféle szervek sejtnövekedésével. Részletes fejezet mutatja be a növekedésvizsgálatoknál alkalmazott antropometriai módszereket (CAMERON). Kitűnő a korai gyermekkorról (JOHNSTON) és a pubertásról (MARSHALL) írott fejezet. Különös érdeklődésre tarthatnak számot a testösszetételről, a növekedés endokrinológiájáról, egyes szervrendszerek, elsősorban az idegrendszer fejlődéséről írott fejezetek. Kiemelkedően fontos a csontérésről írott alapvető fejezet (ROCHE), és a hozzá kapcsolódó részletek, az agy- és arckoponya növekedése, a fognövekedési minták, valamint a fogzás, a fogéletkor kérdései (DEMIRJIAN). A szekuláris növekedésváltozásokról (VAN WIERINGEN) és a testgyakorlásnak, a fizikai aktivitásnak a növekedésre gyakorolt hatásáról (MALINA) olvashatunk kitűnő írásokat. E kötetet két olyan dolgozat zárja, amely elsősorban a gyermekgyógyászati gyakorlatot érinti: a kissúlyú újszülöttek és ezek növekedésének kérdései.

A *3. kötet* két nagyobb egységből áll. Előbb a növekedés, testfejlődés neurobiológiai kérdéseiről találunk kilenc fejezetet, kezdve a korai magzati stádiummal és befejezve a magatartási aspektusokkal. Fontos a cortex éréséről írott fejezet (RABINOWICZ). A központi idegrendszer organizációs kifejlődése és az agy plaszticitása, a légzés beidegződésének fejlődése, az alvás egyes kérdései éppúgy megtalálhatók, mint az agy sexualis differenciálódása vagy a korai idegrendszeri differenciálódás kérdései (BRANDT). E fejezetek szinte mind klinikai tapasztalatokon is alapulnak.

A kötet másik része a táplálkozással, ill. annak a növekedéssel való összefüggésével foglalkozik. Kitűnő a csecsemő táplálkozását és növekedését összefüggéseiben elemző (BERGMANN házaspár), valamint a fehérje- és energiahiányból adódó rossz táplálkozásnak a növekedésre gyakorolt káros következményeiről írott fejezet (MALCOLM). Az egyes populációk gyermekcsoportjainak növekedésére ható genetikai és környezeti tényezők okozta különbségeket az IBP HA szekció munkái alapján mutatja be EVELETH. A gyermektáplálkozás epidemiológiai aspektusai (JELLIFFE házaspár) és az obesitas kérdései (CAHILL és ROSSINI) mellett a hiányos táplálkozás és az egyedfejlődésben mutatkozó zavarokról, valamint a táplálkozás és a mentális fejlődés, ill. tanulás kapcsolatáról olvashatunk.

E kötetben még egy terjedelmes fejezetet találunk, amelyben TANNER felvázolja a növekedés, testfejlődés kutatását BUFFONtól BOASig. (Azóta ezt a témát önálló könyvben is feldolgozta.) Kár, hogy a kelet-európai kutatásokról alig esik szó e tanulmányban.

A szerkesztőket dicséri a könyv logikus felépítése és az egyes fejezetek egységes szerkezete. Minden fejezet ugyanis az adott probléma felvázolásával kezdődik, majd kísérletes (részben saját) eredmények bemutatásával jut el a következtetésekig, az eredmények összefoglalásához, és igen részletes, pontos irodalomjegyzéket is ad.

Mindhárom kötetben tárgymutató is van; néha olyan érzésünk támad, hogy ezek még részletesebbek is lehetnének.

Ez a könyv nemcsak a humánbiológiai, auxológiai kutatások legújabb eredményeinek összefoglalását adja, hanem a gyermekgyógyászat vagy általánosabban a gyermekegészségügy sajátos szempontjait is érvényesíti. Valamennyi tudományterület, amely a növekedéssel, testi fejlődéssel kapcsolatban van, adta legújabb eredményeit, és ugyanakkor kap más, ugyancsak fontos adatokat. Kijelenthetjük, hogy ez a könyv a növekedés morfológiai, fiziológiai, biokémiai, valamint elméleti és módszertani problémáinak első hiteles és majdnem teljes összefoglalása. Nemcsak kézikönyv, amelyből fontos, új adatokat, elméleti és gyakorlati ismereteket szerezhetünk, de szemléletformáló funkciója is kiemelkedő. Ezért minden, növekedéssel foglalkozó laboratórium könyvtárában meg kellene lennie.

A Plenum Kiadó igen szép kiállításban, bőven illusztrálva jelentette meg ezt az alapvető könyvet. Nem ismerjük a példányszámot, de feltételezzük, hogy az szokatlanul magas lehetett. Így is biztosra mehetett a Kiadó: a kötetenkénti 30—40 dolláros ár mellett is nagy keletje és páratlan sikere van a könyvnek. (Ezt igazolja, hogy máris előkészületben van az újabb kiadás.) Köszönet a szerkesztőknek, a szerzőknek és a Kiadónak!

Dr. Eiben Ottó

WALTER, H.: *Sexual- und Entwicklungsbiologie des Menschen.* (Georg Thieme Verlag, Stuttgart, 1978. 268 oldal, 27 táblázattal és 89 ábrával. Ára: DM 14.80)

A „Flexible Taschenbücher" sorozat e kötetének olvasásakor úgy tűnik, hogy WALTER professzor célul tűzte ki, hogy az emberi sexual- és fejlődésbiológia alapvető kérdéseinek tárgyalásánál összekapcsolja a humánbiológiai és az orvosi szemléletet, hogy ezáltal e sokrétű téma leglényegesebb pontjainak komplex megvilágítását tegye lehetővé. Az anatómiai és élettani, a genetikai és patológiai kutatások legfrissebb eredményeinek logikus áttekintésén túl sor kerül az ide tartozó szociálantropológiai problémák elemzésére is.

A könyv két nagy témakörre oszlik a prae- és postnatalis fejlődési szakasznak megfelelően. Először megismerkedhetünk a nemi szervek fejlődésével, felépítésével és funkciójával, majd a megtermékenyítés biológiájával. E két fejezetben különös hangsúlyt kapnak az egészségügyi és szociálantropológiai fejtegetések. A születés előtti időszakról szóló részben az embriogenezis, ill. a magzati fejlődés általános biológiájának — főleg élettanának — leírásán túl a szerző néhány antropológiai érdekességre hívja fel a figyelmet, jóllehet a rasszbeli hovatartozás, ill. a környezeti hatások okozta különbségek között még nem húzhatók meg egyértelműen a határok. A szülés folyamatának és a szoptatás kérdéseinek tárgyalásán túl e fejezet foglalkozik még a praenatalis rendellenességekkel. Részletes képet kapunk a genetikai (génmutáció, kromoszómaaberráció) eredetű, ill. a szerológiai összeférhetetlenség miatt fellépő fejlődési rendellenességekről. Értékes gyakorlati ismereteket nyújt a genetikai tanácsadásról szóló alfejezet.

Ezt követi a nem genetikai feltételhez kötött rendellenességek sorbavétele, a kiváltó okok minősége szerinti csoportosításban.

A postnatalis fejlődésről szóló rész első egysége a pubertás végéig tart. A fejezet nemcsak az antropometria és szomatotipizálás, a csontfejlődés és fiziológiai jellemzők szemszögéből vizsgálja ezt az igen érdekes és sokat kutatott fejlődési szakaszt, hanem remek áttekintést ad a neurohormonális változásokról is, különös tekintettel a nemi érésre. Nem marad el természetesen az ide tartozó genetikai és nem genetikai eredetű betegségek, valamint a szocioökonómiai különbségekre visszavezethető eltérések alapos magyarázata sem. Igen érdekes és viszonylag nagy volumenű az „akceleráció"-nak szentelt szakasz, mely számos vizsgálati eredményt közöl, valamint különböző hipotéziseket ismertet és vitat meg. A továbbiakban a fejlődésbiológia alkalmazási területeire kerül sor, s ebben a gyermekgyógyászattól az apasági vizsgálatokon át az ipari antropológiáig minden lényeges szakág helyet kap.

A felnőttkorról szól a már sokkal rövidebb utolsó fejezet, mely a testi, a fiziológiai és az endokrin változásokkal, morbiditási és mortalitási adatokkal, valamint az öregség és a halál biológiájának ismertetésével zárja az ivarsejtek létrejöttének eredetével induló, és a Homo Sapiens prae- és postnatális fejlődésén át ívelő kört.

A mondanivaló sokfélesége ellenére ez a munka egységes egész, logikus szerkesztése és kitűnő stílusa miatt az egyetemi hallgatókon és a szakembereken túl minden érdeklődő élvezettel forgathatja.

Dr. Pantó Eszter

TANNER, J. M.: *A history of the study of human growth.* (Cambridge University Press, Cambridge—London—New York—New Rochelle—Melbourne—Sydney, 1981. 499 oldal. Ára: £ 30.00)

TANNER professzor új könyve az emberi növekedés tanulmányozásának történetét vázolja fel. A mintegy három és fél évtizedes szakmai tevékenysége során rengeteg történeti adat gyűlt össze kezében, ezeket adja most közre. Az előszóban kifejezi ugyan aggályát, hogy ő nem történész, és könyvét nem is szánja történeti munkának. Valóban, nem az; több annál. Egy széles látókörű, mindenre, ami összefügg a gyermek növekedésével, érzékeny szakember kitűnő írása. Óriási időtartamot, 26 évszázadot fut be 400 oldalon. A feldolgozott irodalom több mint 1200 tétel, felsorolása 52 oldalt tesz ki, és 38 oldalt foglalnak el a jegyzetek, amelyek jórészt személyes hangvételű, érdekes adalékok. A 7 oldalnyi Index hasznosan egészíti ki a könyvet, amely 15 fejezetből áll.

Az ókorral kezdődő áttekintésből SOLONt érdemes kiemelni, aki hétéves periódusokban biológiailag is jó jellemzést adott az emberi életszakaszokról. A középkorban a dominikánus BEAUVAIS *Speculum majus* c. munkájában az alapvető testnedvek predominanciáját úgy írja le, hogy a gyermekkorra 14 éves korig a *phlegma*, aztán 28 éves korig a *cholera*, majd 60 éves korig a *sanguis* jellemző, végül az időskor a *melancholia* kora. A reneszánszban FERNEL használta először a fiziológia kifejezést a növekedésvizsgálatokban.

Az emberi proporciók vizsgálatával, mint tudjuk, igen korán kezdtek foglalkozni, a képzőművészetekben ennek a problémának óriási hagyományai vannak. A természettudományos gondolkodásnak is megfelelő megközelítés ugyancsak eléggé korán jelentkezett. E fejezetben többek között VITRUVIUS, ALBERTI, DÜRER, ELSHOLTZ, BERGMÜLLER, AUDRAN, SCHADOW munkásságával ismerkedhetünk meg.

A negyedik fejezet az antropometria kialakulását írja le. STÖLLER könyvének címében először szerepel a *növekedés* szó (1729). BUFFON és DAUBENTON csecsemőket, kisgyermekeket, sőt abortumokat vizsgált és mért, és itt olvashatunk DE MONTBEILLARDról, az első longitudinális növekedésvizsgálatról. Érdekesen elevenedik fel JAMPERT munkája: ő a berlini Friedrich-kórház (árvaház) neveltjeinek növekedését vizsgálta. Adatait TANNER felvitte a mai brit növekedési standardekre. Tanulságosak az első korszerű növekedésvizsgálatok leírásai, a Carlschule (stuttgarti kadétiskola) vagy az angol Marine Society kadétjainak növekedésvizsgálata, avagy az első regruta-vizsgálatok, majd QUETELET matematikai megalapozású antropometriai vizsgálatai.

A növekedésvizsgálatok a múlt század közepe táján jutottak fontos szerephez a közegészségügyben. Az 1830-as években Manchesterben, Leedsben 8—17 éves gyári munkás gyermekek testmagasságát vizsgálták, különösen HORNER munkássága kiemelkedő. Amerikában ez idő tájt vizsgálták a rabszolgagyermekek növekedését.

Az 1870-es években a növekedésvizsgálatok szocio-demográfiai aspektussal bővülnek, elsősorban BRIDGES, HOLMES, CH. ROBERTS, GALTON és BOWDITCH munkássága nyomán. ROBERTS 1878-ban adta ki az első antropometriai kézikönyvet, GALTON megszerkesztette az első stadiométert, BOWDITCH Bostonban egy család 22 gyermekének növekedését kísérte nyomon 1-től 22 éves korukig, és jól ismerte a környezeti tényezőknek a növekedésre gyakorolt hatását. Kialakult az auxologia, és az iskolaorvosi vizsgálatok egyre több növekedési adatgyűjtéssel egészültek ki. PAGLIANI torinói vizsgálataiból leszűrte a következtetést, hogy a növekedés egyediségét longitudinális módszerrel, míg a növekedés általánosságát keresztmetszeti növekedésvizsgálatokkal lehet eredményesen tanulmányozni. GODIN volt az első, aki a másodlagos nemi jellegek kifejlődését egzakt kritériumok alapján osztályozta. Ő írta meg az első pedagógiai antropológiai kézikönyvet 1919-ben. (A testgyakorlásnak a növekedésre gyakorolt hatását elemző vizsgálatairól MALÁN professzor az 1930-as években beszámolt.) BOAS nevéhez fűződik a növekedésvizsgálatok (fizikai) antropológiai szemléletű megszervezése. D'ARCY THOMPSON pedig elsőként vizsgálta a növekedés folyamatát, a növekedési sebességet. A múlt század utolsó éveiben kezdődtek el az Amerikai Egyesült Államokban azok a longitudinális vizsgálatok, amelyekből az első növekedési standardeket kidolgozták. E tekintetben az 1930-as évek hozták a második nagy korszakot, amikor a növekedéskutatásban a környezeti és a genetikai faktorok hatását már módszeresen vizsgálták.

A klinikai szempontok is egyre inkább érvényesültek a növekedésvizsgálatokban. Ennek jegyében 1753-tól gyűjtöttek testsúly-, testhossz-, fejkerület-adatokat az újszülöttekről, növekedési standardeket dolgoztak ki az 1850-es évektől kezdve. STRATZnak a növekedés során bekövetkező proporcionális változásokról adott leírását, akárcsak a „nyúlási" és „telési" időszakok leírását az idő nem igazolta (vö. EIBEN 1960), jóllehet számos könyv átvette, sőt ZELLERt is félrevezette. Ez utóbbi különben a korai gyermekkor végén jelentkező alakváltozásokról adott leírásával az „iskolaérettségi" vizsgálatok előfutárának tekinthető. SCAMMON (1930) ábráját a növekedés négy alaptípusáról itt eredetiben láthatjuk.

Olvashatunk a fejlődéslélektan és a növekedésvizsgálatok találkozásáról, amely leginkább az amerikai longitudinális vizsgálatokban realizálódott (Iowa, Harvard, Berkley, Fels stb. növekedésvizsgálatok).

A növekedési rendellenességeket főleg az európai longitudinális növekedésvizsgálatokból ismerhetjük meg. Itt olvashatunk a híres Harpenden-növekedésvizsgálatokról és a párizsi Centre International de l'Enfance által koordinált nemzetközi kutatásokról, MONCRIFF első szociálpediátriai vizsgálatairól stb. Az „egyéb európai" vizsgálatok címszó alatt csehszlovák, lengyel, finn, NSZK-beli és török kutatásokról vannak adatok. Magyarországról egy szó sem esik. A „nemzeti" (országos) növekedésvizsgálatok között amerikai, angol, holland és kubai munkákat említ a szerző.

Befejezésül a növekedésvizsgálatok oki megalapozásáról ír TANNER figyelemre méltó zárósorokat: a szociális igényekről, amelyek az iparosodással együtt fejlesztették ki a növekedésvizsgálatokat, felhívták a figyelmet a különböző populációk növekedési rátáiban levő és genetikailag meghatározott különbözőségekre; az orvosi szempontokra, amelyek az egyed növekedését longitudinális módszerrel vizsgálják; és végül olyan intelligencia-aspektusokra, amelyek egy-egy érdekes jelenség oki vizsgálatára vonatkoznak.

E könyvben TANNER professzor jó összefoglalását adja a növekedésvizsgálatok történetének, és az utolsó 100—150 év nyugat-európai és észak-amerikai történéseinek. Kár, hogy a közép-kelet-európai vizsgálatok szinte szóba sem kerülnek. Mindazonáltal a könyv élvezetes stílusban megírt olvasmány mindazoknak, akiket a növekedésvizsgálatok érdekelnek.

Dr. Eiben Ottó

GOLDSTEIN, H.: *The Design and Analysis of Longitudinal Studies. Their Role in the Measurement of Change.* (Academic Press, London, New York, San Francisco, 1979. 199 oldal. Ára £ 13.00. ISBN 0-12-289580-0)

A növekedésvizsgálatok két változata, a longitudinális és a keresztmetszeti egyaránt felvirágzott az utóbbi évtizedekben. Mindkettőnek megvan a maga helye a humánbiológiai kutatásokban, és a tanulmányozni kívánt problémától függ, hogy melyik módszert alkalmazzuk. Mindenesetre. a longitudinális módszer az, amely több módszertani problémát vet fel.

Ezek megoldására, e módszerek összefoglalására tesz kísérletet HARVEY GOLDSTEIN professzor könyve. GOLDSTEIN professzor több mint másfél évtizeden át dolgozott TANNER professzor matematikusaként a híres Institute of Child Health Növekedés és testfejlődés Osztályán. Nem túlzás azt állítani, hogy aligha van olyan probléma e témakörben, amellyel a Tanner-laboratórium ne foglalkozott volna. Már maga ez a tény is garancia arra, hogy a könyv a gyakorlat talajára épül. Ezt különben TANNER professzor is kiemeli a könyvhöz írott előszavában.

Az első fejezetben a szerző a longitudinális vizsgálatok elméletét és gyakorlatát vázolja föl. Szóba kerül itt a mintaválasztás, a mérési technika, a statisztikai modellek kérdése, az időskála, a fejlődési standardek és normák, az adatok feldolgozása stb. Szó esik a „pilot study" és a „quality control" fontosságáról.

A második fejezetben fejti ki a szerző részletesen a mintaválasztás és a vizsgálat megtervezése fontos kérdéseit. Régi igazság ui., hogy a vizsgálat értéke már szinte a tervezésnél eldől. Ha ez szó szerint nem is olvasható így, az egész fejezet ezt támasztja alá. GOLDSTEIN a populáció definiálásával kezdi. Köztudott, hogy egy geográfiailag körülírt populáció jellemzői idővel változnak. Például a 7 éves brit gyermekek testmagasságát említi, amely a 20. század első felében évtizedenként kb. 1,5 cm-t emelkedett, és ez a „szekuláris trend" egy olyan részesemény időbeli megjelenését is befolyásolta, mint amilyen pl. a menarche (lásd TANNER 1955). Ez a történelmi folyamat tehát uralja azokat a változásokat, amelyek az életkorral jelennek meg. És, bár mind az életkort, mind pedig a történelmi időt azonos egységekkel mérjük, soha nem lesznek logikailag különböző fogalmak. Ezért tehát, amidőn egy populációt definiálunk, mindig szükséges annak történelmi eredetét is meghatároznunk, éppúgy, mint földrajzi helyzetét és egyéb jellemző tulajdonságait. Eszerint minden humánbiológiai tanulmány arra a sajátos történelmi korra érvényes, amelyben a kérdéses populáció élt. Nem árt erre emlékezni a hazai növekedésvizsgálatok értékelésénél is.

E fejezetben figyelemre méltó részeket olvashatunk még a minta nagyságával szemben támasztott követelményekről, amelyek életkoronként mások és mások.

A harmadik fejezet a „mérőeszközök" (measuring instruments) időbeli változásairól szól. Mérőeszköz lehet bármely módszer, amellyel információkat gyűjtünk, pl. egy antropométer, amellyel testmagasságot mérhetünk, de mérőeszköz lehet egy jól megszerkesztett interjúkérdőív is. A példák zöme emberi növekedésvizsgálatokkal kapcsolatos.

A negyedik fejezet az időhöz viszonyított méretek modellezését és a vizsgálatok elemzését tárgyalja, megfelelő matematikai apparátussal. Az ötödik fejezet a különböző alkalmakkor végzett vizsgálatokból származó adatok, pl. testméretek elemzésével foglalkozik. Különösen fontos a kettőnél több vizsgálat eredményeinek feldolgozásáról írott rész. De olvashatunk itt a mérési hibáról (amely a hazai antropológiai vizsgálatokban ugyancsak elhanyagolt probléma), a diszkrét adatok, minőségi jellegek feldolgozásának problémáiról (log-lineáris modellekről, log-lineáris path analízis modellekről, recurzív és non-recurzív rendszerekről stb.). Figyelmet érdemel a retrospektív adatok feldolgozásának kérdése is.

A hatodik fejezet hozza talán a legfontosabb és a leggyakorlatibb tudnivalókat, a populáció standardek és/vagy normák problémáját. Ahhoz azonban, hogy ezt valóban felhasználhassuk a mindennapi munkánkban, át kellett rágnunk magunkat a könyvön (ami különben kellemes és nyelvi szempontból sem nehéz olvasmány).

A hetedik fejezet az adatfeldolgozást tárgyalja. Szerény, mindössze 5 oldalas tárgymutató zárja a könyvet.

GOLDSTEIN professzor könyve nagy nyereség a növekedésvizsgálatokkal foglalkozó humánbiológusok, antropológusok, gyermekorvosok, sportkutatók stb. számára.

Dr. Eiben Ottó

LAUGHLIN, W. S.—HARPER, A. B. (Eds): *The first Americans: origins, affinities, and adaptations.* (Gustav Fischer, New York—Stuttgart, 1979, 340 oldal).

Amerika őslakói, az indiánok egyre inkább az antropológusok érdeklődésének a központjába kerülnek. Ennek az a magyarázata, hogy Amerika gyakorlatilag csak egy irányból — Szibériából — népesült be egy keskeny földhídon keresztül, a bevándorlás rövid ideig tartott, és viszonylag rövid idő alatt igen erősen eltérő földrajzi körülményekhez (szubarktikus, mérsékeltövi erdős, préri, trópusi erdők, forró sivatagok és magas hegyek) alkalmazkodtak a bevándoroltak. A kultúráknak igen széles skálája alakult ki, mert például a közép-amerikai indiánok a földművelést, az építészetet, a csillagászatot, a matematikát, a 0 fogalmát és az írást is kifejlesztették, míg az amazonaszi indiánok között kőkori szinten élők is vannak.

A kötet a Wenner—Gren Alapítvány által 1976-ban Burg-Wartensteinben megrendezett konferencia anyagát tartalmazza. A szerkesztők közül W. S. LAUGHLIN a Connecticuti Egyetem Biológiai Antropológiai Laboratóriumának vezetője, A. B. HARPER pedig a munkatársa. Mindketten több kutatást végeztek az Aleutákon, a Parancsnok-szigeteken, Alaszkában, Kanadában, Grönlandon, és Szibériában is jártak.

A kötet tartalmilag három részre oszlik: az első amerikaiak eredetével, az egymással való kapcsolataikkal és az adaptációjukkal foglalkozó tanulmányokra. A 14 tanulmány mindegyike érdekes és értékes információkat tartalmaz. Részletes ismertetésük nem valósítható meg egy rövid recenzió keretén belül, csak egy kis figyelemfelkeltő „ízelítő" adható belőlük.

Az első tanulmányban D. M. Hopkins Beringiának az utolsó eljegesedése (i. e. 20—14 ezerig), valamint a holocén felmelegedés alatti geomorfológiai és klimatikus változásait és ennek az élővilággal való kölcsönhatásait elemzi. J. B. Griffin tanulmánya azt tükrözi, hogy a régészek között még mindig tartja magát az az álláspont is, hogy Észak-Amerika benépesülése csak 25—20 vagy 12 ezer évvel ezelőtt kezdődött volna. Ugyanakkor az újabb kormeghatározási eljárásokkal Del Mare 40 ezer, Lewisville pedig 37 ezer éves ! V. P. Alekszejev a mások (Debec, Trofimova, Levin stb.) által közölt antropometriai adatokat elemzi. Megállapítja, hogy a szibériai lokális rasszok kialakulása igen komplex folyamat volt, továbbá, hogy a mai szibériai népek ősei kevesebb mongoloid jelleget mutatnak, mint utódaik, és inkább emlékeztetnek az észak-amerikai indiánokra. W. S. Laughlin és munkatársai tanulmánya szerint az aleuták és az eszkimók 9—10 ezer éve váltak el egymástól, a Bering-híd partja mellett vándoroltak át Amerikába, míg a többiek a híd közepén. A további kutatásokat elsősorban az nehezíti, hogy az aleuta lelőhelyek mintegy egyharmada, az eszkimóknak pedig kétharmada ma már víz alatt van. M. Lampl és B. S. Blumberg szerint a vércsoport-polimorfizmusoknak igen nagy a variációja az újvilági populációk között, és ezek részletes feltérképezése még a következő évek feladata. J. N. Spuhler 53 észak-amerikai törzs vércsoport-polimorfizmusaiból számolt genetikai távolságot. Részletesen tárgyalja a vizsgálatok értékeléseinek nehézségeit, és végül megállapítja, hogy az indiánok, az eszkimók és az aleuták genetikailag eltérő földrajzi rasszhoz tartoznak, de közel állnak Ázsia mongoloid népességeihez. E. J. E. Szathmáry ettől teljesen eltérő végkövetkeztetéshez jut, mert szerinte az indiánok és az eszkimók igen közel állnak egymáshoz a jellegeik alapján. A többi tanulmány közül kiemelkedik F. E. Johnston és L. M. Schell tanulmánya, akik szerint még nincs elegendő adat ahhoz, hogy az észak-amerikai törzsek antropometriája alapján adaptív eltérések megmagyarázhatók legyenek.

A nem említett metodológiai, epidemiológiai és demográfiai témájú tanulmányok is fontosak lehetnek az Amerika őslakóival kapcsolatos újabb adatok iránt érdeklődőknek.

Dr. Gyenis Gyula

Sakano, N.: *Latent left-handedness. Its relation to hemispheric and psychological functions.* (VEB Gustav Fischer Verlag, Jena, 1982. 122 oldal, 26 ábrával és 19 táblázattal. Ára DDR 35,– M).

Az *Agy- és viselkedéskutatás* című monográfia-sorozat 9. köteteként megjelent könyv a szerzőnek a latens balkezességben megnyilvánuló hemiszférikus és pszichológiai működések lateralizációjára és aszimmetriájára vonatkozó vizsgálatait tartalmazza.

Sakano, N. a Kyoto Egyetem pszichológiaprofesszora, 15 éves munkássága alatt két évet a lipcsei Karl Marx Egyetem Klinikai Neurofiziológiai Tanszékén közösen dolgozott Pickenhain professzorral, aki kiadója ennek a mongráfia-sorozatnak. Számos beszédaktivitással kapcsolatos elektrofiziológiai vizsgálatot végeztek együtt, melyek a két hemiszférium funkcionális aszimmetriájának feltárását célozták.

Sakano vizsgálatainak kiindulópontja Luria 1947-ben közzétett hipotézise volt, mely szerint a jobbkezesekben a nyelvi működés bilaterális reprezentációjának bizonyítéka arra enged következtetni, hogy nagy számban kell lenniük latens balkezeseknek a jobbkezes egyének között, és hogy ez a latens balkezes csoport egy olyan populációt alkot, mely összehasonlítható a tiszta jobbkezesekkel. A szerző vizsgálataiban megállapította, hogy a latens jobb- és balkezessek aránya kb. 1:1 volt a normál népességben. Érdekes az a megállapítása, mely szerint a német egyetemi hallgatók 60%-a volt latens balkezes és 40%-a latens jobbkezes, míg a megvizsgált japán egyetemi hallgatók között 50—50%-ban talált jobb- és balkezeseket (latens kezesek).

A monográfia két részből áll: az első rész a Luria meghatározása szerinti latens kezességre és a kezesség (handedness) manifesztációjára vonatkozó statisztikai és pszichometrikus adatokat, valamint az adatgyűjtés módjának leírásait tartalmazza. Ezek az adatok megerősítik a kognitív mód, a skolasztikus teljesítmény-tesztekkel mért individuális különbségek és a latens kezesség közötti kapcsolatra vonatkozó hipotézist. A második része a könyvnek öt elektrofiziológiai kísérletet és a kísérletek eredményeinek értékelését tartalmazza. Ezek a kísérletek a latens kezességgel kapcsolatban levő hemiszférikus túlsúly két típusának neuropszichológiai alapjait magyarázzák.

A szerző kb. 2000 személyt vizsgált meg. A vizsgált személyek életkora óvodáskortól felnőttkorig terjedt. Alkalmazta a Luria-féle latens kezességre vonatkozó teszteket, a szóbeli—térbeli faktorok vizsgálatának érdekében 8—16 éves gyermekeket intelligencia-tesztekkel, 8—14 éveseket skolasztikus teljesítmény-tesztekkel, míg a 13—16 éveseket, valamint az egyetemi hallgatókat a gondolkodási módra vonatkozó kérdőívekkel (Cognitive Mode Questionnaires = CMQ) vizsgált. Keresztmetszeti és egy 2 évig, illetve 6 évig tartó longitudinális vizsgálatot végzett. Az elektrofiziológiai kísérletek a temporálisan rendezett megítélésre (Temporal order judgements-TO) vonatkoztak. A TO észleléseket összekötötték a verbális és nem-verbális válaszok különböző kombinációjával, és ezeknek a CMQ-hoz és a latens balkezességhez való viszonyát tanulmányozták.

SAKANO megállapította, hogy a latens balkezes fiúk jobban teljesítették a térbeli, mint a verbális feladatokat, míg a latens jobbkezes lányok jobban teljesítették a verbális, mint a térbeli feladatokat. A Kyoto Egyetem bölcsész- és társadalomtudományi fakultásainak hallgatói gyakrabban voltak a Pavlov szerinti „művész"-típusúak, míg a természettudományi fakultások hallgatói nagyobb százalékban voltak a Pavlov szerinti „gondolkodó"-típusba sorolhatók. A természettudományi kar hallgatói között, a latens balkezes egyének között gyakrabban fordultak elő „művész" típusúak, míg a latens jobbkezes egyének között nagyobb százalékban talált a „gondolkodó"-típushoz tartozókat. A nők erősebben asszociálódtak a „művész"-típushoz, a férfiak pedig a „gondolkodó"-típushoz. Végül megállapította, hogy az összes fent említett eredményekben a „crossing-arms test" (a „folding arms" módszer) volt az egyetlen hatásos indexe a latens jobb- és balkezességnek.

A szerző könyvében feldolgozza a jobb- és balkezességgel foglalkozó csaknem teljes szakirodalmat. A bő adatanyaggal ellátott monográfia értékes munka eredménye; legfőbb eredménye, hogy új utat nyitott a LURIA kritériumai szerinti latens balkezesség értékeinek teszteléséhez, a kezesség és a beszéd-lateralizáció, valamint a hemiszférikus predominancia közötti rejtélyes kapcsolatnak a vizsgálatára. Az eredményeket tömör táblázatokkal és jól szerkesztett ábrákkal szemlélteti.

Hasznos információkat nyújt mindazoknak a szakembereknek: antropológusoknak, fiziológusoknak és neuropszichológusoknak, akik a jobb- és balkezességgel, a két hemiszférium funkcionális aszimmetriájával és ezek pszichológiai hatásával foglalkoznak.

Velkey László

A kiadásért felel az Akadémiai Kiadó igazgatója
Műszaki szerkesztő: Sándor István
A kézirat nyomdába érkezett: 1983. II. 17. — Terjedelem: 19,25 (A/5) ív

83.11759 Akadémiai Nyomda, Budapest — Felelős vezető: Bernát György

Folytatás a borító 2. oldaláról

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 Szerkesztő bizottság nem fogad el.

A kéziratokat a szerkesztő címére kell beküldeni, aki a tanulmány beérkezését visszaigazolja. A közlésről — a lektori vélemények alapján — a Szerkesztő bizottság 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.

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az AKADÉMIAI KÖNYVESBOLTBAN: 1368 Budapest, Váci u. 22., telefon: 185—680.

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